

# Assessing Sustainable Development: Toward a Portfolio of Indices?

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## Abstract

This paper selects and discusses indices that seem to be more connected to the definition of development sustainability and/or allow taking into account issues of weak sustainability and strong sustainability systematically. I appreciate them mostly in terms of their ability to provide information on the fulfilment of human needs sustainably. I defend the idea that rather than being measured through a single index, the assessment of sustainable development requires a mix of indices. The main finding is that this portfolio must meet the triptych: current well-being, sustainability of well-being and environmental sustainability. In this regard, indices such as the HDI, the adjusted net saving and the ecological footprint may constitute such a mix or portfolio.

**Keywords:** sustainable development, sustainability indices

## 1. Introduction

The human community has expressed its willingness to promote economic development, social development and the natural environment that are mutually reinforcing, in particular since the Report of the World Commission on Environment and Development: Our Common Future (WCED, 1987). To judge the reality of these commitments and the overall effect of various factors on sustainable development performance, it is necessary to have a measurable index. Consequently, the United Nations Conference on Environment and Development (UNCED) called for the development of sustainable development indicators that can guide policies (UNCED, 1992; Agenda 21, Chapter 40).

The definition of sustainable development is often cited as the following, "Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). Several authors (for example: Theys, 2001) note that this definition is vague and does not provide any guidance concerning the way to achieve the principles it states.

However, within this definition, there is the idea of sustainability: well-being needs to be fulfilled in the long term. But when one analyzes sustainable development indices that are being developed and even studies that try to assess them, there is generally no explicit consideration of both the present and the future. Very often, future well-being is omitted, and often we forget to insist on current well-being as well. The initial propositions of sustainable development measures date back, at least, to Nordhaus and Tobin (1973). In this section I stress the fact that, to date, most of the sustainable development indices fail to apprehend all of its different aspects: current well-being, well-being sustainability and environmental sustainability.

In line with Dasgupta and Mäler (2001), I discuss the limitations of some traditional measures of development (GDP, HDI, etc.). My contribution to the literature is close to that of Gadrey and Jany-Catrice (2007) or Böhringer and Jochem (2007) because I am interested in discussing new indicators of development. However, in this section I focus on indices that seek clearly to provide information on sustainable development or on both development and its sustainability. I have chosen indices of sustainable development that seem to be more connected to the criteria of sustainability indices and/or allow taking into account issues of weak and strong sustainability. These are the Index of Sustainable Economic Welfare/Genuine Progress Index, ISEW/GPI (Daly and Cobb, 1989; Cobb et al., 1995), the Index of Economic Well-Being (Osberg, 1998; Osberg and Sharpe, 1998, 2003, 2006), the Adjusted Net Saving (ANS) or genuine saving (e.g.: Hamilton and Clemens, 1999; Dasgupta and Mäler, 2000), Environmental Space (Opschoor and Weterings, 1994), Material Flow Accounts (e.g.: OECD,

2008) and the Ecological Footprint (Wackernagel and Rees, 1997). I appreciate them mostly in terms of their ability/potentiality to provide information on the sustainable fulfillment of human needs. I try to identify the most promising indices and discuss the way by which, in terms of choosing the indices, it is possible to move from a high number of indices (Parris and Kates, 2003) to relatively few.

In Section 2 I discuss why the traditional indicators of economic performance are not appropriate to measure the sustainability of development. Section 3 presents the two approaches used in the measurement of sustainable development. The first seeks to make adjustments to economic accounts and aggregates, and the second offers physical environmental indicators. Section 4 recalls the criteria with which sustainable development indicators must comply and suggests indices that can be used to measure sustainable development as part of a portfolio. I emphasize the need to distinguish clearly between measures of well-being (current), measures of the sustainability of well-being, and measures of environmental limits. I also stress that it is important to take into account these three dimensions together. Then, Section 5 calls for cooperation to generate consensus. Finally, Section 6 concludes the study.

## **2. National Accounts, Macroeconomic Aggregates and Sustainable Development**

In this section I discuss the shortcomings of national accounts in terms of sustainable development and, subsequently, why current macroeconomic aggregates are not suited to inform about the sustainability of the development process.

### *2.1 The System of National Accounts Questioned*

The system of national income accounts of the United Nations (UN et al., 1993) is one of the most important economic institutions. It determines the empirical basis of economic decision and policy. It also plays a fundamental role in the thinking on economic progress and development (Meyer, 1997). A central component in the work to meet the needs associated with the measurement of sustainable development has been to question national accounts, which are the source of macroeconomic aggregates.

In the context of sustainable development, national accounts fail to take natural resources into account appropriately (Repetto, 1989). For example, the rent from the exploitation of natural resources is recognized as a component of the national income but not of the corresponding decrease of the resources. In this case, it is necessary to adjust the income or net national savings to reflect the decrease (consumption) of the capital stock. Otherwise, the result may be a biased signal of economic activity in resource-rich countries. Another example is that national accounts do not include losses caused by the pollution of economic assets. Similarly, many environmental goods and services are not well-reflected in national accounts and are allocated to other sectors of the economy, particularly because they are not traded on markets. This is true for environmental goods and services harvested by individuals for their own final use (firewood, wild foods) or services provided by forests (tourism and recreation, protection of farmlands, and so on) but are not assigned to the forestry sector of the economy (Lange, 2007). Overall, in this context, the authorities in charge of economic policy simply do not have adequate data (Hamilton and Bolt, 2007). Then, most of the key indicators used for public decision making are 'blind' to the problems of development sustainability.

Within the framework of sustainable development, the enterprise then aims at correcting the recognized shortcomings of national accounts (in terms of environmental data, but also non-market household activities, social indicators, and so on) In fact, these shortcomings of the national accounts had already been detected even before they were actually used as a framework for macroeconomic analysis. For example, Hicks (1940), Hayek (1941), Kuznets (1946) or Samuelson (1961) are among those who first discussed this issue. The role of Simon Kuznets (often considered the father of national accounts) in improving the national accounts is often cited although obviously he was unable to divest them of some of their major shortcomings. Meyer (1997) noted that Kuznets is credited with the first arguments for "defensive" expenditures in the context of the expenditures related to the Second World War.

Kuznets believed that these costs should not be taken into account in estimating the final product. In this same spirit, environmentalists have developed the concept of defensive expenditures in respect of expenditures designed for the protection against phenomena such as pollution or to restore the environment. However, the demand for better accounts persisted, particularly among academics as well as environmental and feminist activists (Repetto, 1989; Waring, 1990). Then, efforts were soon undertaken. Of the countries that initiated (the early 1970s) this movement, the most cited are Norway, the United States, France and the Netherlands (Meyer, 1997). More recently, efforts were focused on the accounting system of the United Nations, the main source of information on national economies. These efforts resulted in the guide called the System of Environmental and Economic Accounting (SEEA) for the construction of 'satellite' environment accounts (UN, 1993; UN et al.,

2003). (Note 1) That said, the SEEA is still a source of information but not of sustainable development indicators *per se*.

## 2.2 The Lack of Appropriate Indicators of Sustainable Development

In this subsection I discuss why some indicators (GDP, HDI, Total Factor Productivity) of well-established reputation are not measures of sustainable development. By drawing mostly on Dasgupta and Mäler (2001), I show that these indicators are either simple measures of economic activity or measures of current well-being. Indeed, one can say that development is sustainable if social welfare, namely the value of the sum of present and future consumption, is increasing during the development process (Hamilton and Ruta, 2007). By designating the welfare by  $V$ , I can write:  $V_t \geq V_{t-1}$ , with  $t$  a positive time index. Therefore, any correct measure of sustainable development must verify this criterion. And since we are not able to measure future well-being, we will seek to identify (current) indicators that report on the future.

### 2.2.1 Gross Domestic Product as an Indicator of Development

GDP measures the net output of goods and services produced by an economy in a given period. It assesses goods and services at market prices, but public services are often valued at their production cost. GDP has been developed by national accountants to measure overall economic activity. It is not designed to measure well-being or development although some of the changes it has undergone have been influenced by the desire to also take into account these limitations (Gadrey, 2003). (Note 2) Thus, the size of GDP in itself tells us nothing about the state of society, the quality of the natural environment, safety, and so on. GDP does not tackle the evolution of social health (inequality, poverty) or the defensive nature of certain expenditures and leisure time (Gadrey and Jany-Catrice, 2007). Generally, it does not include activities without market value. The System of National Accounts (UN et al., 2008) states that it does not see GDP as a measure of well-being. The founders of the national accounts were well aware that GDP is an indicator of income and says nothing about the state of well-being (see e.g.: Kuznets, 1934, 1973). Moreover, GDP as measured today overstates investment and production because it does not deduct the depreciation of capital. It also makes a wrong valuation of changes in the quality of goods and barely grasps the value of services that are increasingly complex and difficult to identify and evaluate. Although it may take into account an estimate of certain goods and services consumed by households (housing food from farmers, etc.) and illegal activities (e.g.: drug cultivation in Colombia), GDP is simply the best available estimation of overall economic activity. It is not a measure of development in general, much less a measure of sustainable development. Its use as a development indicator is a misuse. Overall, GDP is not an adequate measure of changes in wealth.

### 2.2.2 The Human Development Index (HDI) and Sustainability

The United Nations Development Program (UNDP) proposed the Human Development Index (HDI) as part of the launch of its report on Human Development in 1990 and adopted it in place of GDP as a measure of development. The HDI assesses the development of a country based on three attributes (a long and healthy life, knowledge, and a decent standard of living). The index measures performance gaps for each of these three attributes, then calculates the simple average of the performance gap, and finally compares this difference to the average target value that is equal to one. Thus, the lower the average gap, the higher the HDI, and the more the level of development of a country is described as effective.

The measure of the three attributes of development is life expectancy at birth, education (adult literacy rate and gross enrollment ratio) and GDP per capita (PPP). However, current life expectancy at birth does not provide information on what will happen in the future. For instance, deterioration in the quality of institutions may cause a rapid drop in life expectancy. In the criticism of the use of GDP, let us consider its investment component: in the calculation of GDP, investments in human capital and natural capital are often poorly evaluated. In addition, the measure of investment used is not net of capital depreciation. As a result, GDP is not valid as a measure of well-being (see also de the previous subsection), whether current or future (see also discussion above on GDP). Education seems able to capture current well-being and the future: it is both a determinant and a component of development. Nevertheless, education is only one type of capital alongside two others, which are physical capital and natural capital. In itself, education does not inform about intergenerational concerns.

### 2.2.3 Total Factor Productivity and Development Prospect

While GDP and HDI do not withstand analysis as indicators of sustainable development, some authors, such as Hulten (2001), Hamilton and Ruta (2007) or *The Economist* (Note 3), see in Total Factor Productivity (TFP) an indicator of welfare/economic changes. Similarly, the World Bank (2006) and Hamilton and Ruta (2007) argued that this component of wealth is its largest share. According to estimates by the World Bank (2006), on a sample

of 120 developing and developed countries for the year 2000, TFP comprises over 50% of the wealth in nearly 85% of these countries. But what is the residual measure? Does it adequately capture the state of national wealth, development and economic prospects and hence the sustainability of development?

TFP is very much different from GDP and HDI. It is obtained from a neoclassical production function with two types of inputs, capital and labor, and technology. The quality of growth will depend on its sources. We can identify here the sources of growth in a given country. Let us take the example of a law that allows better access to paid employment for women or successive investments that fully allow exploiting the potential of human capital across the population. It would no longer be possible to maintain high growth rates resulting from these improvements. This is simply because we cannot reproduce such policies. But growth caused by technological progress may continue indefinitely as long as a country maintains its capacity for innovation. But to appreciate this capacity for innovation, we need to conduct growth accounting, that is, to establish individual contributions of all three factors (capital, labor, and technology) to output growth. As there is no direct measure of technology, its variation (the growth of TFP) is deduced. To do so, the difference between economic growth rate and growth rates of physical capital and human capital (both weighted by their respective shares in GDP) is calculated to obtain the growth of TFP (as a residual).

Three reasons, at least, can be identified as to why productivity growth fails to be an indicator of sustainable development. First, it can be seen (from equations 3 and 4) that TFP is a source of GDP growth. It is not enough to inform us about economic performance. Moreover, GDP itself does not measure well-being and *a fortiori* prospects of well-being. Secondly, changes in the residual may give a false signal on the state of the real economy. This stems mainly from the fact that national accounts (GDP) do not take into account all factors that contribute to the production of goods and services within the economic territory. For example, undeclared work or environmental goods and services used as productive resources may escape from national accounting. Thus, when 'environmental outsourcing' (Note 4) and/or undeclared work are high in the economy, the residual is greater. Thirdly, TFP is primarily a residual. As such, it tends to reflect our degree of ignorance in explaining economic performance. It can hide the effects of phenomena as diverse as business climate, social instability, corruption and environmental standards.

### 3. Approaches to Measuring Sustainable Development

While there is now a general awareness as to the threats to the environment, there is no measure of sustainable development recognized and accepted by all. In this section, I present the two main approaches to address this issue. On the one hand, we distinguish the approaches that aim at making adjustments to national economic accounts or aggregate economic indicators so that they reflect the role of the environment, damages to it and variations in the stock of natural resources. On the other hand, some approaches generally try to provide physical environmental indicators.

#### 3.1 Green National Accounting

The United Nations System of Environmental and Economic Accounting (SEEA) (UN et al., 2003) seeks to juxtapose 'green' satellite accounts to the conventional national accounts, thus providing a basis for experimentation that may lead to smooth changes to traditional national accounts. It recognizes that national accounts that are the primary source of information on national economies are limited in terms of considering the environment.

It is these limits that the SEEA attempts to compensate by taking into account the stocks and flows of environmental goods and services through its satellite accounts system built on the same structure as the national accounts. These satellite accounts are divided into four main components. Asset accounts, which list the stocks and changes in natural resource stocks; accounts of material flows, energy and pollution (including solid waste) used or generated within the economy, with an explicit consideration of environmental services not traded but that benefit the production of other sectors; accounts on transactions related to the environment, mainly expenditure and fiscal/property revenues related to the protection of the environment and resource management (financial allocations, property rights, taxes, fees and other expenses); and finally, macroeconomic indicators of sustainability such as national wealth (showing regard for natural resources), GDP adjusted net domestic product and the adjusted net savings. The data are presented in both physical and monetary terms. About thirty developed and developing countries in the world have such a practice (see Lange [2007] for details). The SEEA has the advantage of responding to a number of important economic policy issues. Nevertheless, it is less appropriate when, in particular, it concerns methods of assessing the level, the depletion and the degradation of stocks of natural resources (Atkinson et al., 2007).

### 3.2 Adjusted Net Saving

Adjusted net saving (ANS) is also known as genuine saving. It is built on theoretical foundations (see, among others, Pearce and Atkinson, 1993; Hamilton and Clemens, 1999; Dasgupta and Mäler, 2001; Lange et al., 2018). The intuition here is that it is the path of a country's inclusive wealth, i.e. its entire capital base, that determines sustainability (Pearce and Atkinson, 1993; Lindmark et al., 2018). Therefore in practice, ANS extends the conventional measure of (net) saving by adding the accumulation of human capital and deducting the depletion of natural resources (energy and minerals). In calculating ANS, current public expenditures on education (school textbooks, teacher salaries, etc.) are treated as savings rather than consumption since they increase human capital. Energy stocks are those of oil, coal and natural gas. The depletion of the stock of minerals is the sum of the depletion of stocks of bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver. It may also include damages for carbon dioxide and particulate emissions. The calculation of the index is made so that a country that is saving by foregoing consumption (and invests in the form of physical or human capital) increases its adjusted net saving. The reduction in the net stock of natural resources and damages to the environment (effects of emissions of carbon dioxide or particulates) negatively affect the level of genuine savings. To achieve sustainable development, countries should avoid negative levels of ANS. However, this index is often criticized for suggesting weak sustainability while not excluding strong sustainability. Works such as those of Atkinson and Hamilton (2007) and Hamilton and Bolt (2007) argue that ANS can predict changes in consumption. Another important message carried by ANS is that, if countries are unable to achieve weak sustainability, it is likely that it would be even more difficult for them to achieve strong sustainability.

### 3.3 Sustainable Welfare Indicators

The counterpart to green national accounting is provided by a wide range of sustainable development indicators. Unlike the former, they are not based on accounting frameworks or a direct extension of existing macroeconomic aggregates such as GDP. Here we introduce the Index of Sustainable Economic Welfare (ISEW), the Genuine Progress Indicator (GPI) and the Index of Economic Well-Being (IEWB). (Note 5) Of course, these indices are not immune to criticism (see Moffatt [2007] for a recent example). One of the criticisms that may be addressed against these measures, and what is irrefutable, is the fact that they combine into a single index the issue of current welfare and that of its sustainability. We return to this point in Section 4.

#### 3.3.1 The Genuine Progress Indicator

The Index of Sustainable Economic Welfare (ISEW) is a measure of sustainable consumption. The originators of the sustainable welfare indicators are Nordhaus and Tobin (1973). In more recent years, the ISEW has been developed by Daly and Cobb in the book 'For the Common Good' (1989). The discussions and work that followed have led to changes in the ISEW and to renaming it Genuine Progress Indicator (GPI) (by Cobb et al., 1995). They fall under the category of indicators of weak sustainability. (Note 6) These indicators focus not only on the potential of capital to provide future well-being, but also on the factors that cause current well-being. Well-being is seen as the broadest measure of consumers' utility. While different authors each propose a variant of the calculation, Dietz and Neumayer (2007) summarize and propose the following general calculation for the GPI: first, personal consumption weighted by income inequality, household work, non-defensive public expenditure and capital adjustments are added up; and second, defensive private expenditure, difference between consumer spending on durable goods and on service flows from their durables, (Note 7) costs of environmental degradation and depreciation of natural resources are deducted. So, the GPI combines flow from consumption and changes in wealth. Capital stock is viewed as performing two types of functions in well-being: it provides an annual flow of services and ensures sustainability. The index then seeks both to achieve a measure of consumption closest to actual welfare (which goes beyond only marketed goods and services) (Note 8) and to consider the sustainability of consumption (by evaluating the evolution of capital stock). This approach to sustainability is rooted in the 'Hicksian' definition of income as the maximum amount that can be consumed during a period by an economic entity without undermining its starting position (Hicks, 1946). In other words, income is the maximum sustainable consumption. However, there remains some confusion about what GPI actually measures. Does it measure current well-being and sustainability of well-being? Or does it only measure the sustainability of well-being? We will see that the next indicator from the same family, the Index of Economic Well-Being (IEWB), again does not fare better on this point.

#### 3.3.2 The Index of Economic Well-being

The Index of Economic Well-Being (IEWB) that we introduce here resembles in many respects the GPI. However, the IEWB is based on a combination of individual and social well-being and its way of aggregation is quite different from that of GPI. The IEWB is based on the idea that access to economic resources is a central

component of well-being, while recognizing that aggregates from national accounts do not reflect our perception of well-being (Osberg and Sharpe, 2006). The IEWB posits that individuals maximize their utility from a combination of their own well-being and an estimate of their own assessment of the society's well-being. Since each individual is well able to assess his own level of well-being as an individual, people need help only in estimating social well-being. The IEWB then proposes an overall assessment of social well-being, emphasizing both the present and the future. The index distinguishes four dimensions of well-being (valued per capita for the two firsts) (Osberg and Sharpe, 2006):

(1) Effective consumption flows (constant prices), which comprise private consumption of goods and services (adjusted for variation in household size), government services, leisure and life span;

(2) Wealth stocks (constant prices), which comprise produced capital, net change in natural capital, cost of environmental degradation, human capital, investment in research and development and net change in foreign debt;

(3) Income distribution, consisting of poverty level and intensity plus inequality measures;

(4) Economic security, consisting of estimates of risks that may arise from unemployment, illness, single-parent poverty and old age poverty.

Within each of these dimensions of well-being, the raw data have been scaled linearly to avoid implicit weighting and to address differences in directionality. The standardization technique applied is the same as with the Human development index (HDI). Depending on the presence of the directionality problem, the formula applied is  $\frac{Value-Min}{Max-Min}$  or  $\frac{Max-Value}{Max-Min}$ . That produces the same range ([0,1]) for all variables. (Note 9) The sub-components of income distribution and economic security are not expressed in monetary value. They are scaled using the same linear standardization techniques described above and then added up. Within the income distribution dimension, the weights (for inequality and poverty) are left subjective to individual choices. Within the security dimension, objective aggregation weights are used, based on the relative importance of each of the four sub-components (unemployment, illness, single-parent poverty, old age poverty) in the population, for all years. Then the four dimensions are aggregated subjectively toward the IEWB using an arithmetic mean. Different weighting schemes are available depending on individual subjectivity, with a base case of equal weights.

### 3.4 Physical Indicators of Sustainable Development

The physical indicators (non-monetary) of sustainable development are numerous. They focus on stocks and flows of natural capital and tend to be more in tune with the concept of strong sustainability. (Note 10) They also often consider the fact that the use of any resource generates waste that can, in turn, interact with bio-geochemical cycles and impacts other ecological cycles. Most of the resources that perform vital functions on the planet depend on solar radiation and Earth materials (Moffatt, 2007). Hence we must ensure the sustainable use of various resources. We must act so that potentially renewable resources are not exploited at a rate that exceeds their rate of renewal. Similarly, emissions of substances must not exceed the absorptive capacity of environments for receiving them. This implies, in terms of strong sustainability, that on the one hand revenues from the exploitation of non-renewable natural resources (fossil fuels and minerals) should be reinvested in alternative energies (Daly, 1990). On the other hand, efforts should aim at minimizing environmental damage caused by the use of resources. Clearly, when it comes to strong sustainability, we should not be limited to inventory investment in various forms of capital.

Indicators (or methods) such as the Ecological Footprint, Accounts for Material Flow and Environmental Space focus on both stocks and flows, trying to assess the value of the entire stock of natural capital or to measure the distance from the thresholds related to critical resources.

#### 3.4.1 Ecological Footprint

At the heart of the concept of Ecological Footprint is a work by Rees (1992), who studied cities with high levels of resource consumption, and a study by Rees and Wackernagel (1994), where the concept was further developed and applied to Canada. Ecological footprint is an easy concept to understand and measure. Thus, ecological footprint has captured the attention of vast sections of the public, including scientists, policy makers and ordinary citizens alike. The ecological footprint is a part of the approaches that seek to measure the pressures of human activities on the planet. The concept measures the total land and water requirements (for consumption and

waste assimilation) for a human population to indefinitely sustain its current living standard, using prevailing technology. The method consists of comparing the supply of land or sea available to provide the ecosystem services (biocapacity) with the human demand for biocapacity (ecological footprint). To calculate the ecological footprint and the biocapacity, six land use types are identified: cropland, grazing land, forest land, fishing grounds, built-up areas and land for sequestering carbon dioxide. The hectares for each type of bioproductive area are normalized into world average biologically productive land, called global hectares. This is done by multiplying each area with the corresponding yield factor and equivalence factor. Again, human consumption (or waste) data pertaining to each land use type are converted into hectares and then multiplied by the equivalence factor and a relative (world/national) yield factor.

Multiplication by an equivalence factor seeks to reflect the global mean productive potential of a given bioproductive area. Multiplication by a yield factor seeks to reflect the productivity difference between local and global levels. Ultimately, we have a supply equation represented by the biocapacity of a given area, and a demand equation represented by the ecological footprint. The demand from a single geographical entity may exceed its biocapacity (supply), resulting in the depletion of natural resources or net positive ecological import. But a global deficit would not be sustainable. We can thus see whether a given country consumes beyond its biocapacity or not. It is the same at the global level. An important feature of the ecological footprint is that it assigns areas of land required for resources to the consumer rather than the grower. Thus, if a developed country imports resources extracted from a developing country, the land required will be allocated to the former. In practice, it is estimated that globally the ecological footprint exceeds ecological capacity by approximately 30% (WWF, 2008). Studies have also been conducted at lower levels of geographical entities (e.g.: country level), but as such they have little importance as they can simply reflect the distribution of mutually beneficial trade and production (Bergh and Verbruggen, 1999; Moran, Wackernagel et al., 2008). The ecological footprint captures a country and measures its contribution to the global pressure on the resources of the planet.

The concept of ecological footprint has been the subject of much criticism (Ecological economics, 2000). It has evolved, even though many of its critics remain. First, in addition to not covering all dimensions of sustainable development, this indicator does not take into account environmental problems such as those raised by pollution (air except emissions of CO<sub>2</sub>, water and soil), and the disappearance of species are not treated directly. Another serious limitation is that the ecological footprint is an indicator of strong sustainability, which considers that various natural resources can be added to each other in terms of area of land, assuming then that they are substitutable. This premise is questionable (Dietz and Neumayer, 2007). Moreover, since countries have different levels of biocapacity, the calculation of the ecological balance (difference between ecological footprint and biocapacity) is not sufficient in itself to show the 'actual' sustainable development performance of a country. Hence, there is a need for also taking into account the level of the footprint itself (Commissariat Général du Développement Durable, 2009). In addition, other empirical problems arise, including the assessment of areas of land occupied by the consumption of fossil fuels. These areas are evaluated in terms of forest area needed to sequester carbon from the burning of these fossil fuels, ignoring alternatives that save more land.

### 3.4.2 Environmental Space

Environmental space, as promoted by Friends of the Earth, (Note 11) is defined as the total space of the planet available to humanity as a whole for use without depriving future generations of their possible needs. According to various sources (e.g.: Bührs, 2007), this notion was first introduced by Horst Siebert in 1982. However, it has also been put forward by Opschoor and Weterings (1994). These authors present environmental space as reflecting, "That at any given point in time, there are limits to the amount of environmental pressure that the Earth's ecosystems can handle without irreversible damage to these systems or to the life support processes that they enable". The development of this concept is motivated by the fear of the consequences of non-renewable resource depletion, potentially renewable resource overexploitation, exceeding the assimilative capacity of waste, and the issue of intergenerational equity. It is based on two core assumptions: the existence of ecological limits and an equal per capita access to resources. The test for sustainability based on environmental space is that the use of resources and pollution by a country can be compared to the environmental space belonging to that country.

This measure of sustainable development is also the subject of criticism:

- At the current level of technologies and prices, it is difficult to know precisely the level of non-renewable resources and consequently the exact constraints on development.
- The method leads to recommending reductions in the consumption of resources at levels that are difficult to imagine.

- Contrary to what is assumed in this method, apart from carbon dioxide emissions, there is little certainty about the assimilative capacity of waste by the planet.
- The measure is a simple average and no standard deviation is provided.

### 3.4.3 Material Flow Analysis

Material flow analysis (MFA) seeks to address concerns related to the rising use of material over a long period with the risk that we may reach ecological limits. It quantifies in physical units the flow of materials, including timber, agricultural products, metals, fuel, for a given area and period and “hidden” flows, i.e. flows of material (e.g., mining wastes) that are moved during the process of production but are not considered directly in the economy as products. MFA takes into account resources from both the domestic economy and imports that are consumed directly, transformed or used in manufacturing (Linstead and Ekins, 2001). The measure provides an assessment of the total flow of materials in a given area, which may be a national economy or a city. The approach is useful for a detailed analysis of resource use and emissions of pollutants. MFA relates the displacement of materials to environmental risks and impacts and to resource productivity (OECD, 2008). (Note 12) This approach is useful for a detailed analysis of resource use and emissions of pollutants. MFA recommends productivity improvement to reduce the flow of resources. Thus, it arouses enthusiasm in industrialized countries where it is hoped that new technology is expected to comply with this criterion of sustainability. It often uses the term “Factor Four”, referring to the idea of halving the use of resources and doubling production. This proposal is controversial. MFA is not built on a scientific basis and the possibilities offered by technological progress are hypothetical. Another important limitation is that MFA does not distinguish the degree of harmfulness of different environmental flows, as it evaluates all material flow as a mass.

## 4. Defining a Mix of Indices

The definition of sustainable development that we (economists) often refer to is the one made by the Brundtland Report (see also Section 1): “... development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 43). The report emphasized the importance of achieving development that serves different goals: economic development, a better life for all, both at present and in the future, and the respect of “the bounds of the ecologically possible”. Since then the demand for measures that can address the question of whether we are fulfilling our commitment to the goal of sustainable development has become increasingly apparent. To address this issue, many initiatives have emerged, ideas are plentiful, and to date a considerable amount of work has been carried out, of course, with different values added to the cause. That said, there is still no consensus on how progress towards sustainability should be measured.

The challenge remains high more than two decades after the publication of the Brundtland Report and the initial attempts to construct sustainability indicators (e.g.: Repetto et al. [1989] for adjusted net saving). However, Atkinson and Hamilton (2007) arrived at this conclusion, “In all likelihood, a meaningful picture of whether countries are developing sustainably will require a judicious mix of indicators”. In this regard, some propositions are emerging. Moran et al. (2008) have argued for the UNDP’s Human Development Index (HDI) and the Ecological Footprint (among others, Rees, 1992; Rees and Wackernagel, 1994) as a mix of indices that may be used in assessing sustainability. They present HDI as an index of development and the Ecological Footprint as one of the human pressures on the biosphere. In a recent contribution by the French government-mandated Report of the Commission on the measurement of economic performance and social progress (CMEPSP, 2009) (the Stiglitz Report; Chair: Joseph Stiglitz), indicators based on saving rules (e.g.: World Bank’s ANS) and selected physical indicators (e.g.: Ecological Footprint/Carbon Footprint) are viewed as the two measures that seem more suited to determine the mix of indices that we are seeking. Atkinson and Hamilton (2007) also see adjusted net saving as part of any mix on indices. However, the criteria that should guide the construction/evaluation of sustainable development indicators are well-known. They require the indicator to: (a) match rigorously the definition of sustainable development; (b) be comprehensive; (c) be easy to measure and reliable; (d) be based on data that are available regularly; (e) be of political relevance and (f) be based on solid analytical foundations (Böhringer and Jochem, 2007). Following Moran et al. (2008) and the Stiglitz Report, in this paper we focus on the first requirement—to match rigorously the definition of sustainable development. In this regard, both of these two propositions of the mix of indices fail to be reliable measures. They see only two aspects in terms of what the measures should be about. Indeed, Moran et al. (2008) take into account current well-being and environmental limits but not (economic) well-being sustainability; while, when it comes to sustainable development, the Stiglitz Report addresses well-being sustainability and environmental limits but not



current well-being. Based on the Brundtland Report and the definition of sustainable development we have mentioned above (WCED, 1987), any measure or portfolio of measures of sustainability should reflect the triptych: well-being (e.g.: measured by HDI), well-being sustainability (e.g.: measured by ANS) and environmental sustainability (e.g.: measured by Carbon footprint). In the Stiglitz Report it is clearly stated:

“The assessment of sustainability is complementary to the question of current well-being or economic performance, and must be examined separately. This may sound trivial and yet it deserves emphasis because some existing approaches fail to adopt this principle, leading to potentially confusing messages. For instance, confusion may arise when one tries to combine current well-being and sustainability into a single indicator. To take an analogy, when driving a car, a meter that added up in one single number the current speed of the vehicle and the remaining level of gasoline would not be of any help to the driver. Both pieces of information are critical and need to be displayed in distinct, clearly visible areas of the dashboard.” (Note 13)

In this regard, indicators such as the ISEW/GPI and the IEWB, which seek to combine both current well-being and future well-being, are not considered by this study as effective measures of sustainable development. (Note 14) But should we exclude current well-being as part of sustainable development? The answer is no. Similarly, as one single figure that tells us both the vehicle speed and the level of gasoline is not useful, separate figures that say nothing about the current state of our vehicle can mask a breakdown or even a future crash. We cannot talk about sustainability of development if we do not have a certain level of current well-being. For example, overinvestment (an excessive reduction of current consumption) may reduce the profitability of investment or simply deprive us of the minimum well-being necessary to enjoy the future. It is also a matter of equity to current generations. It seems difficult to separate the words “sustainability” and “development” when it comes to how we judge progress in a post-Brundtland world. The Brundtland Report made it clear that development is about the present and the future. The phrase sustainable development itself conveys the idea of current well-being, but a current well-being that is sustainable. This vision explains why many of the sustainable development indices that are being developed seek to measure sustainable development through a single figure while combining current well-being and future well-being. They are wrong in doing so through a single figure, but they are not wrong in their intention. To sum up, a measure of sustainable development must simultaneously include a measure of current well-being, a measure of well-being sustainability and a measure of ecological limit, but through separate figures.

We also need to take note of the shortcomings of each index viewed as a component of the mix of indices. For example, the calculation of ANS should be limited to assets that are less controversial to evaluate. We economists should accept that we cannot measure all things. Indeed, most criticisms of the ANS are about the integration of least-economic variables such as damage caused by emissions of particulate pollutants and carbon dioxide. Regarding international comparisons, ANS must be based on purchasing power parity (PPP); this improvement is important since we are dealing with living standards. It will also help to address a criticism it faces: it tends to favor developed countries.

Maybe the most important weakness in the genuine saving and the weak sustainable development theories is the treatment made of well-being. As already noted, the measurement of well-being by consumption (even largely measured) is questionable.

The question is “What makes people happy?” (among others) (Ng, 1997; Kahneman et al., 1997; Dixon, 1997; Layard, 2003). Work in this field led to three major conclusions based on psychological, anthropological and neuroscientific data. First, the traditional measures of well-being based on income are not relevant. Secondly, the assessment of welfare should be based on interpersonal comparisons and relative position. Third, everyone has common identifiable psychological and biological characteristics related to their well-being (Gowdy, 2005). It, therefore, seems that if we want to build a true theory of sustainable development, we must also consider direct measures of well-being such as “fair allocations”, capabilities and subjective measures of well-being, even more so given that the scientific methods used in this area now allow for reliable measures of cardinal utility (e.g.: Ng, 1999). However, the results in this field argue that almost half of individual well-being depends on inherited predispositions. Health, education, personal relationships, intelligence and religion form the bulk of the other half, while income, age and gender have only a limited effect (Gowdy, 2005). Adams (2010) recalls that subjective measures of well-being tend to contradict the Easterlin paradox (Easterlin, 1974) according to which there is little correlation between per capita revenue and happiness in international comparisons. That said, expenditures for early childhood and families, investment in recreational infrastructure and social cohesion are not taken into account in the ANS calculation, all of which are important determinants of welfare.

Ecological footprint could be reduced to carbon footprint in order to focus on the climate change issue. It is also not comprehensive. For example, it does not take into account all the issues that concern pollution and species loss. And no less important, there are several methodological difficulties posed by the ecological footprint that undermine its policy relevance, particularly at the country level (CMEPSP, 2009). HDI also has its limitations due to its bounded nature and the fact that it does not capture certain consumptions (relevant for life quality) in developed countries (Moran et al., 2008). Yet, determining a portfolio of sustainable development indices requires more than just a contribution to the literature, we need a model for consensus building.

### 5. Building Consensus for New Measurements of Sustainable Development

Faced with the difficulty of ‘imposing’ a new development index, there are more and more voices clamoring to suggest that this is due to the lack of legitimacy of these indices. These statements call for a democratic process of generation, even for mass communication campaigns to be undertaken. However, here also we must not deceive ourselves about how we question the legitimacy of new indicators that should constitute alternative measures to GDP. Indeed, very often one is tempted to think that it is up to ordinary citizens in different countries to define new indices of development and not experts. This is not exactly our point of view. As Jeffrey Sachs (Note 15) states, we believe that the process of responding to the challenges facing us in terms of sustainable development often goes through the following steps: science (i.e. experts who reveal the problem), then public awareness (citizens asking for change), then alternative technology (experts find the technological response) and, finally, international agreements can be achieved (the role of politicians).

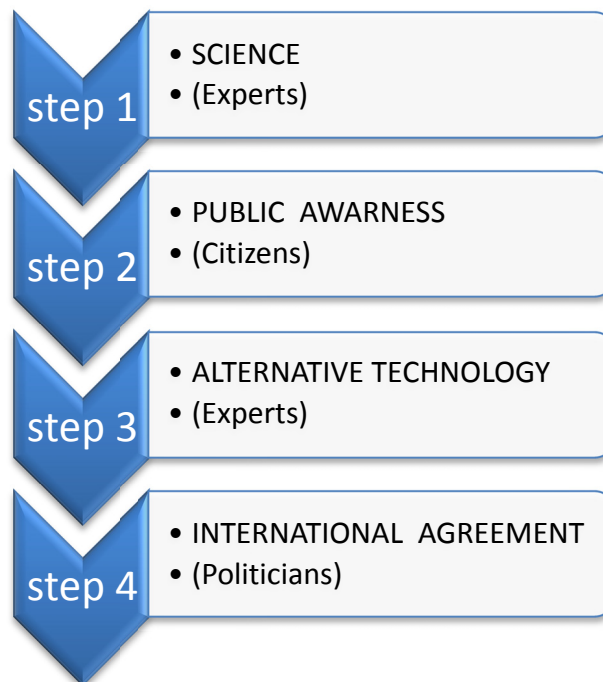


Figure 1. Reaching agreement on sustainable development issues

Source: author

What does reaching consensus on measuring sustainability issues mean in terms of economic perspective and development indices? It is for experts to demonstrate and communicate the limitations of indicators such as GDP and thus raise the level of public demand for new indicators. From there, it is still the work of experts to propose alternative indicators that citizens can adopt. And once the new indicators are developed, politicians in every country can appropriate them for the conduct and reporting of national policies. Today, we are at the stage of looking for alternative indicators. This is where the process seems to stumble since none of the numerous new indicators has unanimity. This is not for lack of legitimacy. Rather, the answers we have hitherto are not convincing. Today public legitimacy exists widely, calling for development indicators other than GDP to be adopted by citizens and policymakers.

What we need today is more cooperation among researchers. It is important that we launch a concerted process. It could cluster around institutions such as the United Nations (with the SNA) and the World Bank (Department of Sustainable Development), uniting all the major initiatives that exist on the measurement of sustainable development. This would allow more focused competition in the production of development indicators and generate synergy. Because of their role and experiences with national accountants and policymakers from different countries, such organizations can easily play a vital role in forging a consensus for governments on how to measure sustainable development and ownership.

## 6. Conclusion

It is undeniable that efforts have been made following the Brundtland Report and regarding the pressing need to build sustainable development indicators.

Throughout this paper, we have surveyed the question of the measurement of sustainable development. We recalled why such aggregates as GDP or the HDI are incomplete to paint the picture of the sustainability of the development process. The main answer is that they fail to tell us anything meaningful about the future.

Promising new indicators of (sustainable) development that attempt to fill the gap are prominently based on inclusive wealth, environmental sustainability (physical indicators) and measures of current well-being. This work has put forward many proposition, but it appears that rather than being measured through a single index, the assessment of sustainable development requires a mix of indices (Atkinson and Hamilton, 2007). The search for this portfolio (a word used by Atkinson and Hamilton, 2007) of index is just starting. We emphasized in this work the fact that this portfolio must match the triptych: current well-being / sustainability of well-being / environmental sustainability. In this regard, indices such as the human development index, the adjusted net saving and the ecological footprint are among the indices that are 'serious' candidates to constitute such a portfolio. However, even for these indices, we must recognize their respective limits. We also need more cooperation and synergy from the major initiatives that are underway in the building of new development measures.

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## Notes

Note 1. A more comprehensive version than the 1993 edition.

Note 2. That said, there is a correlation between GDP and living conditions in most countries.

Note 3. Issue of 10 February 2001.

Note 4. I introduce this phrase to describe the failure to pay for the environmental goods and services used (or for damage caused) in economic production.

Note 5. There are also the Sustainable Net Benefit Index (SNBI) and the Measure of Domestic Progress (MDP).

Note 6. Initially they were promoted to be indicators of strong sustainability. But based on the assumption of substitutability between different components of well-being they fall under the weak sustainability.

Note 7. The logic here is that it is services that provide utility to consumers that count, not the products that generate these services.

Note 8. Although the GPI considers them as the main component of welfare.

Note 9. A weakness of this procedure is the sensitivity of the results to the minimum and maximum values that may change depending on the groups of individuals (statistical units) taken into account.

Note 10. Recall that strong sustainability means that one cannot substitute other forms of capital to natural capital, either in whole or because there are critical levels in some of these natural resources.

Note 11. Environmental NGO: <http://www.foe.co.uk/>

Note 12. Eurostat provides data (except for the flow of water and air) for the calculation.

Note 13. CMEPSP, 2009, p. 17.

Note 14. But one should recognize that in the construction of these indices a clear distinction is made between these two aspects.

Note 15. Jeffrey Sachs, Survival in the Anthropocene, Reith lectures, Peking University, Beijing, 18 April 2007.

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