AMERICAN UNIVERSITY OF BEIRUT

DOES DEVELOPED MEAN SUSTAINABLE?

by
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A simplified concept of sustainability is being widely discussed in the context of the Sustainable Development Goals because of the environmental threat that the world is facing. A more complete definition of this concept presented by the Brundtland Report and the Rio Declaration expresses sustainability as system that involves four different dimensions: economic, social, environmental and technological.

The objective of this thesis is to analyze if the countries that are considered developed today are closer to this complete definition of sustainability by ranking them using a new composite index, the Sustainable Development Index (SDI). This ranking will help to derive conclusions that could suggest what policies are promoting positive outcomes and which ones should be reconsidered.

The findings suggest that some of the considered developed countries today are closer to sustainability. However there are countries that present much better performance when compared to their Human Development Index (HDI) rank, due to successful policies that make them closer to the goal of sustainable development.

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“IT ALWAYS SEEMS IMPOSSIBLE UNTIL IT'S DONE.”

Nelson Mandela

CHAPTER I

INTRODUCTION

Some people have a narrow understanding of the concept of sustainability that only includes environmental issues, so, in the literature, most of the time sustainability is connected only to natural resources or environmental damage analysis. However, in 1987, a United Nations Report entitled "Our Common Future" also known as the Brundtland Report (1987), stated that to "make development sustainable [is] to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, G., 1987, p.9).

Sustainable development is a broad concept but it can be summarized in four main dimensions: a good standard of living (economic), social fairness, environmental awareness and knowledge advancement (technology and innovation). These dimensions were described by Bacescu (2009) as a system (presented later in the literature review) that takes into consideration not only the Brundtland Report idea but also the Rio Declaration from 1992 that reaffirms the necessity of the commitment of countries, people and society to protect the global environment and development. The Brundtland Report suggests an attempt to promote multilateralism and cooperation between nations, with the objective of reaching a better future for people today and for future generations.

The United Nations (UN) have been concerned with issues of sustainability, for this reason in 1990 they started the process that gave origin to the Millennium Development Goals (MDGs) presented in 2001 (Loewe, M. 2012). It was in 1990 also that UN released the first version of the Human Development Index (HDI) that had the objective to rank the level of

development of countries based on three indexes, Economics, Education and Heath, that is also related to the MDGs that were concerned with poverty, nutrition and health.

In parallel after the 1992 Rio Declaration there was concern not only with those basic features of development but also with the broader concept of sustainability that gathers socio-cultural, political, environmental and intergeneration factors. For this reason, in 2012, during the Rio +20 conference the Sustainable Development Goals (SDGs) were suggested.

The SDGs were seen as less global than the MDGs, and on the other hand the MDGs were seen as a simplistic and incomplete definition for human development. Loewe (2012) says that both are valid concerns and should be taken into consideration where the MDGs are preconditions to the SDGs, and the best alternative is to work in a post-2015 agenda that can bring those two groups closer to each other so the most serious concerns of both can be addressed.

It is with this in mind and the importance of the September 2015 UN summit that has the objective of defining a new agenda for the future that we propose an indicator that can evaluate sustainability and show that both MDGs and SDGs can be combined in an indicator that can consider the multiple dimensions of human development.

Actually the SDGs has the commitment to achieve 17 goals[1] that can be gathered exactly in the four dimensions that we are going to present in this work, in order to promote inclusive economic growth, good quality institutions, environmental preservation, technological development and innovation, and better living standards.

In order to reach this goal, this thesis analyzes what is considered developed today, taking into consideration available variables that can express those factors and create a composite index called the "Sustainable Development Index" (SDI). The question that we are trying to address is:

[1] Table 18 Appendix presents the 17 Sustainable Development Goals (UN)

are developed countries sustainable or at least closer to what is defined by sustainability? With the SDI it will be possible to evaluate which countries are successful at reaching this goal and what has been done in those countries to get them closer to this concept.

This index is inspired by the HDI which aggregates three different indexes to build a ranking.

This work is organized in six sections, in addition to this one. Section 2 gives an overview of the literature considering the reasons for the creation of the HDI, its concepts, theories and critiques, as background for the construction of the SDI.

Sections 3, 4 and 5 present how the economic, social, technological and environmental systems are included and how their indexes are calculated in order to build the SDI. Section 6 presents the results of the SDI and provides some explanations for the performance of countries that stand out in the analysis. Finally, section 7, concludes the analysis with some policies and remarks regarding indicators and relevant analysis that should be considered in the future.

CHAPTER II

LITERATURE REVIEW

The aim of this study is to suggest a measure for sustainable development, one that considers the full meaning of sustainability, enhancing the analysis to its four dimensions: Economic, Social, Environmental and Technological.

The starting point for any development index should be analyzing the most important and commonly used tool to measure development so far, the HDI. This index was the result of the frustration of having GDP (Gross Domestic Product) as the only development measure available to evaluate how well a country was performing when compared to others, so it focuses more on the ends of development, the human beings, rather than the means, the commodities (Sen & Anand 1994). Because of its simplicity and the availability of data provided by state institutions, this index is widely used and has become a guide for policymakers allowing them to make decisions and track the results of their actions (Klugman & Choi 2011).

The objective of the HDI is to measure how the environment that people live in is contributing to the reproduction of their capability to function, this means their doings and beings, putting human activity as the central matter for development (Sen & Anand 1994). The index was born from the collaboration of two economists Mahbub ul Haq and Amartya Sen, but it is Sen's Capability Approach (CA) that supported the framework on which the index was based. This theory's main focus is on the analysis of how people can achieve different functionings based on their choices.

The foundations of CA are in the constant necessity of the economy to pursue development, as the "enhancement of living conditions" (Sen, A. 1988 p. 11). At the time he introduced this theory, economic development analysis was strongly linked to economic growth

because this was thought to be the primary mean to achieve better conditions of living. However, Sen's approach highlights that there are other variables that contribute to the quality of living and that affect the welfare of the society.

Sen (1988) tries to show that what matters for development is the nature of how the ends, the human beings, are succeeding in living, valuing their ability to "being well nourished, being free from avoidable morbidity, being able to move about as desired, and so on" (Sen, A. 1988 p. 15). These aspects he named the functionings of people, observable[2] actions and feelings of human beings, the things a person is or does during their lifetime, based on the private and public goods and environmental context they live in. This principle of functioning, he claims, was already present in Karl Marx and Adam Smith's writings.

Those functionings will be determined by the person's freedom to choose and his/her ability to enjoy these freedoms. This ability is called capability, it is specific to each and every human being, who chooses from their capability set their functionings (Sen, A. 1993).

Following this rationale, the functionings of individuals that determine their behavior are connected to the context that they live in. In addition to their capability set, it is their freedom of choice that determines their actions.

However it is important to consider that a given degree of freedom will not instigate the same action for each and every person. Each individual has their own values, preferences and capabilities that may result in different choices. With this we achieve Sen's distinction between (1.1) person's well-being and (1.2) the person's pursuit of overall agency goals and (2.1) achievement, and (2.2) the freedom to achieve (Sen, A. 1993). This last concept is more general

[2] This term is used by Fitoussi & Malik (2013)

and can be common to different people. It is here that the evaluation of functionings and capabilities starts, with indicators of health, morbidity and literacy (Sen, A. 1988).

So, what is relevant to this analysis, in terms of general evaluation is the level of freedom that the individuals have and not necessarily their choices. Sen (1999) emphasizes that development is the removal of the "unfreedoms"[3]. He uses poverty as one example but points out that wealth will not lead to all freedoms, since there are social freedoms, like civil rights, political participation, security and etc. that also determine development.

With that we can assume that the construction of the HDI is an attempt to capture the level of freedom. When analyzing the success of the HDI, Sen (2000) states that this index was a pluralistic solution and alternative to the monoconcentration measure that was being used (GDP). Because there is no "value-neutral engineering solution" (p.21) able to measure the whole concept of development the HDI, to some extent, captures the social features which contribute to development, integrating measures that account for longevity, education and income.

The HDI represents an important step in the field of development economics and the evaluation of human wellbeing. The focus of the index is to see how people's capabilities can be enhanced using those three determinants of standard of living and to focus on the human being as an end. As mentioned earlier, this index became a parameter for nations to understand where their development status stands, but more importantly, it brought to the agenda the capabilities approach.

[3] Unfreedoms is a term used by Sen in his book "Development as Freedom" that can be understood as the restrictions that humans experience in their choices due the lack of opportunity, health, education and etc. "The removal of substantial unfreedoms, it is argued here, is constitutive of development" (Sen, A. 1999, p. xii)

At this point it is relevant to add to this analysis a different understanding of the CA that is introduced by Nussbaum and which complements the theoretical framework of this study adding a political normative perspective that is essential for human development.

She emphasizes even more the idea of each and every human being as an end, something she states is not being stressed enough in Sen's work. This comes with the importance she gives not only to cultural but also gender distinctions that are relevant to the definition of the individual's capabilities (Nussbaum, M. 2000).

The prominent difference between Sen and Nussbaum is the vision of the CA and how to make use of its findings. First Nussbaum (2000) does not see the CA as a comparative measure that should pursue full capability equality. Her concept is characterized by the idea of a threshold, a "social minimum" (p.6) that can provide dignity for the human being.

Secondly, she presents the CA as a tool that can provide a normative proposal capable of deriving constitutional principles which will work as a guide so society can demand action from its governments. She thus constructs a list of central capabilities that guarantee that "the life that includes them [is] fully human" (Nussbaum, M 2000, p.74).

Nussbaum's list is complex and descriptive, and includes aspects like emotional balance, the ability to use imagination or the right to have relationships. Some of those goals, which she calls "natural goods"[4], cannot be the direct objects of public policy, however, they can at least, be affected by the environment that public policies can provide. Here it is important to mention that Sen considers that building such a list will depend on the purpose and context at the moment and for him this should not be in the hands of a theorist but should be the result of a democratic process (Robeyns, I. 2005).

[4] Natural Goods is a terminology that she brings from John Rawls, "goods in whose acquisition luck plays a substantial role. Thus, governments cannot hope to make all citizens healthy, or emotionally balanced, since some determinants of those positive states are natural or luck-governed." (Nussbaum 2000, p. 81)

Nussbaum also provides more details on the different types of capabilities, classifying them in three groups. The first is the Basic Capabilities, those that are essential to every human being, "these capabilities are sometimes more or less ready to function: the capability for seeing and hearing is usually like this…however, they are very rudimentary, and cannot be converted into functioning" (Nussbaum 2000, p. 84).

Second is the group of Internal Capabilities that are considered more mature capabilities, developed in accordance to what each person is concerned with and by the environment and support they have. Finally there are the Combined Capabilities, expressed as the combination of the external condition that can determine the internal ones. In this sense Internal and External Capabilities go together and their interdependence is clear, where the internal capability might develop if the external one provides the proper factors.

It is crucial to say that Nussbaum (2000) introduces the notion of capabilities as political goals, hence she adds the normative perspective that is missing in Sen's work but is implicit in the Human Development Reports.

Sen's and Nussbaum's CA also have their critics. Qizilbash (1996), for example, says that both views do not succeed at expressing properly human development because of the lack of pluralism, the individualism of the CA that expresses the differences between each and every human being is something that cannot be applied to a group or society independent of their class, culture or development level. In Qizilbash's opinion a more appropriate approach for human development is the one presented by James Griffing that introduces prudential values as the core of his theory, listing basic human values that can be valid for anyone that pursues a better life.

To clarify more the concept of prudential values, Qizilbash (1997) makes an analogy of this well-being view with morality principles, underlining the pluralism or "irreducibility" notion

that is concerned with societal interests and obligations so everyone can enjoy a good life. In accordance to this he declares that freedom is a prudential value and he also presents a list[5] of values, with some characteristics that remind us of Nussbaum's list and the HDI, which should be considered for everyone although each individual might attribute different weightings according to their interests. In this work he goes further and suggests a well-being index dividing the variables set in two groups "(a) measures of access to, or availability of goods that can be transformed into, the stuff of prudential value; and (b) measures relating directly to the prudential values on the list." (Qizilbash 1997, p.2014)

This attempt to build a Well-being Index, closer to the concept of prudential values, was not the first one. According to Qizilbash (1997) Dasgupta and Weale developed a Borda[6] Ranking for 48 of the poorest countries considering variables similar to the HDI, such as per capita income, adult literacy and life expectancy at birth and the infant mortality rate, together with indices of political and civil rights. In Qizilbash's opinion, in order to be more in line with the prudential values theory per capita income should be replaced by per capita consumption to represent the "enjoyment" value. He also states that there are other prudential values that were not considered, like "accomplishment", due the lack of unemployment data for those countries.

Another conclusion from Qizilbash (1997) that should be taken into consideration when constructing this kind of composite index is that poor and rich countries should not have the same weights or the same components, although they should still represent a prudential value, so for example, in rich countries, he suggests that there is no reason to consider literacy rates, but

[5] (i) minimum levels of health, nutrition, shelter, sanitation, rest and security; (ii) certain basic mental and physical capacities and literacy; (iii) some level of self-respect and aspiration; (iv) enjoyment; (v) autonomy; (vi) liberty; (vii) significant personal relations and some participation in social life: (viii) accomplishment and; (ix) understanding." (Qizlbash 1997, p.2011)

[6] The Borda Ranking considers only the position of the country, ordinal information, without an index but a Borda Score, meaning that an analysis with N countries the worst will score one and the highest scoring N. (Qizilbash 1997)

other variable that can express the prudential value of "understanding". He also mentions the necessity of analyzing those comparisons in stages[7] so the result can be fair.

Gasper (2002) presents a stronger critique of the CA, more regarding its theoretical and philosophical underpinnings, especially its relevance for the construction of a complete theory of human development. He states that one of the biggest limitations of Sen's CA is restricting human wellbeing to a set of choices without discussing the contents of these choices. In his opinion a deeper psychological analysis of people's satisfaction is required, including emotions and empathy. He also mentions the "social exclusion" characteristic of Sen's approach, questioning the possibility of his individualistic concept (especially ethically) to fit a social framework, remembering that inclusion and inter-relations are essential to human wellbeing.

This affirmation is consistent with the impossibility within Sen's framework of listing central capabilities, unlike Nussbaum who states that political principles should be considered relevant capabilities and guaranteed for humans by their governments. Robeyns (2005), as mentioned before, in defense of Sen, says that there are different capabilities for different purposes due CA's interdisciplinary characteristic, so defining the relevant ones should not be left to theorists.

Another relevant critique to Sen's CA is the one presented by David Clark (2005) that suggests that this theory is nothing more than a different way of explaining the Basic Needs Approach (BNA), introduced by Paul Streeten et al in 1981, where he writes that "the basic needs concept is a reminder that the objective of the development effort is to provide all human beings with the opportunity for a full life" (Streeten, P.1994, p. 234).

[7] "(a) rank countries in terms of each prudential value; (b) use these rankings to rank countries in terms of overall well-being using the Pareto rule; and (c) for those countries that are Pareto non-comparable, use a broad set of non-zero weights and use these to calculate a weighted average of rank order position, or weighted Borda score." (Qizilbash 1997, p.2022-2023)

There is still a long road to develop this concept and mature its ideas. Sen, Nussbaum, Robeyns and other authors are improving the idea and emending the main CA theory by adding the connection of CA with gender equality, social justice or sustainability, that are relevant to other theorists' understanding and that can respond to some of their critics.

More recently an interest has emerged in the literature of combining CA with Sustainable Development (SD), in order to bring a more complete understanding of development, the concept of Sustainable Human Development.

Some of the authors that tried to link CA and SD like Voget-Kleschin (2013) and Schultz et al (2013) point to limitations of the CA due to its focus on an individual level rather than a societal level, but the real critique in terms of the disconnect with sustainability is the absence of any intergenerational consideration and variables that would make this possible, like the environment. On the other hand, they recognize that CA can give an interesting perspective to SD theory because of its descriptive base, defining what accounts for a good life capturing environmental and societal conditions to enhance human capabilities, the means to develop the ends, and with this perspective CA adds a normative angle to SD providing the base to conduct policies that can enhance human choices. (Voget-Kleschin 2013)

Based on this "emerging episteme" (Birkin & Polesie 2013), which considers nature to be more than an instrument, but also a way of giving continuity to humanity (Mabsout 2015), and on the principles that connect inclusiveness and freedoms to well-being across different generations, the suggestion of this study is to develop an index that can be compared to the HDI in order to understand if those countries that are considered developed in this index also hold the same positions when evaluated from the sustainability perspective.

This new measure will follow the HDI concept of composite index, considering not only the CA but also characteristics of the prudential values theory and BNA, in an attempt to evaluate how free people are to make their own choices, free in the sense of having all the structure, liberty and equality to make economic, political, social and any other life decision, as long as to reach those freedoms the individual behaves ethically and morally without affecting the well-being and freedom of other people[8]. With this we try to include common interests measured with the available data, considering inclusiveness, civil and political freedoms and intergeneration components.

This is something closer to the External Capabilities (that are considered in the group of combined Capabilities) defined by Nussbaum[9] (1988) that are the external factors that facilitate or at least do not provide any kind of impediment to promoting the Internal Capabilities. However it differs from her theory in the sense that here it is measured at the societal and intergenerational levels, focusing on the universal, common, aspects that determine Sustainable Development (SD).

Some features of the Sustainable Development Index have already been addressed by Fitoussi and Malik (2013) that present the importance of including other political and social competencies that are essential for individual well-being in the human development measure, so it is possible to define the capabilities sets not only for human development, but also for sustainable development.

Fitoussi and Malik (2013) also state that in order to derive proper sustainable policies it is important to have a complete definition of sustainability, considering that inequality, democracy and financial austerity affect the stock of capabilities. This stock works as the balance sheet of

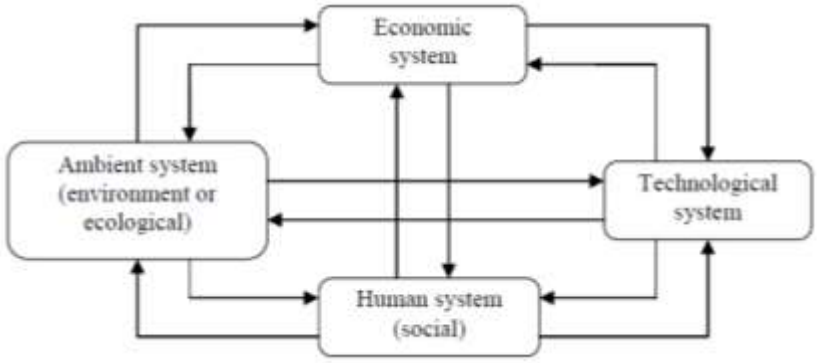
[8] See Qizilbash, M. (1996) p. 146
[9] See Qizilbash, M. (1996) p. 149

the economy where we have tangible goods, like public and private assets, an educated population and natural resources, and intangible goods such as social competencies characterized by the degree of social cohesion, social inclusion and good democratic institutions.

Some authors already suggested the inclusion of environmental measures to the HDI, like Crabtree (2012) and others like Moran et al (2008) have already done this by combining the HDI with the Ecological Footprint to biocapacity ratio.

But sustainability is not only about preserving natural resources for future generations, it is also about perpetuating technologies, knowledge, developed societal structures and institutions that can guarantee to future human beings conditions for a good life. Bacescu (2009) provided a useful conceptual framework when analyzing principle 3 of the Rio Declaration and the Brundtland Report (Figure 1) where a sustainable country is the nation that can preserve and generate appropriate systems (Economic, Social, Environmental and Technological) that will remain available for future generations.

Figure 1 - Interaction and Compatibility of four systems



Note: Extracted from Marius Bacescu (2009) p.1

Although it is clear that it is a major challenge to combine all the available data to build such an index, we attempt to justify every component of the index on the basis of better

capturing the concept of sustainability in development in order to examine the ranking of countries that would result from such a measure.

CHAPTER III

ECONOMIC INDEX AND EVALUATION

The Sustainable Development Index (SDI), as mentioned before, will be a composite index that considers four different dimensions of society and human well-being. The Economic System is one of the most complicated ones to evaluate, since the objective here is not to consider that the wealthiest country is better, but how the economic performance of this country can contribute to a better life for their citizen. In this section we will explain how each approach mentioned in the literature review contributed to the construction of the Economic Index that will be used as an indicator in the Sustainable Development Index.

The most controversial component of the HDI index is GNI Per Capita. Many economists question whether this variable can represent human development rather than expressing economic power. For this reason the adjustment for inequality, as performed by the United Nations, tries to include the character of equality and wealth distribution as development features. If we follow the CA framework, this index is an instrument, a tool, a means to reach some essential freedoms, like freedom from starvation, freedom to have basic needs such as clothes, medicines or shelter, as suggested by Sen, so people's capabilities can turn into functionings.

When we use the premises of BNA, this index should be based on a variable measuring the ability to meet basic needs. In this regard, we may be more interested in consumption rather than income. Sometimes, especially in underdeveloped countries, household income cannot provide all needs, that's why some social programs, private or governmental, try to provide to those in need the minimum consumption for subsistence.

Finally, if we consider the prudential values approach (Qizilbash 1997), this economic indicator should be seen as a representation of the "accomplishment" value. This value will be represented in the index by the unemployment indicator.[10]

Taking these facts into consideration, the suggestion is to combine in the economic index, which will be part of the sustainable development index, those three components in order to take into account not only the freedoms but other basic features that are essential to determine the quality of life.

The suggestion here is to create a composite economic index with three important economic variables[11], GNI per capita, as considered in the HDI, consumption per household and unemployment. Those three basic economic indicators together give us a better view of sustainable development for our final index. The combination of those three will track whether consumption is aligned with income, but also see if it is possible to achieve a comfortable life, and preserve that possibility for future generations. The idea is to include in the indicator the different perspectives afforded by the different approaches to reach a better measure of individual well-being taking into consideration the liberty to participate in the market and to reach accomplishment, the freedom to be well nourished and access to basic needs.

[10] "… there is accomplishment. It is hard to think of a measure of this. Recall that accomplishment is the sort of achievement that gives life point and weight. A life without it is thought of (to use Griffin's terms) as frittered away and wasted. The variable which most closely reflects such a sense of waste in society is the level of unemployment. Indeed, this is the only plausible aggregate indicator of the shortfall in accomplishment. Employment is not always conducive to accomplishment: sometimes it is uninteresting and soul-destroying. Lack of employment may also be causally related to a loss of self-esteem and basic provision (especially in the absence of unemployment insurance schemes). The waste associated with unemployment, however, is the feature most relevant for our purposes." (Qizilbash, M. 1997, p.2015)

[11] Gross national income (GNI) per capita (2011 PPP $) extracted from the HDI 2014. Household final consumption expenditure per capita (constant 2005 US$) and Unemployment, total (% of total labor force) (national estimate) data were extracted from the World Bank database, always considering the last data available. Angola, Kiribati, Libya, Liechtenstein, Oman, Turkmenistan and Uzbekistan unemployment data was collected from different sources like CIA Factbook, World Bank special analysis, Reuters and United Nations Economic Commission for Europe (UNECE).

Each measure will be transformed into an indicator then the indicators will be aggregated in one index following closely the methodology used in the HDI. The GNI Index was calculated by using the HDI formula, where X stands for the observed value of each country:

GNI Index = LN(GNIX) - LN(GNI min) / LN(GNI max)-LN(GNI min)

We also used the limits suggested by the HDI 2014, with a minimum of US$100 and a maximum of US$ 75.000[12]. It should be noted that the lowest GNI per capita in 2014 is US$ 443.96 for the Democratic Republic of the Congo, this means that a US$ 100 minimum is low even for the consumption patterns that showed a minimum of US$114.47 (Eritrea 2011).

The Consumption (CSM) indicator was calculated using the same approach, but here, the boundaries where more complicated to define. According to the World Bank Data, the lowest consumption value is of US$114.47 (Eritrea) and the highest is US$32,413.97 (Switzerland). However, Pritchett (1997) in his attempt to define a lower bound to GDP per capita uses the information supplied by "Ravallion, Datt and van de Walle (1991) that argue that the lowest defensible poverty line based on achieving minimally adequate consumption expenditures is P$252 per person per year" (Pritchett, L., 1997 p.8), and based on that value the minimum GDP per capita, as he calculated, should be of US$ 437.

This gives us that consumption should represent approximately 60% of the GDP per capita, at least for subsistence in poor countries, so considering the lowest GNI per Capita value US$443.96, the minimum consumption should be around US$266. The maximum considered was Switzerland's consumption because it coincides exactly with 60% of GNI per capita.

[12] "The low minimum value for gross national income (GNI) per capita, $100, is justified by the considerable amount of unmeasured subsistence and nonmarket production in economies close to the minimum, which is not captured in the official data. The maximum is set at $75,000 per capita. Kahneman and Deaton (2010) have shown that there is a virtually no gain in human development and well-being from annual income beyond $75,000. Assuming annual growth rate of 5 percent, only three countries are projected to exceed the $75,000 ceiling in the next five years." (HDR, 2014)

It is relevant to mention that many poverty studies consider consumption a better measure of human welfare (Haughton, J. H., & Khandker, S. R., 2009) than income for developing countries (Meyer, B. D., & Sullivan, J. X. 2003). Both data used here, GNI per capita (PPP) and Household consumption were extracted from the World Bank databases. The first indicator is a weighted average of the aggregate value that considers the output produced, meaning that it does not capture the true productivity per capita of each individual.

For example, in the case of China, the GNI per capita (PPP) is US$ 11,477.15, their consumption per household is around US$ 1,306.78, only less than 12% of the GNI per capita, but when we consider the average wage[13] of the population, that is around US$ 1.500 we can assume that the income per capita is not completely reliable. On the other hand, in the case of Norway, the GNI per capita is US$ 63,909.45, consumption is US$ 32,123.17, more than 50% of the GNI, and finally the average wage is US$ 3,678. It is also interesting to add that in China the GINI coefficient is 42.06 while for Norway is 25.8.

In this sense, here is another relevant reason to combine the use of the GNI per capita with household consumption and add to the index distributional considerations that are extremely relevant to the well-being analysis. What it was possible to notice in the data is that the higher the GINI the more interesting to the analysis is to consider consumption instead of the GNI per capita.

The consumption indicator takes into account household expenditures on goods and services, considering their market value. A study developed by Oulton (2012) shows that there are strong correlations between the consumption indicator and the other welfare variables, but it is interesting to call attention to the GINI coefficient indicator, where there is a negative

[13] Average wages by country, in purchasing power parity dollars, 2012. Source: BBC. Data extracted from http://www.statista.com/statistics/226956/average-world-wages-in-purchasing-power-parity-dollars/.

correlation between those two indicators meaning that the higher the inequality the lower the consumption.

Figure 2 - Correlation between household consumption and welfare indicators

	Real HC per head	*Life expect-ancy*	*Infant mortality*	*Gini coeff-icient*
Real HC per head	1.00			
Life expectancy	0.71	1.00		
Infant mortality	-0.65	-0.92	1.00	
Gini coefficient	-0.55	-0.54	0.43	1.00

Source: Extracted from Outlon (2012) p.9

Based on those facts the comparison between GNI and Consumption can generate some interesting theories, for example, the higher the consumption-income ratio the more appropriate, for our purposes, becomes the income indicator and it can also suggest better income distribution. Some countries in the analysis corroborate this fact, especially OECD countries, where 24 out of 32, present a consumption to income ratio higher than 40% and when we exclude United States, they all present a GINI coefficient lower than 40.

Unfortunately, despite the facts, there is no strong empirical evidence that can prove this theory. However, it expresses, once again, the relevance of including the consumption variable in the analysis once there is the possibility of capturing, to some extent, the inequality condition that might be present in a country.

Another relevant detail is that we did not consider for the Consumption variable the log form because when we repeated the calculation using consumption in log form, the results of the first 15 positions do not change much, and the ranking of the top 3 countries is preserved. The major change is the appearance of the Arab Countries, Kuwait and United Arab Emirates that have high GNI per capita but low consumption expenses. The reason for that might be that the citizens of those countries usually have many services and benefits offered by their government

without the charge of taxes, reducing their household expenditures, something uncommon when compared to the rest of the world, so although ideal, they do not express the reality.

Table 1 - Consumption Index using LN

Country	Economic Index	HDI	Difference (HDI-EI)
Norway	1	1	0.00
Switzerland	2	3	1.00
Luxembourg	3	21	18.00
Hong Kong SAR, China	4	15	11.00
Austria	5	20	15.00
Australia	6	2	4.00
United States	7	5	2.00
Germany	8	6	2.00
Iceland	9	13	4.00
Japan	10	17	7.00
United Arab Emirates	11	37	26.00
Singapore	12	9	3.00
Kuwait	13	43	30.00
Netherlands	14	4	10.00
Canada	15	8	7.00

Table 2 - Consumption Index SDI formula

Country	Economic Index	HDI	Difference (HDI-EI)
Norway	1	1	0.00
Switzerland	2	3	1.00
Luxembourg	3	21	18.00
United States	4	5	1.00
Iceland	5	13	8.00
Hong Kong SAR, China	6	15	9.00
Australia	7	2	5.00
Austria	8	20	12.00
Germany	9	6	3.00
Japan	10	17	7.00
United Kingdom	11	14	3.00
Denmark	12	10	2.00
Canada	13	8	5.00
Sweden	14	12	2.00
Netherlands	15	4	11.00

CSM Index = (CSM X - CSM Min) / (CSM Max – CSM Min[14])

With regards to the unemployment (UNP) we modify the index to:

UNP Index: (UNP X – UNP Max) / (UNP Min – UNP Max[15])

For unemployment, which tries to capture the accomplishment value, there are many discussions on how much is the maximum level accepted. According to the theory of the Phillips curve there is a short run tradeoff between inflation and unemployment, so the maximum unemployment rate depends on the inflation target that the country pursues. The average NAIRU (Non-accelerating Inflation Rate of Unemployment) calculated in 2013 for OECD is 7.6%,

[14] Since in this variable there were countries with values lower than the Minimum, in order not to include negative values they had the minimum considered in their observations, meaning they scored 0. As mentioned before the data considered is the last available, and in this case the range is from 2005-2013.

[15] The boundaries in this index do not respect the maximum and minimum observed, so in order to not present values lower than 0 or higher than 1 those boundaries were considered as the maximum and minimum values accepted, just like what is considered in the HDI calculation. Data range from 1986-2012.

however, this value is considered high for developing countries that according to 2014 International Labour Organization (ILO) report present an average of 5.4%.

The data for unemployment shows that the lowest unemployment rate was registered in Cambodia, only 0.2% and the highest was recorded in Congo Democratic Republic (73%). Respecting the estimations from NAIRU and ILO we will consider a minimum of 5%, in accordance to the unemployment rate in developing countries, and a maximum of 31% (Mauritania) that is the fourth highest unemployment rate, which is less an outlier when compared to the other economies.

Considering the availability of data for all three indicators it was possible to gather the information of 154 countries, while the HDI is calculated for a total of 187. In order to better express the findings of the economic index, tables 3, 4 and 5, presented below show in the first three columns the ranking based on the Composite Economic Index, the following three columns are the result of the GNI PPP Index used in the HDI formula. Finally, the last column shows the difference in positions[16] between the HDI to the Economic Index of the SDI.

What is interesting to point out is that the Economic index calculated based on the three variables mentioned before presents a rank close to the one of the HDI. When we analyze the first 15 positions in the Economic Index, Table 6, the difference between the two indexes is small, and it is smaller than the difference between the two economic indicators presented in the previous tables.

The biggest gaps in the comparisons of the Economic Index with the HDI result (Table 6) are in Luxemburg, Austria and The Netherlands. Both Luxemburg and Austria achieve higher positions in the Economic Index due to their favorable GNI per capita and consumption values,

[16] All the comparisons performed to the HDI ranking consider only the countries that there is data available to, in other words countries that have a calculated index, so the changes in position can be fairly expressed.

together with low unemployment rates, especially between the OECD countries. In the HDI their indexes are affected specially because of the education variables. The Netherlands on the other hand, also presents the same equilibrated GNI-consumption relation but it has lower values for the two variables and a slightly higher unemployment rate affecting negatively it position in the Economic index.

Norway assumes the first position in both indexes suggesting a better alignment of the Economic index calculated here and the HDI total rank. On the other hand if we compare the position of Norway with the Ranking derived from the HDI GNI calculation (Table 3) we find a difference of 4 positions. Using the same analysis the difference in positions is even more significant for countries like Qatar and Kuwait that present very high GNI per capita.

Table 3 - Economic Index vs. HDI GNI Index

Ranking Composite Economic Index			Ranking HDI GNI PPP			Difference (HDI-EI)
1	0.99	Norway	1	1.00	Qatar	-22.00
2	0.98	Switzerland	2	1.00	Kuwait	-18.00
3	0.94	Luxembourg	3	0.99	Singapore	-16.00
4	0.93	United States	4	0.99	Brunei Darussalam	-21.00
5	0.90	Iceland	5	0.98	Norway	4.00
6	0.87	Hong Kong SAR, China	6	0.96	Luxembourg	3.00
7	0.86	Australia	7	0.96	United Arab Emirates	-10.00
8	0.86	Austria	8	0.95	Switzerland	6.00
9	0.86	Germany	9	0.95	Hong Kong SAR, China	3.00
10	0.85	Japan	10	0.95	United States	6.00
11	0.84	United Kingdom	11	0.94	Saudi Arabia	-22.00
12	0.84	Denmark	12	0.92	Sweden	-2.00
13	0.84	Canada	13	0.92	Germany	4.00
14	0.82	Sweden	14	0.92	Austria	6.00
15	0.82	Netherlands	15	0.92	Denmark	3.00
16	0.81	Finland	16	0.91	Netherlands	1.00
17	0.80	United Arab Emirates	17	0.91	Oman	-113.00
18	0.80	Belgium	18	0.91	Canada	5.00
19	0.79	Singapore	19	0.91	Australia	12.00
20	0.78	Kuwait	20	0.90	Belgium	2.00
21	0.78	New Zealand	21	0.89	Finland	5.00
22	0.77	France	22	0.89	Japan	12.00
23	0.75	Qatar	23	0.89	France	1.00
24	0.74	Korea, Rep.	24	0.89	Iceland	19.00
25	0.73	Brunei Darussalam	25	0.88	United Kingdom	14.00
26	0.72	Italy	26	0.88	Ireland	-2.00
27	0.72	Israel	27	0.87	Italy	1.00
28	0.72	Ireland	28	0.87	New Zealand	7.00
29	0.70	Malta	29	0.87	Bahrain	-1.00
30	0.69	Bahrain	30	0.86	Spain	-68.00
31	0.69	Cyprus	31	0.86	Korea, Rep.	7.00
32	0.69	Trinidad and Tobago	32	0.86	Israel	5.00
33	0.67	Saudi Arabia	33	0.85	Malta	4.00
34	0.67	Slovenia	34	0.84	Slovenia	0.00
35	0.65	Czech Republic	35	0.84	Cyprus	4.00
36	0.65	Chile	36	0.84	Trinidad and Tobago	4.00
37	0.65	Mexico	37	0.83	Greece	-66.00
38	0.64	Russian Federation	38	0.83	Czech Republic	3.00
39	0.64	Malaysia	39	0.83	Portugal	-19.00
40	0.64	Panama	40	0.83	Lithuania	-32.00
41	0.64	Uruguay	41	0.82	Estonia	-7.00
42	0.63	Antigua and Barbuda	42	0.82	Russian Federation	4.00
43	0.62	Cuba	43	0.82	Latvia	-45.00
44	0.62	Kazakhstan	44	0.81	Equatorial Guinea	-96.00
45	0.62	Romania	45	0.81	Malaysia	6.00
46	0.61	Bahamas, The	46	0.81	Libya	-80.00
47	0.61	Belarus	47	0.81	Poland	-5.00
48	0.61	Estonia	48	0.81	Bahamas, The	2.00
49	0.60	Argentina	49	0.81	Hungary	-13.00
50	0.60	Turkey	50	0.81	Chile	14.00

Table 4 - Economic Index vs. HDI GNI Index (continuation)

Ranking Composite Economic Index			Ranking HDI GNI PPP			Difference (HDI-EI)
51	0.60	Barbados	51	0.80	Cuba	8.00
52	0.60	Poland	52	0.80	Kazakhstan	8.00
53	0.60	Brazil	53	0.79	Croatia	-39.00
54	0.60	Peru	54	0.79	Antigua and Barbuda	12.00
55	0.60	Lebanon	55	0.79	Turkey	5.00
56	0.60	Thailand	56	0.79	Uruguay	15.00
57	0.59	Azerbaijan	57	0.78	Romania	12.00
58	0.59	Portugal	58	0.78	Argentina	9.00
59	0.59	Ecuador	59	0.78	Venezuela, RB	-2.00
60	0.59	Mauritius	60	0.78	Gabon	-60.00
61	0.59	Venezuela, RB	61	0.77	Mauritius	1.00
62	0.58	Hungary	62	0.77	Belarus	15.00
63	0.58	China	63	0.77	Panama	23.00
64	0.58	Costa Rica	64	0.77	Lebanon	9.00
65	0.58	Turkmenistan	65	0.77	Mexico	28.00
66	0.57	Sri Lanka	66	0.76	Azerbaijan	9.00
67	0.57	Mongolia	67	0.76	Bulgaria	-24.00
68	0.57	Timor-Leste	68	0.76	Suriname	-9.00
69	0.56	Guatemala	69	0.75	Botswana	-49.00
70	0.56	Paraguay	70	0.75	Montenegro	-53.00
71	0.56	El Salvador	71	0.75	Brazil	18.00
72	0.56	Lithuania	72	0.74	Barbados	21.00
73	0.56	Tonga	73	0.74	Iran, Islamic Rep.	-20.00
74	0.55	Indonesia	74	0.74	Thailand	18.00
75	0.55	Grenada	75	0.74	Costa Rica	11.00
76	0.55	Bhutan	76	0.73	Algeria	-18.00
77	0.55	Suriname	77	0.72	South Africa	-68.00
78	0.55	Belize	78	0.72	Turkmenistan	13.00
79	0.54	Bolivia	79	0.72	Colombia	-7.00
80	0.54	Ukraine	80	0.72	China	17.00
81	0.54	Nigeria	81	0.71	Jordan	-19.00
82	0.54	India	82	0.71	Serbia	-60.00
83	0.53	Uzbekistan	83	0.71	Peru	29.00
84	0.53	Honduras	84	0.71	Dominican Republic	-21.00
85	0.53	Pakistan	85	0.70	Tunisia	-50.00
86	0.53	Colombia	86	0.70	Egypt, Arab Rep.	-22.00
87	0.53	Fiji	87	0.70	Grenada	12.00
88	0.53	Latvia	88	0.70	Ecuador	29.00
89	0.53	Dominica	89	0.69	Timor-Leste	21.00
90	0.53	Philippines	90	0.69	Belize	12.00
91	0.52	Bulgaria	91	0.68	Sri Lanka	25.00
92	0.52	Croatia	92	0.68	Dominica	3.00
93	0.52	Iran, Islamic Rep.	93	0.68	Albania	-14.00
94	0.52	Algeria	94	0.68	Namibia	-31.00
95	0.51	Ghana	95	0.68	Indonesia	21.00
96	0.51	Vanuatu	96	0.67	Mongolia	29.00
97	0.51	Morocco	97	0.67	Ukraine	17.00
98	0.51	Spain	98	0.67	Jamaica	-12.00
99	0.50	Cambodia	99	0.66	Armenia	-38.00
100	0.50	Jordan	100	0.65	Paraguay	30.00

Table 5 - Economic Index vs. HDI GNI Index (continuation)

Ranking Composite Economic Index			Ranking HDI GNI PPP			Difference (HDI-EI)	
101	0.50	Bangladesh	101	0.65	El Salvador	↑	30.00
102	0.50	Cameroon	102	0.65	Fiji	↑	15.00
103	0.49	Greece	103	0.64	Morocco	↑	6.00
104	0.49	Nepal	104	0.64	Georgia	↓	-29.00
105	0.49	Dominican Republic	105	0.64	Guatemala	↑	36.00
106	0.48	Sierra Leone	106	0.64	Bhutan	↑	30.00
107	0.48	Albania	107	0.63	Philippines	↑	17.00
108	0.48	Egypt, Arab Rep.	108	0.63	Guyana	↓	-9.00
109	0.48	Benin	109	0.63	Angola	↓	-40.00
110	0.48	Jamaica	110	0.61	Bolivia	↑	31.00
111	0.47	Chad	111	0.61	Swaziland	↓	-35.00
112	0.47	Burkina Faso	112	0.60	Nigeria	↑	31.00
113	0.47	Rwanda	113	0.60	Tonga	↑	40.00
114	0.46	Zimbabwe	114	0.60	Uzbekistan	↑	31.00
115	0.46	Uganda	115	0.60	India	↑	33.00
116	0.46	Madagascar	116	0.58	Pakistan	↑	31.00
117	0.46	Guyana	117	0.56	Honduras	↑	33.00
118	0.46	Botswana	118	0.56	Yemen, Rep.	↓	-25.00
119	0.46	Guinea	119	0.54	Ghana	↑	24.00
120	0.45	Gabon	120	0.53	Sudan	↓	-19.00
121	0.45	Mozambique	121	0.52	Sao Tome and Principe	↓	-23.00
122	0.45	Haiti	122	0.52	Djibouti	↓	-30.00
123	0.44	Montenegro	123	0.51	Mauritania	↓	-28.00
124	0.44	Niger	124	0.51	Zambia	↓	-17.00
125	0.44	Namibia	125	0.50	Cambodia	↑	26.00
126	0.44	Libya	126	0.50	Lesotho	↓	-24.00
127	0.44	Afghanistan	127	0.50	Bangladesh	↑	26.00
128	0.44	Liberia	128	0.50	Vanuatu	↑	32.00
129	0.43	Burundi	129	0.49	Cameroon	↑	27.00
130	0.43	Oman	130	0.48	Tajikistan	↓	-6.00
131	0.43	Kenya	131	0.47	Nepal	↑	27.00
132	0.43	Senegal	132	0.46	Senegal	→	0.00
133	0.43	Georgia	133	0.46	Kenya	↑	2.00
134	0.42	Mali	134	0.45	Afghanistan	↑	7.00
135	0.42	Tunisia	135	0.44	Sierra Leone	↑	29.00
136	0.41	Tajikistan	136	0.43	Benin	↑	27.00
137	0.40	Armenia	137	0.42	Haiti	↑	15.00
138	0.40	Malawi	138	0.42	Chad	↑	27.00
139	0.39	Sudan	139	0.42	Burkina Faso	↑	27.00
140	0.37	Equatorial Guinea	140	0.41	Comoros	↓	-8.00
141	0.37	Zambia	141	0.41	Mali	↑	7.00
142	0.36	Serbia	142	0.40	Rwanda	↑	29.00
143	0.36	Yemen, Rep.	143	0.40	Solomon Islands	↓	-10.00
144	0.36	Sao Tome and Principe	144	0.39	Uganda	↑	29.00
145	0.36	South Africa	145	0.39	Madagascar	↑	29.00
146	0.33	Swaziland	146	0.39	Zimbabwe	↑	32.00
147	0.31	Ethiopia	147	0.39	Ethiopia	→	0.00
148	0.28	Comoros	148	0.37	Guinea	↑	29.00
149	0.28	Angola	149	0.35	Mozambique	↑	28.00
150	0.25	Lesotho	150	0.33	Niger	↑	26.00
151	0.18	Mauritania	151	0.30	Liberia	↑	23.00
152	0.18	Djibouti	152	0.30	Burundi	↑	23.00
153	0.14	Solomon Islands	153	0.30	Malawi	↑	15.00
154	0.08	Congo, Dem. Rep.	154	0.23	Congo, Dem. Rep.	→	0.00

Table 6 - Economic Index Vs. HDI: first 15 positions

Country	Economic Index	HDI	Difference (HDI-EI)
Norway	1	1	0.00
Switzerland	2	3	1.00
Luxembourg	3	21	18.00
United States	4	5	1.00
Iceland	5	13	8.00
Hong Kong SAR, China	6	15	9.00
Australia	7	2	5.00
Austria	8	20	12.00
Germany	9	6	3.00
Japan	10	17	7.00
United Kingdom	11	14	3.00
Denmark	12	10	2.00
Canada	13	8	5.00
Sweden	14	12	2.00
Netherlands	15	4	11.00

CHAPTER IV

SOCIAL INDEX

The Social Index is the combination of the life quality indicators already considered in the HDI, health and education, with variables that represent human rights, political freedom, inclusiveness and gender equality.

Due to the quality of the health (HH) and education (ED) indicators of the HDI, they will be considered as they are, respecting the method and values described in the HDI Report of 2014. Where health is measured based on the Life Expectancy (LE) at birth and education is a composite index that considers Mean Years of Schooling (MYS) and Expected Years of Schooling (EYS)[17]:

HH Index: (LE – LE Min) / (LE Max-LE Min)

ED Index: (((MYS – MYS Min) / (MYS Max – MYS Min)) + ((EYS – EYS Min) / (EYS Max – EYS Min)))/ 2

In order to evaluate human rights and political freedom, a composite index was calculated that considers the Polity IV[18] (PIV) score, which estimates the level of democracy of a country based on the institutional characteristics of the election process, more precisely determining how free people are to take part in elections. This variable does not give a proper evaluation of civil

[17] In the 2014 HDR LE has a minimum of 20 years and a maximum of 85, those limits, according to the report, are based on historical evidence. MYS has a minimum of 0 and maximum of 15 and EYS minimum is 0 and maximum is 18. "The maximum for mean years of schooling, 15, is the projected maximum of this indicator for 2025. The maximum for expected years of schooling, 18, is equivalent to achieving a master's degree in most countries." (HDR, 2014)

[18] The Polity IV index is obtained by the subtraction of the Autocracy from Democracy Scores. Each of these groups are scored in subcategories of four categories: Competitiveness of Executive Recruitment, Openness of Executive Recruitment, Constraint on Chief Executive, Competitiveness of Political Participation. The result is a number in the scale from -10 (Strongly Autocratic) to 10 (Strongly Democratic). (Polity IV Project: Dataset Users' Manual, 2010)

liberties, this is the reason why it was combined with the Economist Intelligence Unit (EIU) democracy index.

The EIU index not only considers the political process in its analysis, it also accounts for civil liberties and functioning of the government[19]. Although this last indicator seems more complete than Polity IV, it is useful to combine the two different measures in order to reduce measurement error.

DMC Index: (((PIV – PIV Min) / (PIV Max – PIV Min)) + ((EIU – EIU Min) / (EIU Max – EIU Min)))/ 2

Finally, to complement the democracy measure it is relevant to account also for institutional quality, this measure of governance can affect all the dimensions of the Sustainable Development Index. The quality of institutions can determine, with their policies and administrative arrangements, growth patterns, technological advance and environmental degradation control.

The Institutional Index (IST) allows us to understand how reliable institutions are and if they guarantee to the population an environment in which they can be free to make choices without limiting or restricting their capabilities due to ineffective policies, corruption or violence. This index was constructed based on the Worldwide Governance Indicators, from the World Bank Group, that measures Voice and Accountability (VA), Political Stability and Absence of Violence (PSAV), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL) and Control of Corruption (CC).

[19] This index generates countries scores based on Electoral process and pluralism, Functioning of government, Political participation, Democratic political culture and Civil liberties. (EUI Democracy Index Report (2013)

IST Index: (((VA – VA Min) / (VA Max – VA Min)) + ((PSAV – PSAV Min) / (PSAV Max – PSAV Min)) + ((GE – GE Min) / (GE Max – GE Min)) + ((RQ – RQ Min) / (RQ Max – RQ Min)) + ((RL – RL Min) / (RL Max – RL Min))+ ((CC – CC Min) / (CC Max – CC Min)))/6

The inclusion of political analysis and civil liberties in the social index follows the suggestions of many authors (Sen (2000), Nussbaum (2000), Qizilbash (1996, 1997), Dasgupta and Weale (1992), and Fitoussi and Malik (2013)) that identified that the freedom to take part in the political process and the guarantee of equal rights independent of gender or class are essential means to enhance people's choice, capability and functioning sets.

It is in this sense that in the social indicator gender equality is also considered, so it is possible to measure if inclusion in the political process and the respect of civil rights is extended to each and every human being. To this end, we used the Gender Inequality Index (GII) from the Human Development Report, which accounts for the inequality between men and women in "reproductive health, empowerment and the labor market" (HDR, 2014).

Combining all the available data it was possible to create a ranking of 132 countries. When comparing the ranking derived from the Social Index to the HDI total rank we can see that the first positions do not present big changes, except by the significant decrease in the rank of United States and Singapore.

The United States' position is mostly affected by its score on the Gender Inequality Index. Although one of the most advanced countries, it has one of the highest GII among its category in the HDI (Very High Developed), and ranks fourth highest when compared to the other OECD countries (behind Mexico, Turkey and Chile).

In the case of Singapore the Democracy Index is the main reason for its change of position. According to the EIU index Singapore is considered a Hybrid Regime because of its

low scores in Political Participation and Electoral Process. The Freedom House[20] Analysis affirms that the dominance of the People's Action Party (PAP) helped to develop the country's economy but restricted individual freedom and slowed down political development.

[20] Freedom House is another organization that studies the Countries political systems, just like the Economist Intelligence Unit (EIU)

Table 7 - Social Index Vs. HDI

Ranking Social Index			HDI Index			Difference (HDI-SI)
1	0.95	Norway	1	0.94	Norway	0.00
2	0.94	Switzerland	2	0.93	Australia	-3.00
3	0.94	Sweden	3	0.92	Switzerland	1.00
4	0.93	Netherlands	4	0.92	Netherlands	0.00
5	0.93	Australia	5	0.91	United States	-16.00
6	0.93	Denmark	6	0.91	Germany	-3.00
7	0.92	New Zealand	7	0.91	New Zealand	0.00
8	0.92	Finland	8	0.90	Canada	-2.00
9	0.92	Germany	9	0.90	Singapore	-22.00
10	0.91	Canada	10	0.90	Denmark	4.00
11	0.91	Austria	11	0.90	Ireland	-1.00
12	0.90	Ireland	12	0.90	Sweden	9.00
13	0.88	Japan	13	0.89	United Kingdom	-3.00
14	0.88	Belgium	14	0.89	Korea, Rep.	-5.00
15	0.88	Slovenia	15	0.89	Japan	2.00
16	0.88	United Kingdom	16	0.89	Israel	-6.00
17	0.88	France	17	0.88	France	0.00
18	0.86	Czech Republic	18	0.88	Austria	7.00
19	0.86	Korea, Rep.	19	0.88	Belgium	5.00
20	0.85	Spain	20	0.88	Finland	12.00
21	0.85	United States	21	0.87	Slovenia	6.00
22	0.85	Israel	22	0.87	Italy	-1.00
23	0.85	Italy	23	0.87	Spain	3.00
24	0.84	Cyprus	24	0.86	Czech Republic	6.00
25	0.84	Estonia	25	0.85	Greece	-4.00
26	0.84	Portugal	26	0.85	Qatar	-49.00
27	0.83	Lithuania	27	0.85	Cyprus	3.00
28	0.83	Poland	28	0.84	Estonia	3.00
29	0.81	Greece	29	0.84	Saudi Arabia	-57.00
30	0.80	Chile	30	0.83	Lithuania	3.00
31	0.80	Singapore	31	0.83	Poland	3.00
32	0.78	Hungary	32	0.83	United Arab Emirates	-28.00
33	0.78	Croatia	33	0.82	Portugal	7.00
34	0.78	Latvia	34	0.82	Chile	4.00
35	0.77	Uruguay	35	0.82	Hungary	3.00
36	0.77	Costa Rica	36	0.82	Bahrain	-37.00
37	0.76	Mauritius	37	0.81	Cuba	-40.00
38	0.75	Bulgaria	38	0.81	Kuwait	-34.00
39	0.73	Malaysia	39	0.81	Croatia	6.00
40	0.72	Romania	40	0.81	Latvia	6.00
41	0.69	Argentina	41	0.81	Argentina	0.00
42	0.68	Albania	42	0.79	Uruguay	7.00
43	0.68	Jamaica	43	0.79	Belarus	-36.00
44	0.68	Mexico	44	0.78	Romania	4.00
45	0.68	Panama	45	0.78	Libya	-45.00

Table 8 - Social Index Vs. HDI (continuation)

Ranking Social Index			HDI Index			Difference (HDI-SI)
46	0.67	Mongolia	46	0.78	Oman	-32.00
47	0.67	Botswana	47	0.78	Russian Federation	-22.00
48	0.67	Turkey	48	0.78	Bulgaria	10.00
49	0.67	Brazil	49	0.77	Malaysia	10.00
50	0.67	Peru	50	0.77	Mauritius	13.00
51	0.65	South Africa	51	0.77	Panama	6.00
52	0.65	Bosnia and Herzegovina	52	0.77	Lebanon	-14.00
53	0.65	Thailand	53	0.76	Venezuela, RB	-34.00
54	0.64	Armenia	54	0.76	Costa Rica	18.00
55	0.64	Sri Lanka	55	0.76	Turkey	7.00
56	0.63	El Salvador	56	0.76	Kazakhstan	-37.00
57	0.63	Ukraine	57	0.76	Mexico	13.00
58	0.63	Colombia	58	0.75	Sri Lanka	3.00
59	0.62	Philippines	59	0.75	Iran, Islamic Rep.	-49.00
60	0.62	United Arab Emirates	60	0.75	Azerbaijan	-34.00
61	0.62	Suriname	61	0.75	Jordan	-19.00
62	0.62	Dominican Republic	62	0.74	Brazil	13.00
63	0.61	Namibia	63	0.74	Peru	13.00
64	0.61	Tunisia	64	0.73	Ukraine	7.00
65	0.61	Indonesia	65	0.73	Bosnia and Herzegovina	13.00
66	0.61	Lebanon	66	0.73	Armenia	12.00
67	0.60	Ecuador	67	0.72	Thailand	14.00
68	0.60	Paraguay	68	0.72	Tunisia	4.00
69	0.59	Russian Federation	69	0.72	China	-15.00
70	0.59	Bolivia	70	0.72	Algeria	-19.00
71	0.58	Ghana	71	0.72	Albania	29.00
72	0.58	Kuwait	72	0.72	Jamaica	29.00
73	0.58	Bahrain	73	0.71	Colombia	15.00
74	0.58	Nicaragua	74	0.71	Ecuador	7.00
75	0.58	Qatar	75	0.70	Suriname	14.00
76	0.57	India	76	0.70	Dominican Republic	14.00
77	0.57	Cuba	77	0.70	Mongolia	31.00
78	0.57	Oman	78	0.68	Indonesia	13.00
79	0.57	Belarus	79	0.68	Botswana	32.00
80	0.56	Jordan	80	0.68	Egypt, Arab Rep.	-29.00
81	0.56	Guyana	81	0.68	Paraguay	13.00
82	0.56	Honduras	82	0.67	Gabon	-14.00
83	0.56	Bhutan	83	0.67	Bolivia	13.00
84	0.56	China	84	0.66	El Salvador	28.00
85	0.55	Guatemala	85	0.66	Philippines	26.00
86	0.55	Saudi Arabia	86	0.66	South Africa	35.00
87	0.54	Venezuela, RB	87	0.64	Iraq	-23.00
88	0.54	Zambia	88	0.64	Guyana	7.00
89	0.54	Algeria	89	0.63	Guatemala	4.00
90	0.53	Libya	90	0.62	Namibia	27.00

Table 9 - Social Index Vs. HDI (continuation)

Ranking Social Index			HDI Index			Difference (HDI-SI)
91	0.53	Senegal	91	0.62	Honduras	9.00
92	0.53	Lesotho	92	0.62	Morocco	-9.00
93	0.53	Kazakhstan	93	0.61	Nicaragua	19.00
94	0.52	Azerbaijan	94	0.61	Tajikistan	-11.00
95	0.52	Kenya	95	0.59	India	19.00
96	0.51	Gabon	96	0.58	Bhutan	13.00
97	0.51	Nepal	97	0.58	Cambodia	-1.00
98	0.51	Cambodia	98	0.57	Ghana	27.00
99	0.50	Rwanda	99	0.56	Congo, Rep.	-25.00
100	0.50	Bangladesh	100	0.56	Zambia	12.00
101	0.50	Morocco	101	0.56	Bangladesh	1.00
102	0.50	Benin	102	0.54	Nepal	5.00
103	0.49	Malawi	103	0.54	Pakistan	-3.00
104	0.47	Papua New Guinea	104	0.54	Kenya	9.00
105	0.47	Tajikistan	105	0.53	Swaziland	-14.00
106	0.47	Pakistan	106	0.51	Rwanda	7.00
107	0.46	Uganda	107	0.50	Cameroon	-19.00
108	0.45	Iran, Islamic Rep.	108	0.50	Yemen, Rep.	-19.00
109	0.45	Egypt, Arab Rep.	109	0.49	Zimbabwe	-4.00
110	0.45	Iraq	110	0.49	Papua New Guinea	6.00
111	0.44	Liberia	111	0.49	Mauritania	-11.00
112	0.42	Haiti	112	0.49	Lesotho	20.00
113	0.42	Zimbabwe	113	0.49	Senegal	22.00
114	0.41	Mali	114	0.48	Uganda	7.00
115	0.41	Burundi	115	0.48	Benin	13.00
116	0.41	Mozambique	116	0.47	Togo	-1.00
117	0.40	Togo	117	0.47	Sudan	-11.00
118	0.40	Ethiopia	118	0.47	Haiti	6.00
119	0.39	Swaziland	119	0.47	Afghanistan	-11.00
120	0.39	Niger	120	0.44	Gambia, The	-5.00
121	0.39	Sierra Leone	121	0.44	Ethiopia	3.00
122	0.39	Mauritania	122	0.41	Malawi	19.00
123	0.38	Burkina Faso	123	0.41	Liberia	12.00
124	0.38	Congo, Rep.	124	0.41	Mali	10.00
125	0.37	Gambia, The	125	0.39	Mozambique	9.00
126	0.37	Cameroon	126	0.39	Burundi	11.00
127	0.36	Yemen, Rep.	127	0.39	Burkina Faso	4.00
128	0.33	Sudan	128	0.37	Sierra Leone	7.00
129	0.32	Congo, Dem. Rep.	129	0.37	Chad	-3.00
130	0.30	Afghanistan	130	0.34	Central African Republic	-1.00
131	0.28	Central African Republic	131	0.34	Congo, Dem. Rep.	2.00
132	0.27	Chad	132	0.34	Niger	12.00

Table 10 – Comparison of the top 15 first positions for the Social Index with HDI and HDI Index for Education and Health

Country	Social Index	HDI	Difference (HDI - SI)
Norway	1	1	0.00
Switzerland	2	3	1.00
Sweden	3	12	9.00
Netherlands	4	4	0.00
Australia	5	2	3.00
Denmark	6	10	4.00
New Zealand	7	7	0.00
Finland	8	20	12.00
Germany	9	6	3.00
Canada	10	8	2.00
Austria	11	18	7.00
Ireland	12	11	1.00
Japan	13	15	2.00
Belgium	14	19	5.00
Slovenia	15	21	6.00

Country	Social Index	HDI Health and Education	Difference (HDI - SI)
Norway	1	3	2.00
Switzerland	2	8	6.00
Sweden	3	16	13.00
Netherlands	4	4	0.00
Australia	5	1	4.00
Denmark	6	13	7.00
New Zealand	7	2	5.00
Finland	8	19	11.00
Germany	9	6	3.00
Canada	10	11	1.00
Austria	11	23	12.00
Ireland	12	5	7.00
Japan	13	15	2.00
Belgium	14	22	8.00
Slovenia	15	14	1.00

CHAPTER V

TECHNOLOGICAL AND ENVIRONMENTAL INDEXES

So far the analysis of this study has not presented major changes in the structure of the indexes that are part of the HDI. Although the environment has already been the focus of UN debates, for example in the 2011 HDR, the first attempt to combine this indicator with the HDI was done by Moran et. al (2008), where they crossed HDI data with an environmental indicator, the Ecological Footprint. Their finding was interesting, and the inspiration to develop this study, that only one country, Cuba, showed the minimum requirements for sustainable development.

This analysis goes a little further including technology as another element to reach sustainable development, according to Bacescu's (2009) integration system, previously presented. Usually technology is presented as a determinant for economic growth, as in Evenson and Singh (1997) who use evidence from Asia, but here we highlight how technology might contribute to sustainable development.

Technological Index

Technology might play an important role in the search for renewable energies and new and more efficient production methods that can not only reduce energy need but also can have less of an environmental impact. Technology and investment in Research and Development (R&D) are also the key to reduce environment degradation, to identify alternatives to resources depleted or close to depletion, and maybe at some point help with environment regeneration.

However Technology and innovation, as mentioned above, can be linked to almost every activity sector of the society like industry, services, health, and environment etc. There are many other ways how technology and innovation could facilitate and create, for the next generation, a better life and this is the reason why this component should be included in the SDI.

Archibugi and Coco (2005) point out important constraints regarding the use of technological indexes for comparison between countries, saying the bigger the range of the countries in the analysis the more problematic is the choice of variables to build the index especially because of the availability of data and the change of the level of technological progress in different stages of development.

Based on a survey of the available technological indexes[21], Archibugi and Coco (2005), suggest that technological capabilities can be summarized in heterogeneous elements that can be aggregated along three axes:

- Embodied/Disembodied: where technical change can be embodied in equipment and machines and disembodied in human skills. This gives an idea of evaluating physical and human capital indicators;
- Codified/Tacit: is more related to the scientific work generated on the researching process, publications and patents. Here the main concern is the human learning potential and qualification;
- Generation/Diffusion: here the concern is about the use of technology. It is extremely important to generate innovations but it is even more essential to apply them and share them in order to benefit from them.

Based on these three categories some technological indexes present common variables like level of education, patents registered, R&D investments, technology production (exports or

[21] "We consider five different attempts to measure technological capabilities: the World Economic Forum (WEF) Technology Index (WEF, 2001, 2002, 2003; Furman et al., 2002), the United Nations Development Program (UNDP) Technology Achievement Index (TAI) (UNDP, 2001; Desai et al., 2002), our own ArCo (Archibugi and Coco, 2004), the United Nations Industrial Development Organization (UNIDO) Industrial Development Scoreboard (UNIDO, 2002; Lall and Albaladejo, 2001), and finally the Science and Technology Capacity Index developed by the RAND Corporation and associated partners (Wagner et al., 2004). Throughout this piece, they will be referred as WEF, UNDP, ArCo, UNIDO, and RAND. We also draw our attention on the work carried out by the World Bank Institute programme "Knowledge and Development" Knowledge Assessment Methodology (KAM), although this is not strictly comparable with the others." (Archibugi & Coco, 2005 p.179)

value added) and technological access (imports). Since education was already included in our social index here it would be interesting to explore the other remaining dimensions.

Patents (PT) can be an unfair technology measure especially because the index we are trying to build considers all countries in all stages of development, so countries that are pursuing development based on assimilation and imitation will score lower positions even though their effort to improve technology is strong. For this reason we will consider two different technology indexes, one that includes this variable and one without it.

Archibugi and Coco (2005) suggested the use of US Patent Trademark Office (USPTO) data due to their capacity to standardize registration, so the patents considered follow a common rule. The authors alert that the only problem using this variable is the possible bias in the value for the United States, due to the relative ease of registration of patents for residents of the United States. As an alternative we found that OECD statistics record patent applications to the EPO (European Patent Office) and the difference between this indicator and the USPTO for the US is higher than 200% while for other countries never more than 100%, so we decided to consider EPO[22] data in our indicator.

R&D investments as a percentage of GDP (R&D) seems to be a more suitable indicator once it considers the effort of the country to pursue innovations and improve their human capital based on their macroeconomic conditions. The data was extracted from the World Bank.

Finally to measure technology generation, we consider exports of high technology as a percentage of manufactured exports (EXT). This variable not only takes into consideration the size of the country because it is a percentage of manufactured exports but it also can be applied for all the different types of technological development (innovation, assimilation or imitation).The percentage of high-technology exports might also represent a country's concern

[22] The value considered was the total amount of Patent Applications to EPO from 2000 to 2012.

with policies that can privilege their comparative advantage with more high value added items and the attempt to diversify their exports portfolio.

Here we will not consider technology imports because while it can represent a way to access new technologies, it also can be interpreted as dependence on foreign technology (Archibugi & Coco, 2005).

TCH1 Index = (((R&D – R&D Min) / (R&D Max – R&D Min)) + ((PT – PT Min) / (PT Max – PT Min)) + ((EXT – EXT Min) / (EXT Max – EXT Min)))/ 3

TCH2 Index = (((R&D – R&D Min) / (R&D Max – R&D Min)) + ((EXT – EXT Min) / (EXT Max – EXT Min)[23]))/2

For R&D expenditure, we have a total of 116 observations, where South Korea presents the highest percentage, 4.04 (the maximum considered in this index) and where 0 is the minimum. When it comes to Patents, there are 132 observations and the highest value is for Japan with 529,616.00 and the minimum value considered is also 0.

Finally, for EXT, with 146 observations, the maximum value was presented by Solomon Island, 87%, however this is not a representative number since their size in current US$ is negligible (122,555.00). We use an average of the recently industrialized countries that promote exports of high-technology products, China, Singapore and South Korea that gave us a maximum value of 33%.

The combination of the 3 variables in TCH1 provided us with an index for 101 countries, where the first positions are no surprise, Japan, South Korea, Switzerland, Singapore and Germany. When compared to TCH2 the difference is only significant for Germany and Japan that dropped to 7th and 4th positions respectively.

[23] Considering the last data available for the variables R&D range is from 1999-2012 and for Exports 1992-2012.

It is not a surprise Japan and South Korea have the highest positions in the TCH index. Their recent development, just like the other Asian Tigers, allowed them to focus on the industrialization process based on technology and innovation generating economic growth especially due to the high valued exports. Japan, China and South Korea, for example, are responsible for almost 17%[24] of the world's exports, however, when we analyze the High-technology exports[25] their representation increases to 40%.

Another interesting fact about this index is that considering the first twenty positions, 35% of the countries are not OECD members. The point here is that OECD countries are still a majority in the first positions, but their representation is getting smaller, especially when considering new variables.

[24] CIA Factbook estimations available at the link: https://www.cia.gov/library/publications/the-world-factbook/rankorder/2078rank.html#wfbtop
[25] High-technology exports (current US$) World Bank Data

Table 11 - Technological Indexes: Comparison of TCH1 and TCH2

Ranking	TCH1	Country	TCH2	Ranking	Difference (TCH1 - TCH2)
1	0.79	Japan	0.69	5	-4
2	0.67	Korea, Rep.	0.90	1	1
3	0.51	Switzerland	0.75	3	0
4	0.51	Singapore	0.76	2	2
5	0.50	Germany	0.60	12	-7
6	0.50	Israel	0.73	4	2
7	0.48	France	0.67	6	1
8	0.45	China	0.65	7	1
9	0.43	Sweden	0.63	9	0
10	0.42	Malaysia	0.63	8	2
11	0.41	United States	0.62	10	1
12	0.40	Malta	0.60	11	1
13	0.40	United Kingdom	0.55	20	-7
14	0.40	Netherlands	0.57	14	0
15	0.40	Denmark	0.59	13	2
16	0.39	Finland	0.57	15	1
17	0.38	Ireland	0.56	16	1
18	0.37	Costa Rica	0.56	17	1
19	0.37	Austria	0.55	19	0
20	0.37	Cuba	0.55	18	2
21	0.36	Iceland	0.54	21	0
22	0.35	Panama	0.52	22	0
23	0.34	Philippines	0.51	24	-1
24	0.34	Australia	0.49	26	-2
25	0.33	Norway	0.49	25	0
26	0.32	Czech Republic	0.48	27	-1
27	0.32	Kazakhstan	0.48	28	-1
28	0.31	Canada	0.40	35	-7
29	0.31	Belgium	0.45	29	0
30	0.29	Slovenia	0.44	30	0
31	0.29	Hungary	0.44	31	0
32	0.29	Estonia	0.43	33	-1
33	0.26	Uganda	0.39	36	-3
34	0.23	Thailand	0.35	37	-3
35	0.21	Brazil	0.31	39	-4
36	0.21	New Zealand	0.31	40	-4
37	0.20	Mexico	0.30	41	-4
38	0.20	Luxembourg	0.30	42	-4
39	0.19	Italy	0.27	46	-7
40	0.18	Spain	0.27	44	-4
41	0.18	Lithuania	0.27	43	-2
42	0.18	Russian Federation	0.27	45	-3
43	0.17	Cyprus	0.26	47	-4
44	0.17	Portugal	0.25	48	-4
45	0.16	Croatia	0.25	49	-4
46	0.15	Latvia	0.23	50	-4
47	0.15	Greece	0.23	51	-4
48	0.15	Tunisia	0.22	52	-4
49	0.15	Poland	0.22	53	-4
50	0.14	India	0.20	55	-5

Table 12 - Technological Indexes: Comparison of TCH1 and TCH2 (continuation)

Ranking	TCH1	Country	TCH2	Ranking	Difference (TCH1 - TCH2)
51	0.14	Kenya	0.21	54	-3
52	0.13	Brunei Darussalam	0.20	56	-4
53	0.13	Argentina	0.20	57	-4
54	0.13	Bulgaria	0.20	58	-4
55	0.13	Uruguay	0.20	59	-4
56	0.13	Morocco	0.19	60	-4
57	0.13	Ukraine	0.19	61	-4
58	0.11	South Africa	0.16	62	-4
59	0.11	Bolivia	0.16	63	-4
60	0.11	Romania	0.16	64	-4
61	0.11	Ghana	0.16	65	-4
62	0.10	Mongolia	0.15	67	-5
63	0.09	Azerbaijan	0.14	68	-5
64	0.09	Turkey	0.13	69	-5
65	0.09	Belarus	0.13	70	-5
66	0.08	Chile	0.12	71	-5
67	0.08	Indonesia	0.12	72	-5
68	0.08	Serbia	0.12	73	-5
69	0.08	Gabon	0.12	74	-5
70	0.08	Burkina Faso	0.12	75	-5
71	0.08	Paraguay	0.11	76	-5
72	0.07	United Arab Emirate	0.11	77	-5
73	0.07	Colombia	0.10	78	-5
74	0.07	Namibia	0.10	80	-6
75	0.06	Jordan	0.09	81	-6
76	0.05	Guatemala	0.08	84	-8
77	0.05	Senegal	0.08	85	-8
78	0.05	El Salvador	0.08	86	-8
79	0.05	Armenia	0.07	87	-8
80	0.05	Peru	0.07	88	-8
81	0.05	Oman	0.07	89	-8
82	0.05	Ethiopia	0.07	90	-8
83	0.04	Pakistan	0.07	91	-8
84	0.04	Ecuador	0.07	92	-8
85	0.04	Egypt, Arab Rep.	0.06	93	-8
86	0.04	Mauritius	0.06	94	-8
87	0.04	Georgia	0.06	95	-8
88	0.04	Nigeria	0.06	97	-9
89	0.03	Bosnia and Herzego	0.04	100	-11
90	0.02	Seychelles	0.04	101	-11
91	0.02	Sri Lanka	0.03	103	-12
92	0.02	Albania	0.03	104	-12
93	0.02	Honduras	0.03	105	-12
94	0.01	Kuwait	0.02	106	-12
95	0.01	Madagascar	0.02	107	-12
96	0.01	Saudi Arabia	0.02	108	-12
97	0.01	Jamaica	0.02	109	-12
98	0.01	Algeria	0.01	111	-13
99	0.01	Nicaragua	0.01	112	-13
100	0.00	Trinidad and Tobago	0.01	114	-14
101	0.00	Iraq	0.01	116	-15

Environmental Index

Finally, the last index that will compose the SDI, is concerned with the environmental conditions. This component of the SDI is one of the most discussed nowadays and is often taken as a synonym of sustainable development. In this analysis we combined the data from the National Footprint Account (NFA) with the Environmental Sustainability Index (ESI).

The NFA calculates the demand[26] on nature and the biocapacity available for more than 140 countries with the objective to evaluate if consumption is in accordance with the actual environmental capacity and if it is permitting the environment to regenerate.

This indicator makes use of UN data sets on Food, Agriculture and Trade and Energy agencies information in order to calculate the ecological consumption per habitant and the availability of resources in six different categories: Cropland, Grazing, Forest Product, Fish, Carbon and Built up land. The main objective of the calculations is to reach a balance that expresses deficit or surplus of the environmental footprint to biocapacity per habitant in Global Hectares (GHA).

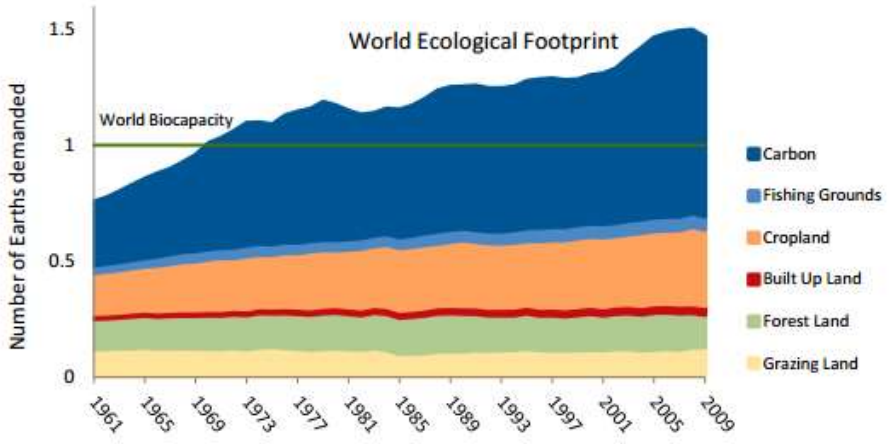
- Cropland considers all the productive land, "including livestock feeds, fish meals, oil crops and rubber…and it is calculated using data on production, import and export of primary and derived agricultural products." (Borucke, M. et all 2013, p.524)
- Grazing Land is an addition account to cropland used to feed animals;
- Fishing grounds are based on the estimation of required amount of space to sustain aquatic species production and maintain sustainable extraction for consumption;

[26] "Ecological Footprint and biocapacity values are expressed in mutually exclusive units of area necessary to annually provide (or regenerate) such ecosystem services. They include: cropland for the provision of plant-based food and fiber products; grazing land and cropland for animal products; fishing grounds (marine and inland) for fish products; forests for timber and other forest products; uptake land to neutralize waste emissions (currently only the areas for absorbing anthropogenic carbon dioxide emissions are considered); and built-up areas for shelter and other infrastructure". (Borucke, M. et all 2013, p.519)

- Forest Land calculation is based on "the annual harvest of fuel wood and timber to supply forest products." (Borucke, M. et all 2013, p.524)
- Carbon Footprint is the only category that accounts for a waste product, the carbon dioxide (CO2), produced primarily by the process of generating energy, according to the data from the International Energy Agency (IEA), and other estimations that consider other types of CO2 emissions like transport and oceans sequestration, that can also be referred as storage[27]. It counterpart considers the world storage capacity, or in other words the absorption of this waste in different ways like forest for carbon uptake.
- Built-up Land considers the area that could be used for cropland but instead is built for human use.

According to the 2012 edition of the NFA, the one used here for the environmental index, each person is consuming the equivalent of 2.6 GHA that means that it would be needed 1.47 planets to supply this demand, like showed in Figure 3.

Figure 3 - World Ecological Footprint 2012



Source: National Footprint Accounts, 2012 Edition, p. 6

[27] CO2 sequestration is the process of injecting the gas into deep underground rock formations that can store the CO2 and prevent it to be in the atmosphere. (For more details: http://www.epa.gov/climatechange/ccs/)

As shown in Figure 3, the world's biocapacity is kept constant and it was enough to supply humanity demand until the 1970's, after that the use of fossil fuels[28] to generate energy have increased dramatically changing to a deficit scenario. We have been experiencing a constant increase of carbon emissions and today they represent the biggest concern of environmental damage. This report shows a deficit of about 0.8 GHA per habitant in the world and the highest deficit is concentrated in high income countries as expected, at 3.6 GHA per habitant.

In order to complement this information we use the ESI calculated by a partnership between the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network (CIESIN) at Columbia University. The most recent data available refer to the 2005 report that considers the environmental situation until 2000.

The ESI is more concerned with environmental performance and the decision making process of countries. They gather 21 indicators that represent five categories: Environmental Systems, Reducing Environmental Stresses, Reducing Human Vulnerability to Environmental Stresses, Societal and Institutional Capacity to Respond to Environmental Challenges and Global Stewardship[29].

The rankings in the two indexes, NFA and ESI, present major differences, as showed in Table 1. We derive our Environmental (ENV) Index as follows:

ENV Index = (((NFA – NFA Min) / (NFA Max – NFA Min)) + ((ESI – ESI Min) / (ESI Max – ESI Min)))/2

[28] Information extracted from: Global greenhouse gas emissions increased 75% since 1970. http://www.pbl.nl/en/dossiers/Climatechange/TrendGHGemissions1990-2004

[29] The list of variables that are considered by the ESI is available in the Appendix, Table 1. Esty, D. C., Levy, M., Srebotnjak, T., & De Sherbinin, A. (2005) p.1

In order to provide a better comparison we also provide the CO2 index, based on the World Bank data for CO2 emissions per capita. These data are considered in both indexes and that is why they were not included in the ENV index. It is also important to mention that this ranking in presented in the opposite direction, where a lower CO2 emission means a higher position.

As we know, CO2 emissions are higher in countries with high industrial activity and that's the reason why smaller countries with low production would score better, so, to avoid unfair comparisons, the CO2 rank was built based on the level of development that each country was categorized in the HDI (Very high, High, Medium and Low human development). This means that there are 4 first positions in the CO2 index, Singapore, Sri Lanka, Timor-Leste and Lesotho.

Analyzing the data it is possible to see that countries with abundant natural resources score better, which, according to the NFA Biocapacity calculations, is the case of Bolivia, Mongolia, Canada, Australia, Finland, Congo, Sweden, Uruguay, New Zealand and Paraguay that has a Biocapacity in global hectares per person higher than 10.

The availability of natural resources is closely related with CO2 emission per capita especially because of the electricity generation sector. For example Uruguay has more than 60% of its electricity generated by hydropower what contribute to its position of 12 out of 49 in the group of highly developed countries.

Table 13 - Environmental Index and Differences between the Two Environmental Variables

Ranking	EI		NFA	ESI	Difference (ESI-NFA)	CO2
1	0.85	Finland	6	1	-5	34
2	0.81	Bolivia	1	19	18	20
3	0.78	Uruguay	11	3	-8	12
4	0.75	Norway	17	2	-15	35
5	0.75	Sweden	13	4	-9	13
6	0.74	Canada	5	6	1	37
7	0.70	Australia	4	13	9	38
8	0.67	Brazil	10	11	1	14
9	0.67	New Zealand	7	14	7	19
10	0.66	Congo, Rep.	2	39	37	7
11	0.65	Paraguay	8	17	9	14
12	0.63	Central African Repub	9	25	16	7
13	0.63	Argentina	15	9	-6	6
14	0.60	Latvia	16	15	-1	3
15	0.58	Namibia	12	32	20	19
16	0.58	Estonia	14	27	13	36
17	0.58	Mongolia	3	68	65	32
18	0.56	Peru	22	16	-6	11
19	0.54	Colombia	23	22	-1	8
20	0.52	Lithuania	32	23	-9	5
21	0.52	Russian Federation	19	33	14	46
22	0.51	Croatia	40	20	-20	7
23	0.51	Austria	106	10	-96	23
24	0.49	Costa Rica	83	18	-65	9
25	0.49	Panama	41	28	-13	18
26	0.49	Albania	75	24	-51	5
27	0.48	Botswana	34	34	0	27
28	0.48	Switzerland	129	7	-122	9
29	0.47	Papua New Guinea	33	36	3	31
30	0.47	Slovenia	77	29	-48	20
31	0.47	Ireland	108	21	-87	26
32	0.46	Chile	29	42	13	4
33	0.45	Mali	39	40	1	4
34	0.45	Denmark	114	26	-88	25
35	0.43	Cameroon	38	49	11	29
36	0.43	Zambia	28	57	29	2
37	0.43	Myanmar	44	48	4	20
38	0.43	France	99	35	-64	12
39	0.43	Malaysia	78	38	-40	40
40	0.43	Madagascar	25	60	35	12
41	0.43	Germany	115	31	-84	27
42	0.43	Ecuador	42	50	8	15
43	0.42	Guinea-Bissau	20	73	53	19
44	0.42	Ghana	72	47	-25	4
45	0.41	Armenia	92	44	-48	4
46	0.41	Japan	123	30	-93	28
47	0.41	Belarus	86	46	-40	36
48	0.41	Nicaragua	36	62	26	13
49	0.41	Hungary	68	52	-16	10
50	0.40	Senegal	53	56	3	33
51	0.40	Tunisia	84	53	-31	16
52	0.39	Cuba	100	51	-49	2
53	0.39	Bulgaria	46	66	20	33
54	0.39	Uganda	82	55	-27	14
55	0.39	Guinea	31	76	45	15
56	0.39	Cambodia	50	65	15	3
57	0.39	Bosnia and Herzegovir	85	58	-27	43
58	0.39	Portugal	118	37	-81	8
59	0.39	Gambia, The	60	67	7	25
60	0.38	Malawi	51	70	19	9
61	0.38	Indonesia	47	72	25	24
62	0.37	Thailand	94	69	-25	27
63	0.37	Venezuela, RB	49	77	28	39
64	0.37	Congo, Dem. Rep.	21	108	87	5
65	0.37	United States	121	45	-76	40
66	0.36	Honduras	45	82	37	18

Table 14 - Environmental Index and Differences between the Two Environmental Variables (continuation)

Ranking	EI		NFA	ESI	Difference (ESI-NFA)	CO2
67	0.36	Kazakhstan	79	74	-5	47
68	0.36	Nepal	58	80	22	18
69	0.36	Mauritania	18	118	100	35
70	0.36	Sri Lanka	88	75	-13	1
71	0.36	Mozambique	27	100	73	17
72	0.36	Chad	30	98	68	3
73	0.35	Benin	71	81	10	34
74	0.35	Romania	48	88	40	24
75	0.34	Liberia	26	114	88	21
76	0.34	Angola	24	117	93	41
77	0.34	Greece	116	63	-53	21
78	0.34	Netherlands	131	41	-90	32
79	0.34	Serbia	97	84	-13	35
80	0.34	Burkina Faso	55	91	36	13
81	0.34	Turkey	87	86	-1	25
82	0.33	United Kingdom	119	61	-58	22
83	0.33	Italy	120	64	-56	17
84	0.33	Nigeria	67	93	26	32
85	0.33	Niger	54	97	43	10
86	0.33	Jordan	110	79	-31	22
87	0.33	Spain	117	71	-46	14
88	0.33	Israel	127	59	-68	29
89	0.33	India	69	95	26	23
90	0.33	Kenya	73	94	21	27
91	0.33	Rwanda	56	101	45	6
92	0.32	Ukraine	57	103	46	37
93	0.32	South Africa	103	89	-14	34
94	0.32	Sierra Leone	43	115	72	16
95	0.32	Togo	66	105	39	24
96	0.32	Algeria	102	90	-12	21
97	0.32	Morocco	81	99	18	21
98	0.32	Azerbaijan	98	92	-6	30
99	0.31	Bangladesh	62	107	45	5
100	0.31	Czech Republic	111	85	-26	31
101	0.31	Mexico	112	87	-25	23
102	0.30	Guatemala	91	110	19	12
103	0.30	Egypt, Arab Rep.	93	109	16	26
104	0.30	Dominican Republic	90	113	23	13
105	0.30	Syrian Arab Republic	95	112	17	28
106	0.30	Jamaica	107	102	-5	19
107	0.30	Poland	109	96	-13	24
108	0.29	El Salvador	105	111	6	17
109	0.29	Philippines	80	120	40	16
110	0.28	Zimbabwe	76	121	45	37
111	0.26	Pakistan	65	124	59	39
112	0.26	Burundi	70	123	53	2
113	0.25	Tajikistan	61	127	66	6
114	0.24	Sudan	37	133	96	28
115	0.24	Ethiopia	74	128	54	8
116	0.24	Korea, Rep.	125	116	-9	33
117	0.23	Yemen, Rep.	64	130	66	40
118	0.23	Iran, Islamic Rep.	113	125	12	41
119	0.23	China	104	126	22	34
120	0.22	Libya	126	119	-7	44
121	0.22	Lebanon	122	122	0	29
122	0.21	Belgium	132	106	-26	30
123	0.20	Haiti	63	134	71	23
124	0.19	Uzbekistan	96	135	39	30
125	0.18	Saudi Arabia	124	129	5	39
126	0.17	Turkmenistan	89	137	48	35
127	0.17	Iraq	101	136	35	31
128	0.16	United Arab Emirates	137	104	-33	42
129	0.10	Trinidad and Tobago	135	132	-3	49
130	0.04	Kuwait	0	131	131	45

CHAPTER VI

THE SUSTAINABLE DEVELOPMENT INDEX

Finally, in this section our objective is to talk about the results of the combination of our four indexes. Since we developed two technology indexes (TCH1 and TCH2) we will present two tables of SDI, however when it comes to the analysis part the results are similar, because the same set of countries emerge as worth noting under both indexes.

As we can see in Table 1 the first places of the SDI are similar to the one in the HDI, as Norway keeps the first place. Norway is a model country with good quality institutions that allow it to deal with its natural resources adequately and as a result it is able to experience high income levels and impressive social standards. Norway is the second largest oil producer in the World, behind Saudi Arabia, and this activity contributes to more than 40% of it GDP, but the country does not present signs of any rent-seeking activity due to the government efforts to deal carefully with the oil money (Gylfason, T., 2002).

According to Gylfasson (2002) Norway had a different trajectory than other oil producer countries, like Saudi Arabia, Venezuela or Mexico, because it was already considered developed by the time they discovered oil resources, with a well-organized political system and good institutions. Considering this fact, this is one of the first evidences of the importance to include the institutional analysis in the SDI, because it expresses the importance of institutional quality in the sustainable development of a country rather than its economic performance. The proper management of oil money can bring better quality life for the actual and future generations and avoid the Natural Resources Curse, vastly mentioned in the literature. Gylfasson (2002) mentions that it was registered and increase of 36% of people attending universities and colleges between 1980 and 1997, meaning that they managed to improve the other social features.

Norway is also considered a pioneer in environmental policies and due to its Carbon Tax it is also investing in carbon-neutral technology, like the carbon sequestration facility that has been active since 1996 (Rao, A. B., & Rubin, E. S., 2002). Its concern with the environment is another reason why it maintains its first position in both ranks. Although its technology index is not among the highest, the investments in this area are considerable; R&D expenditure (% of GDP) is 1.65%.

Finland reaches the second place in the SDI index, even with a considerable low technology index (TCH1 0.39 and TCH2 0.57) the proper balance between the other indexes guarantees it high rank, especially because it environmental index. Finland holds the first position in the ESI rank due to its abundance in natural resources and low population density.

Although, the SDI and the HDI rank the same country first, there are some countries that are worth talking about especially because of the positive changes in their ranking. Bolivia, Paraguay, Brazil, Mongolia, Costa Rica, Malaysia, Namibia, Panama, Philippines, Uganda and Finland are the ones that present the biggest changes when compared to their HDI position, each with and increase higher than 17 positions.

It is really interesting to point out the appearance of two Sub Saharan countries between the ones that showed good improvement. Uganda and Namibia change 18 and 20 positions respectively. Uganda shows impressive scores on its Technology indexes (TCH1 and TCH2) as a result of the country's recent changes in trade policies that reduced trade costs, in Foreigner Direct Investment incentives with the creation of the Uganda Investment Authority (UIA), in privatization programs and in the diversification of their exports portfolio. According to the

United Nations Comtrade Database[30], between 2005 and 2010 Uganda's exports increased almost 100%, and the share of technology products in this total went from 2% to 9%.

Mongolia's result is driven by its democracy index. This country's success in transition after 1990 is considered an extraordinary case. Fish (1998) states that the conditions for the transition were not favorable, with low living standards, high dependence of Soviet aid and no democratic tradition until 1990, but "the combination of institutional stimulus and capable leadership produced one of the postcommunist region's most mature political party systems…While it supports rigorous measures to control crime and eschews pure libertarianism, it also favors destatization and deregulation in economic and social policy." (Fish, M. S. 1998, p.135). It built a system that incentivizes civil participation and the society corresponded getting closer to the political system. Fish concludes saying that "it represents the triumph of choice, will, leadership, agency, and contingency over structure, history, culture, and geography." (p. 140)

When we analyze the first thirty positions Brazil and Costa Rica present the biggest changes in their ranks, increasing 26 and 22 positions (TCH1) respectively. One thing those two countries have in common is their rainforest and the recent efforts to preserve their biodiversity. Their ecological footprint, consumption of the environment, according to NFA calculations are lower than 3 Global hectares per person, a reasonable number for countries that are still experiencing their industrial development (high income countries present a value higher than 5, also according to the NFA).

Pagiola (2008) talks about Costa Rica's initiative of charging for environmental services. Their program, Payment for Environmental Services (PES), is contributing to control deforestation damage and reduce pollution, by charging for water and biodiversity use and

[30] http://comtrade.un.org/

carbon sequestration users. Part of the program is financed by fuel tax revenues that correspond to the carbon sequestration benefit.

The interesting part of this program is that it comes closer to one of the policy suggestions of the Green Growth Theory explained by Jacobs (2012). He states three possibilities for how green economies can generate growth, the Keynesian environmental stimulus, the market failure correction and innovation and industrial policy.

Using the market failure example, economies neglect to account for the natural capital used in their production process, effectively subsidizing the use of nature and this promotes an indiscriminate overuse of natural and environmental resources. When Costa Rica charges for the use of the environmental system, it is trying to correct this failure in an attempt to preserve natural capital so it can be available for next generations.

Costa Rica in 2010 also made a commitment to become carbon-neutral by 2021, with the condition of receiving external support. According to the website Climate Action Tracker[31] the country developed a climate change strategy to reach this goal that cover six areas: "mitigation, adaptation, measuring, capacity building, awareness raising and public education funding, with the common objective of aligning policies with climate change as part of a long-term strategy for sustainable development. Recent legislation in the energy sector includes the creation of a voluntary carbon market and the 2013 Biofuels Law."

However it is not only their biocapacity and concern about the environment that is helping them to reach better positions. Costa Rica also presents a better technological index than Norway in both comparisons due their high-technology exports. Costa Rica was a country specialized in exports of basic primary goods such as sugar, coffee, and bananas, but their efforts to focus in apparel exports allowed the country to experience a relatively good development, that

[31] http://climateactiontracker.org/countries.html

despite the low value added generated in this activity (Sanchez-Ancochea, D. 2006) helped the country to diversify its economy and generated resources that were invested in other sectors.

"Costa Rica's conscientious effort to expand spending in health and education and consolidate a well-educated middle class" (Sanchez-Ancochea, D., 2006 p.998) increased their human capital assets, that combined with a strong policy of manufacturing exports diversification helped the country to reduce their primary exports to less than 15% of the total. (Sanchez-Ancochea, D. (2006). Their human capital facilitated the immigration of big technology intensive companies like Intel, Abbot and Baxter, but Costa Rica has a long way to go to reach growth levels similar to those of countries like Singapore (Sanchez-Ancochea, D. (2006).

This country also developed its other social indicators over the years. According to Rosero-Bixby (1990) the country was able to increase life expectancy to levels close to those of developed countries, mostly because of the improvements done in the health care system. He also points out that among Latin American countries, Costa Rica is more developed socially than economically because of the social democratic welfare-oriented system of government that favored social programs in the areas of education, labor, social security and health. "The budget outlay for health in the public sector is very high. It represents seven percent of the Gross Domestic Product – similar to the also high expenditures in education" (Rosero-Bixby, L. 1990) p.34

In conclusion, Costa Rica still has a long way to go in the development of its four dimensions, but it is clear that some balance in being kept and this equilibrium is the key factor for its considerable change in ranking.

When it comes to Brazil it is possible to say that it is an emerging power that still faces big challenges but its indicators have shown remarkable progress in the last few years. As a member of the BRIC (Brazil, Russia, India and China) it represents one of the big opportunities of South America, and when compared to the BRIC group it has the second highest economic index, the highest social index, the second highest technology index and the highest environmental index.

Brazil's economic performance has been modest in the past 10 years. Its big kick off happened between the 60's and 80's, when average GDP growth rate was around 9% due the high investments in infrastructure and public companies concerned with providing the base for industrialization, especially oil and electricity, performed by the dictatorial military government. Recently economic growth is below 3% on average.

In the social field, however, the country's performance has been much more significant, especially due the social program "Bolsa Família" (BF) that helped millions of citizens to go above the poverty line and improved income distribution indicators. Hall (2006) reminds us that Conditional Cash Transfers (CCT) are popular in many American Latin countries as an attempt to help families to invest in health and education and, finally, break the inter-generation poverty transmission. The data presented by Hall (2006) shows that BF expenditures alone in 2005 represented 0.5% of the Brazilian GDP benefiting over 44 million people.

Comparing the HDI results between 2000 and 2013, Brazil's education index went from 0.58 to 0.66 (14% increase) and life expectancy from 70.3 to 73.9 (5% increase) suggesting some impact of the social program. The scores are still far from other countries in Latin America, for example Argentina, but considering the size of the country and population, this represents a major change. Hall (2006) adds that the program still has some flaws that might be tackled

especially because of the possible dependence, clientelism and the misuse of the transfers to manipulate populations' political decisions.

Rasiah (2004) presents some interesting evidence about the technological development in Brazil. This Latin American country developed knowledge in pharmaceuticals, automotive, aeronautic and agricultural industries. According to Rasiah (2004) although government and universities contribute to R&D, it was FDI that contributed more to development and the formation of fixed capital, bringing with it advanced knowledge and state-of-the-art technology. This became a problem especially because the negative impact it had on the balance of payments due to the payment of dividends and profits remittances (in 2012 was responsible for more than 50% of the current account deficit)[32], little amounts reinvested in the country and the small contribution to the exports value.

Dahlman (2008) compares Brazil to China and India, and suggests that the country still has no focus on industry and services, with high tariffs and with exports based on primary commodities (46%), not giving the country much comparative advantage. However investments in renewable energy technology, especially with the Ethanol Program, have caught the world's attention. An expansion of this program has the potential to replace 10% of the gasoline used in the world that would mean not only the reduction of the use of fossil fuels but also less damage to the environment.

Goldemberg (2007) states that the introduction of ethanol in the Brazilian market came from a government resolution in the 70's that mandated the mixture of ethanol to gasoline in order to reduce oil imports which at that time was consuming one-half of the exports resources. He also adds that taxes on gasoline were used to finance the subsides for the development of the

[32] Brazilian Central Bank (BACEN) data.

Ethanol Program at the beginning and the efficiency in its productive process has allowed one of the lowest costs among the present ethanol technologies developed in other countries.

Based on the Brazilian case, the use of technology to promote new efficient and environmentally friendly resources is in line with the new era of sustainable development.

It is also relevant to note that despite their economic performance, some of the richest Arab Oil Countries, presented the biggest negative changes, which is the case of Saudi Arabia, Kuwait and United Arab Emirates (UAE) that declined 51, 41 and 29 positions respectively. Despite what some might think, the lack of democracy was not a decisive factor for this outcome. If we exclude the democracy variable from the analysis their declines persist high 40, 36 and 21 respectively. The only problem is that there is no way to confirm how democracy would have affected the other variables considered in the index and maybe change their rank.

The lack of investments in R&D and small efforts of the GCC countries to change their focus from oil and gas activity are the main reasons for their low positions. Although they are among the richest countries in the world, almost no progress has been made in the field of technological and environmental development and one of the main reasons for that, as mentioned by the International Renewable Energy Agency (IRENA), is the "absence of renewables friendly regulations and highly subsidized fossil fuels"[33]. Most of the Middle East has almost 100% of their energy production based on fossil fuels, and as a result of this they have the highest rates of CO2 emissions per capita. Despite the fact that they have one of the greatest potentials to produce solar energy due to their geography, development in this field is slower than expected considering their investment capacity.

[33] http://www.irena.org/DocumentDownloads/factsheet/Renewable%20Energy%20in%20the%20Gulf.pdf

The changes in ranking highlight how the SDI is a development analysis tool that is less affected by economic performance and is more sensitive to the equilibrium of the systems in order to guarantee to future generations the proper conditions so they can enjoy a better life.

Table 15 - SDI results (TCH1)

Ranking	SDI	Country	HDI	Difference (HDI-SDI)
1	0.76	Norway	1	0
2	0.74	Finland	19	17
3	0.74	Sweden	11	8
4	0.74	Japan	14	10
5	0.73	Switzerland	3	-2
6	0.71	Australia	2	-4
7	0.70	Canada	8	1
8	0.68	Germany	6	-2
9	0.66	Austria	17	8
10	0.65	Denmark	9	-1
11	0.64	New Zealand	7	-4
12	0.64	France	16	4
13	0.64	United States	5	-8
14	0.62	Korea, Rep.	13	-1
15	0.62	Netherlands	4	-11
16	0.62	Ireland	10	-6
17	0.61	United Kingdom	12	-5
18	0.60	Israel	15	-3
19	0.58	Estonia	25	6
20	0.58	Slovenia	20	0
21	0.58	Uruguay	38	17
22	0.55	Malaysia	43	21
23	0.55	Costa Rica	45	22
24	0.55	Belgium	18	-6
25	0.54	Panama	44	19
26	0.54	Brazil	52	26
27	0.54	Czech Republic	23	-4
28	0.52	Italy	21	-7
29	0.52	Lithuania	27	-2
30	0.52	Hungary	32	2
31	0.51	Latvia	36	5
32	0.51	Argentina	37	5
33	0.51	Bolivia	68	35
34	0.50	Chile	31	-3
35	0.50	Croatia	35	0
36	0.49	Portugal	30	-6
37	0.49	Cuba	33	-4
38	0.48	Russian Federation	41	3
39	0.48	Mongolia	64	25
40	0.47	Paraguay	67	27
41	0.47	Poland	28	-13
42	0.47	Spain	22	-20

Ranking	SDI	Country	HDI	Difference (HDI-SDI)
43	0.47	Peru	53	10
44	0.46	Thailand	56	12
45	0.46	Kazakhstan	47	2
46	0.46	Mexico	48	2
47	0.45	China	58	11
48	0.45	Greece	24	-24
49	0.45	Bulgaria	42	-7
50	0.45	Romania	40	-10
51	0.45	Philippines	70	19
52	0.44	Colombia	62	10
53	0.43	Namibia	73	20
54	0.43	Turkey	46	-8
55	0.42	Belarus	39	-16
56	0.42	Albania	60	4
57	0.41	Ecuador	63	6
58	0.41	United Arab Emirates	29	-29
59	0.41	Indonesia	65	6
60	0.40	Ghana	77	17
61	0.40	Ukraine	54	-7
62	0.40	Sri Lanka	49	-13
63	0.39	Uganda	81	18
64	0.39	India	76	12
65	0.39	Tunisia	57	-8
66	0.38	El Salvador	69	3
67	0.38	Azerbaijan	50	-17
68	0.38	Armenia	55	-13
69	0.37	Guatemala	72	3
70	0.37	Honduras	74	4
71	0.37	Jamaica	61	-10
72	0.36	Jordan	51	-21
73	0.36	Morocco	75	2
74	0.36	South Africa	71	-3
75	0.35	Kuwait	34	-41
76	0.35	Senegal	80	4
77	0.35	Saudi Arabia	26	-51
78	0.35	Kenya	79	1
79	0.35	Algeria	59	-20
80	0.33	Pakistan	78	-2
81	0.32	Egypt, Arab Rep.	66	-15
82	0.32	Burkina Faso	83	1
83	0.25	Ethiopia	82	-1

Table 16 - SDI results (TCH2)

Ranking	SDI	Country	HDI	Difference (HDI-SDI)
1	0.80	Norway	1	0
2	0.79	Switzerland	3	1
3	0.79	Finland	19	16
4	0.78	Sweden	11	7
5	0.75	Australia	2	-3
6	0.72	Canada	8	2
7	0.71	Japan	14	7
8	0.71	Austria	17	9
9	0.70	Denmark	9	0
10	0.70	Germany	6	-4
11	0.69	United States	5	-6
12	0.69	France	16	4
13	0.68	Korea, Rep.	13	0
14	0.67	New Zealand	7	-7
15	0.67	Netherlands	4	-11
16	0.66	Ireland	10	-6
17	0.66	Israel	15	-2
18	0.65	United Kingdom	12	-6
19	0.62	Slovenia	20	1
20	0.62	Estonia	25	5
21	0.61	Malaysia	43	22
22	0.60	Costa Rica	45	23
23	0.60	Uruguay	38	15
24	0.59	Belgium	18	-6
25	0.58	Panama	44	19
26	0.58	Czech Republic	23	-3
27	0.56	Brazil	53	26
28	0.55	Hungary	32	4
29	0.55	Lithuania	27	-2
30	0.54	Italy	21	-9
31	0.54	Cuba	33	2
32	0.53	Latvia	36	4
33	0.53	Argentina	37	4
34	0.53	Bolivia	70	36
35	0.52	Croatia	35	0
36	0.51	Portugal	30	-6
37	0.51	Chile	31	-6
38	0.50	Russian Federation	41	3
39	0.50	China	59	20
40	0.50	Kazakhstan	47	7
41	0.49	Mongolia	65	24
42	0.49	Thailand	57	15
43	0.49	Spain	22	-21
44	0.49	Philippines	72	28
45	0.49	Poland	28	-17
46	0.48	Mexico	48	2
47	0.48	Paraguay	69	22
48	0.47	Peru	54	6
49	0.47	Greece	24	-25
50	0.47	Bulgaria	42	-8
51	0.46	Romania	40	-11
52	0.45	Colombia	63	11
53	0.44	Zambia	82	29
54	0.44	Turkey	46	-8
55	0.43	Namibia	75	20
56	0.43	Belarus	39	-17
57	0.43	Uganda	87	30
58	0.42	Botswana	67	9
59	0.42	United Arab Emirates	29	-30
60	0.42	Ecuador	64	4
61	0.42	Ukraine	55	-6
62	0.42	Albania	61	-1
63	0.42	Ghana	81	18
64	0.42	Indonesia	66	2
65	0.41	Mozambique	90	25
66	0.41	Tunisia	58	-8
67	0.41	Tajikistan	78	11
68	0.41	India	79	11
69	0.40	Sri Lanka	49	-20
70	0.39	Azerbaijan	51	-19
71	0.39	El Salvador	71	0
72	0.38	Armenia	56	-16
73	0.38	Morocco	77	4
74	0.38	Guatemala	74	0
75	0.37	South Africa	73	-2
76	0.37	Jordan	52	-24
77	0.37	Honduras	76	-1
78	0.37	Kenya	85	7
79	0.37	Jamaica	62	-17
80	0.36	Senegal	86	6
81	0.36	Kuwait	34	-47
82	0.35	Saudi Arabia	26	-56
83	0.35	Cambodia	80	-3
84	0.35	Nepal	83	-1
85	0.35	Algeria	60	-25
86	0.35	Mali	89	3
87	0.34	Iran, Islamic Rep.	50	-37
88	0.33	Pakistan	84	-4
89	0.33	Burkina Faso	92	3
90	0.32	Egypt, Arab Rep.	68	-22
91	0.29	Burundi	91	0
92	0.25	Ethiopia	88	-4
93	0.20	Congo, Dem. Rep.	93	0

CHAPTER VII

CONCLUSION

The objective of this work, rather than to present a ranking of countries, is to turn attention to some features that represent sustainable development. The main frustration with the HDI is the simplicity of the index to define such a complex state of individual societies and their capabilities without being concerned with other features that represent development, better human life and intergenerational dynamics that define sustainability. The SDI is an attempt to combine some variables available today in order to get closer to the analysis of sustainability, but there are still many challenges to get to a better measure.

The expectations around the UN summit that is going to happen this year are extremely high and this work reinstates the importance of the commitment of countries to pursue a "set of Sustainable Development Goals (SDGs), which will build upon the Millennium Development Goals and converge with the post 2015 development agenda"[34] in order to get closer to what society needs to reach development.

The importance of adding to the HDI different economic, institutional, democratic, gender equality, technology and environmental variables came with the complexity of the meaning of development and now is the time to bring examples that can be replicated using the strength of each country so it is possible with mutual contribution, instead of competition, to reach sustainability and guarantee better living conditions to current and future generations.

The SDI is a composite index inspired by the HDI and it considers those four dimensions in its composition. The economic index takes the suggestion of the HDI measure of standard of living using GNI per capita and adds to it unemployment, to measure individual

[34] https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals

accomplishment, and the consumption per household as a complement measure to define a better life.

The social index combines the health and education indexes from the HDI with institutions, democracy and gender equality variables in order to express other capabilities that might interfere with individual freedom.

Technology and Environment are two indicators that help to bring to the index the intergenerational dimension where knowledge advancement plays an important role. The combination of those two new features along with the other two dimensions constitutes sustainable development.

However, we were able to capture some successful policies that were adopted by some impressive performers among developing countries. As seen in the case of Costa Rica, Brazil and Uganda, FDI and foreign firms can be responsible for the development of technology and inclusion of developing countries in the international trade market generating resources that can be invested in other sectors of the economy.

In addition to the trade policies, it is essential to focus on social policies that invest in education and health, as in the case of Costa Rica, in order to create strong human capital that can attract those foreign firms and employ the local citizens. This will not only develop the domestic market but also create new opportunities.

It is also interesting to call attention to the success of the Brazilian case that combined economic interests with the development of a green technology and this should motivate, especially Arab Countries, to invest in renewable resources in order to make this technology efficient and affordable not only for its citizens but also to benefit from international

commercialization. Recently in the media[35] Saudi Arabia expressed interest in investing in solar energy to export to nearby countries and this might be a good beginning.

Finally, as we know, natural resources are not distributed equally in the world, but their benefits can be socialized. Environmental policies are strongly dependent not only on a country's government but also on international interests, just like the conditional carbon neutrality goal presented by Costa Rica. However, to prove the commitment with international investments with transparency, institutions need to be reliable and transparent so they can pass credibility and integrity with those resources.

The SDI still fails to express the full meaning of sustainability. It is essential to note that as suggested by the Common Future Report, sustainable development can be reached with multilateral cooperation between countries, where each one can contribute with what they can to protect the human race. In this sense, sustainability cannot be the goal of a country and its citizens, but the objective of the whole world.

For this reason, the analysis will never be complete if it fails to consider the cooperation between countries to develop knowledge, like the research programs that have scientist from different parts of the world, or the environmental protection of some natural reserves financed by international organizations.

Furthermore, it is important to add that many of the variables used in the HDI and SDI have conceptual flaws that generate exclusion measures when it considers a group of people natural of a specific country, rejecting the others that are part of the territory but not of it Nation. When we say human we are not specifying a nationality but a species, hence the importance of developing better variables that can include everyone is essential to the sustainable purpose. So as a suggestion, the variables collected using surveys, especially the ones that consider

[35] http://www.ft.com/cms/s/0/3d108c3e-3fb5-11e2-b2ce-00144feabdc0.html#axzz3Pq8FMztZ

unemployment, consumption, health and education, should be applied to each and every human being resident in a determined territory, avoiding the exclusion of those people that are contributing to the GDP but are not responsibility of the governments. Development needs to be applied to everyone with no conditions or restrictions, because sustainability can happen only if everyone is treated as equal.

REFERENCES

Anand, S., & Sen, A. (1994). Human Development Index: methodology and measurement (No. HDOCPA-1994-02). Human Development Report Office (HDRO), United Nations Development Programme (UNDP).

Anand, S., & Sen, A. (2000). Human development and economic sustainability. World development, 28(12), 2029-2049.

Anja, B., & Neil, F. (2012). Intellectual property rights, innovation and technology transfer: a survey

Bacescu, Marius. (2009) Sustainability, mankind single chance. Annals of Spiru Haret University, Economic Series, v. 1, n. 1, p. 81-86.

Borucke, M., Moore, D., Cranston, G., Gracey, K., Iha, K., Larson, J., ... & Galli, A. (2013). Accounting for demand and supply of the biosphere's regenerative capacity: The National Footprint Accounts' underlying methodology and framework. Ecological Indicators, 24, 518-533.

Brundtland, G. (1987). Our common future: Report of the 1987 World Commission on Environment and Development.

Clark, D. A. (2005). The Capability Approach: Its Development, Critiques and Recent Advances.

Dahlman, C. (2008). Innovation Strategies of Three of the BRICS: Brazil, India and China-What can we learn from Three Different Approaches?.

Dasgupta, P., & Weale, M. (1992). On measuring the quality of life. World Development, 20(1), 119-131.

EIU Democracy Index (2013) Democracy in limbo. A report from The Economist Intelligence Unit. http://www.eiu.com/Handlers/WhitepaperHandler.ashx?fi=Democracy_Index_2013_WEB-2.pdf&mode=wp&campaignid=Democracy0814

Esty, D. C., Levy, M., Srebotnjak, T., & De Sherbinin, A. (2005). Environmental sustainability index: benchmarking national environmental stewardship. New Haven: Yale Center for Environmental Law & Policy, 47-60.

Evenson, R. E., & Singh, L. (1997). Economic growth, international technological spillovers and public policy: Theory and empirical evidence from Asia (No. 777). Economic Growth Center, Yale University.

Fish, M. S. (1998). Mongolia: democracy without prerequisites. Journal of Democracy, 9(3), 127-141.

Fitoussi, J-P., Malik, K. (2013) Choices, capabilities, and sustainability. Human Development Report Office Occasional Paper.

Goldemberg, J. (2007). Ethanol for a sustainable energy future. science,315(5813), 808-810.

Gould, D. M., & Gruben, W. C. (1996). The role of intellectual property rights in economic growth. Journal of development economics, 48(2), 323-350.

Gylfason, T. (2002). Natural resources and economic growth: what is the connection? (pp. 48-66). Physica-Verlag HD.

Hall, A. (2006). From Fome Zero to Bolsa Família: social policies and poverty alleviation under Lula. Journal of Latin American Studies, 38(04), 689-709.

Haughton, J. H., & Khandker, S. R. (2009). Handbook on poverty and inequality. World Bank Publications.

HDR (2014). Human Development Report 2014- Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience. UNDP Human Development Reports (2014).

Helpman, E. (1992). Innovation, imitation, and intellectual property rights (No. w4081). National Bureau of Economic Research.

Jacobs, M. (2012). Green growth: economic theory and political discourse.Grantham Research Institute on Climate Change and the Environment Working Paper, 92.

Klugman, J., Rodríguez, F., & Choi, H. J. (2011). The HDI 2010: new controversies, old critiques. The Journal of Economic Inequality, 9(2), 249-288.

Knack, S., & Keefer, P. (1995). Institutions and economic performance: Cross-country tests using alternative institutional measures. Economics & Politics, 7(3), 207-227.

Loewe, M. (2012). Post 2015: How to Reconcile the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs)?.

Mabsout, R. (2015). Mindful Capability. Manuscript submitted for publication.

Measuring technological capabilities at the country level: A survey and a menu for choice. Research policy, 34(2), 175-194.

Meyer, B. D., & Sullivan, J. X. (2003). Measuring the well-being of the poor using income and consumption (No. w9760). National Bureau of Economic Research.

Milner, C., Morrissey, O., & Rudaheranwa, N. (2000). Policy and non-policy barriers to trade and implicit taxation of exports in Uganda. Journal of Development Studies, 37(2), 67-90.

Moran, D. D., Wackernagel, M., Kitzes, J. A., Goldfinger, S. H., & Boutaud, A. (2008). Measuring sustainable development—Nation by nation. Ecological economics, 64(3), 470-474.

Nussbaum, M. C. (2000). Women and human development: The capabilities approach. Cambridge University Press.

Obwona, M. B. (2001). Determinants of FDI and their impact on economic growth in Uganda. African Development Review, 13(1), 46-81.

Oulton, Nicholas (2012a). "The wealth and poverty of nations: true PPPs for 141 countries". Centre for Economic Performance, Discussion Paper no. 1080. [http://cep.lse.ac.uk/pubs/download/dp1080.pdf].

Pagiola, S. (2008). Payments for environmental services in Costa Rica.Ecological economics, 65(4), 712-724.

Pritchett, L. (1997). Divergence, big time. The Journal of Economic Perspectives, 3-17.

Qizilbash, M. (1996). Capabilities, well-being and human development: A survey. The Journal of Development Studies, 33(2), 143-162.

Rao, A. B., & Rubin, E. S. (2002). A technical, economic, and environmental assessment of amine-based CO2 capture technology for power plant greenhouse gas control. Environmental Science & Technology, 36(20), 4467-4475.

Rasiah, R. (2004). Foreign firms, technological capabilities and economic performance: evidence from Africa, Asia and Latin America. Rajah Rasiah (2004) Foreign Firms, Technological Capabilities and Economic Performance: Evidence from Africa, Asia and Latin America, Cheltenham: Edward Elgar.

Robeyns, I. (2005). The capability approach: a theoretical survey. Journal of human development, 6(1), 93-117.

Rodríguez-Clare, A. (2001). Costa Rica's development strategy based on human capital and technology: how it got there, the impact of Intel, and lessons for other countries. Journal of Human Development, 2(2), 311-324.

Rosero-Bixby, L. (1990). Socioeconomic development, health interventions and mortality decline in Costa Rica. Scandinavian journal of social medicine. Supplementum, 46, 33-42.

Sanchez-Ancochea, D. (2006). Development trajectories and new comparative advantages: Costa Rica and the Dominican Republic under globalization. World Development, 34(6), 996-1015.

Schultz, E., Christen, M., Voget-Kleschin, L., Burger, P. (2013) A sustainability-fitting interpretation of the capability approach: Integrating the natural dimension by employing feedback-loops. Journal of Human Development and Capabilities, 14, Forthcoming.

Sen, A. (1988). The concept of development. Handbook of development economics, 1, 9-26.

Sen, A. (1993). Capability and well-being (pp. 30-53). na.

Sen, A. (1999). Development as freedom. Oxford University Press.

Sen, A. (2000). A Decade of Human Development, Journal of Human Development, 1:1, 17-23, DOI: 10.1080/14649880050008746

Sen, A. (2009). The idea of justice. Harvard University Press.

Sen, A. (2013). The ends and means of sustainability. Journal of Human Development and Capabilities, 14(1), 6-20.

Streeten, P. (1994). Human development: means and ends. The American Economic Review, 232-237.

Voget-Kleschin, L. (2013) Using the capability approach to conceptualize sustainable development. Greifswald Environmental Ethics Papers.

APPENDIX

Table 17 - Appendix – 2005 Environmental Sustainability Index – Variable Transformations after Imputations

Variable	Variable Code	Transformation	Constant*
Urban population weighted SO_2 concentration	SO2	Logarithm	0
Threatened mammal species as percentage of known mammal species in each country	PRTMAM	Logarithm	0
Freshwater availability per capita	WATAVL	Power ¼	1
Internal groundwater availability per capita	GRDAVL	Power ¼	0
Anthropogenic NO_x emissions per populated land area	NOXKM	Square root	0
Anthropogenic SO_2 emissions per populated land area	SO2KM	Logarithm	0
Anthropogenic VOC emissions per populated land area	VOCKM	Logarithm	0
Coal consumption per populated land area	COALKM	Square root	0
Vehicles in use per populated land area	CARSKM	Logarithm	0
Generation of hazardous waste	HAZWST	Power ¼	0
Industrial organic water pollutant (BOD) emissions per available freshwater	BODWAT	Square root	496
Fertilizer consumption per hectare of arable land	FERTHA	Square root	0
Pesticide consumption per hectare of arable land	PESTHA	Logarithm	0
Percentage of total forest area that is certified for sustainable management	FORCERT	Square root	0
Child death rate from respiratory diseases	DISRES	Square root	0
Average number of deaths per million inhabitants from floods, tropical cyclones, and droughts	DISCAS	Square root	0
IUCN member organizations per million population	IUCN	Square root	0
Local Agenda 21 initiatives per million people	AGENDA21	Logarithm	0
Number of ISO 14001 certified companies per billion dollars GDP (PPP)	ISO14	Square root	0
Carbon emissions per million dollars GDP	CO2GDP	Logarithm	0
Carbon emissions per capita	CO2PC	Logarithm	0

* If the observed minimum of the variable is negative, a constant is added such that the transformation of negative values can be computed. For example, if the minimum observed value is -5, a constant value of 6 is added to all observations before the logarithm or power transformation is computed.

Source: Extracted from the 2005 Environmental Sustainability Index. (Esty, D. C., Levy, M., Srebotnjak, T., & De Sherbinin, A. (2005) p.56)

Table 18 - Appendix – Sustainable Development Goals (UN)

Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts*
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Source: Extracted from the United Nations Sustainable Development: Knowledge Platform. https://sustainabledevelopment.un.org/focussdgs.html