Statistics Netherlands
Division of Macro-economic Statistics
Department of National Accounts

MEASURING SUSTAINABLE DEVELOPMENT: A METHODOLOGICAL AND EMPIRICAL INVESTIGATION

Jan Pieter Smits and Rutger Hoekstra

Summary: There is a wide-spread feeling among economists, statisticians and policy makers that society needs to develop measures which go "beyond GDP". Most recently, the publication of the Stiglitz-Sen-Fitoussi Report the call for proper measurement of human well-being and sustainable development has increased considerably. However, the last few decades have seen the introduction of countless composite indicators and indicator sets, none of which has been adopted unanimously as the alternative to GDP.

This conceptual framework and indicator system which can describe human well-being and sustainable development appropriately. The conceptual framework is based on the Stiglitz-Sen-Fitoussi Report as well as the sustainability concept as put forward by the Brundtland Commission ("Our Common Future"). The proposed indicator system distinguishes the human well-being for a country in the "here and now", and compares it to the well-being for future generations ("later") and people elsewhere on the planet ("elsewhere").

The framework is illustrated by providing an empirical application using the World Development Indicators of the World Bank.

Keywords: sustainable development, sustainability, human well-being, human capital, economic capital, natural capital, social capital

Table of contents

1. Introduction[1]

There is a wide-spread feeling that society needs a better statistical 'compass'. It is argued that in defining our societal goals we should go beyond economic indicators such as Gross Domestic Product (GDP). Although this macro-economic indicator plays an important role in society and government policy, it is widely acknowledged that GDP does not cover all issues relating to human well-being and sustainable development.

The last two decades have seen a huge proliferation of methods and indicators to measure sustainable development. In light of the great variety in existing sustainable development indicator (SDI) sets, there is a need to harmonise the measurement of sustainable development.

Section two of this paper gives a short overview of the literature on the measurement of "GDP and Beyond" and identifies the main debates in the statistical work as far as the measurement of sustainable development are concerned. In section three a conceptual framework to measure sustainable development is presented. Section four presents the actual measurement system which consists of three dashboards, presenting indicators for current well-being, as well as indicators focusing on the needs of future generations (capital indicators) and indicators which capture the (environmental) pressure of a country on the rest of the world. In other words, three different dashboards are presented to chart human well-being "here and now", "later" and "elsewhere". Section five presents some empirical applications showing to what extent international differences in GDP per head of population match with international variation of well-being indicators. Besides, indicators are presented which give an idea to what extent vital resources were depleted because of which the future potential of well-being might be undermined. The concluding section captures the main results of the paper and identifies a research agenda.

---

[1] The framework presented in this paper is based on the work by the authors for the *Sustainability Monitor for the Netherlands* (CBS et al., 2009; 2011) as well as the *Task Force for Measuring Development (TFSD)* which they chair. The TFSD is a joint endeavour by the UNECE, Eurostat and OECD. Other members of the task force are the World Bank, the European Commission and ten countries are represented (Australia, Canada, Germany, France, Netherlands, New Zealand, Norway, Switzerland, United Kingdom and United States). The TFSD will present its final report to the Conference of European Statisticians in June 2013. The authors would like to thank all the members of the task force and our collaborators on the Sustainability Monitor for their cooperation. Although the sections 1-4 lean heavily on the work of the TFSD, the opinions expressed in this paper should not be interpreted as the official position of the TFSD.

2. Debates on "GDP and Beyond"

Economic measurement has deep historical roots[2], but its modern variety finds its origin in the period of the Great Depression of the 1920s and 1930s. In the following decades, the initial ideas were debated and elaborated by a number of prominent economists. Kuznets, Leontief and Stone received Nobel prizes for work related to the National Accounts. (Studenski, 1958; Bos, 2003). "A System of National Accounts and Supporting Tables, Studies in Methods" was first published in 1953. The handbook subsequently evolved into the System of National Accounts (SNA), and was updated several times to reflect the most recent insights and statistical developments (1960, 1964, 1968, 1993).[3] The latest 2008 revision bolsters the SNA as one of the most important statistical standards to date (SNA, 2008).

The SNA has been criticised since its inception for what the system measures and what it does not (for an overview of arguments, see van den Bergh, 2008). Some very fundamental debates and disagreements even preceded the publication of the SNA guidelines.[4]

The critique on GDP swelled in the 1950s and 1960s n response to increasing environmental concerns. Influential books such as Rachel Carson's "Silent Spring" (1962), Garret Hardin's "Tragedy of the Commons" (1968) and Paul Ehrlich's "Population Bomb" (1968) set the tone for a growing academic and popular interest in environmental issues. In the early 1970s the concern for negative aspects of growth even increased. In that year, the Club of Rome report "Limits to growth" was published (Meadows et al, 1972). In the same year the UN Conference on the Human Environment was held in Stockholm. The Conference agreed that economic development and environmental quality must be managed in a mutually beneficial way.

The concept of sustainable development made an international breakthrough

---

[2] The World Bank (2011) sees the Doomsday book, commissioned by William the Conqueror in 1058/59, as one of the first efforts to measure "wealth". At the end of the 17th century, national income estimates were produced in England (Petty, 1665; King 1696). Later, Francois Quesnais produced the *Tableau Economique*. For a history of this early period, see Studenski, 1958; Bos, 2003.

[3] For a link to all versions of the SNA see http://unstats.un.org/unsd/nationalaccount/hsna.asp

[4] For example, there was a large debate on the inclusion of government output as a producing sector. Kuznets, who was against the inclusion of government output, lost this debate against the Keynesian school of thinking (Lintott, 1996). The current GDP estimates would be very different if these debates had led to different conclusions.

due to the seminal Brundtland report, which was published in 1987.[5] The report was named after Gro Harlem Brundtland, the chairperson of the United Nation's World Commission on Environment and Development (WCED, 1987). The report was important in broadening the scope of sustainable development beyond environmental concerns, to include social aspects both on a national and an international scale.

Within this context the criticism of macro-economic measures such as GDP, which do not incorporate environmental or other external effects, swelled. This led to many initiatives to "correct" GDP and other macroeconomic aggregates in the 1960s, so that they would provide a better indicator for (social) welfare or sustainable welfare. A variety of *economic composite indicators* emerged in the 1960s and 1970s. Many focussed on aspects such as the monetization of household work and the "correction" for defence expenditures. In the 1970s a number of initiatives appeared aiming to "correct" national accounts aggregates, such as the Measure of Economic Well-being (MEW) (Nordhaus and Tobin, 1973) and Sustainable National Income (SNI) (Hueting, 1974).

The economic composite indicators of the 1990s built on the earlier "corrected" macro-economic indicators. Examples include the Index of Sustainable Economic Welfare (ISEW) (Cobb, 1989), the Genuine Progress indicator (GPI) (Cobb et al, 1995), the Index of Economic Well-being (IEWB); the Genuine Savings (Pearce an and Atkinson, 1993) and the Sustainable Net Benefit Indicator (Lawn and Sanders, 1999).

A second type of composite indicators, which is not based on economic theory, also emerged. While the methodologies for these composites vary, they are typically calculated as an average of a number of average indicators. The Human Development Index (HDI), published on an annual basis by the UNDP and which has a weighted value of economy, education and health, is the best known example (UNDP, various years). The Ecological Footprint (EF), also a very influential indicator, measures the requirements of consumption packages of national

[5] Note that the term "sustainable development" was coined, at least in an international document, by the International Union for the Conservation of Natural Resources (IUCN) which published the World Conservation Strategy (WCS) in 1980. The report did not, however, contain a specific definition of sustainable development.

economies using a land area metric (Rees and Wackernagel, 1994).[6] Other examples of *non-economic composites* include the Happy Planet Index (HPI), the Sustainable Society Index (SSI) and the Living Planet Index (LPI).[7]

A third type of indicators that gained prominence in the 1990s and 2000s is based on the direct measurement of subjective well-being. These indicators are created by asking individuals about their life satisfaction or by measuring people's feelings over recent episodes of their life (Kahneman and Kruger, 2006). Although these subjective measures have been analysed since the 1970s (Easterlin, 1974), the field has greatly gained in stature in the last decade (Anielski, 2007 and Layard, 2011).

These composite and wellbeing measures provide a single indicator to measure human well-being or sustainable development. However, it is also possible to use a set of indicators to measure these multidimensional phenomena. In the 1990's and 2000s, in the wake of the United Nations conferences in Rio (1992) and Johannesburg (2002), this approach became increasingly popular. The development started with the United Nations CSD list of indicators at the beginning of the 1990s. From the mid-1990s onwards, many statistical offices started to produce indicator sets for sustainable development or societal progress.

The post-Brundtland and post-Rio period has seen many national and international measurement initiatives.[8] However, there seems to be little convergence towards a common approach. In the process of harmonisation of measurement approaches, there are still issues that need to be clarified in order to

---

[6] See http://www.footprintnetwork.org for extra information. For a critical appraisal, see van den Bergh and Verbruggen (1999).

[7] For the Happy Planet Index (HPI), see: happyplanetindex.org); Sustainable Society Index (SSI) (Van der Kerk, 2008; http://www.ssfindex.com/ssi/) and the Living Planet Index (LPI) (WWF, 2010).

[8] Examples include 1991 - Commission for Sustainable Development (United Nations), 2001 – European Strategy for Sustainable Development (European Commission), 2007 – GDP and Beyond (European Commission), 2007 - Task Force for Measuring Sustainable Development (UNECE/OECD/Eurostat), 2007 – Progress of Society (OECD), 2009 - Stiglitz Commission, 2010 – Sponsorship group on measuring progress, well-being and sustainable development (Eurostat, INSEE), 2012 – E-frame (European Commission).

find a common approach. Different solutions to these key questions lead to different ways to measure sustainable development. It is therefore important to understand these varying approaches to see whether a common approach can be developed. This section focuses on five important issues in the field of operationalising and measuring sustainable development:

- Starting point for building SDI sets
- Ecological versus broad societal perspective
- Integrated versus future-oriented view
- Monetisation
- Composite indicators versus SDI sets

2.1 Starting point for building SDI sets

There are different ways in which SDI sets can be built. In some cases a system of measurement is solely based on theoretical notions. An example is the capital approach, aiming to measure the different types of capital that should be preserved for future generations as a prerequisite for sustainable development. In other cases, stakeholders are asked to identify those areas which should be part of an SDI set. This description refers to two polar cases. In practice, it is difficult to classify approaches. Some SDI sets lean more towards the conceptual approach while others are more aligned with policy themes.

The advantage of the policy approach is the close link between indicators and policy. Linking the indicators to policies ensures their wide visibility. The disadvantage is that the indicators may be biased towards particular policy priorities at the expense of other aspects of sustainable development. Furthermore, it is difficult to ensure continuity as changes in policy priorities may make it necessary to replace indicators.

The advantage of the conceptual approach is that it looks at sustainable development as a whole, encompassing all its relevant aspects. It is closely related to measurement theory and permits the detection of the fundamental trade-offs between human well-being “here and now”, “elsewhere” and “later”. The disadvantage is that the relevance of these indicators may not be recognised by policy makers, as they can not be directly used for policy monitoring or formulation. Therefore, statistical offices may run into difficulties in ensuring stakeholder support for this kind of work.

2.2 Ecological versus broad societal perspective

Most of the early literature on sustainable development focused on the environmental aspects of sustainable development. The Brundtland Report helped to broaden the concept to include economic, social and institutional aspects, and the SDI sets adopted in many countries reflect this broad concept. Of course, this broad view on sustainable development has its advantages as human well-being "here and now", "elsewhere" and "later" is linked to more than just environmental aspects. Even though environmental issues are an important aspect of sustainable development, increasingly a broader perspective is applied.

2.3 Integrated versus future-oriented view

Two different views have been expressed on how to interpret the concept of sustainable development. The "integrated view" states that the goal of sustainable development is to ensure both the well-being of those currently living and the potential well-being of future generations. The "future-oriented view" strictly focuses on the well-being of future generations. Both views have their advantages and disadvantages.

The integrated approach aims to reconcile the needs of present and future generations. This approach considers both the intra- and inter-generational aspects important. The intra-generational aspects relate to the fairness of distribution, i.e. the distribution between different social groups within one country as well as the global distribution between the high-income and less developed countries. The inter-generational aspects focus on the question of whether enough assets are left for future generations so that they can generate sufficient well-being. The integrated approach builds on the work of the Brundtland Commission, calling attention to the fundamental trade-offs between human well-being "here and now", "elsewhere" and "later".

The future-oriented approach focuses on the inter-generational issues and is often operationalised in terms of the capital approach: maintenance of the stocks of capital is an important prerequisite to maintaining human well-being in the long run. This approach was the one used by the Working Group on Statistics on Sustainable Development (WGSSD) (CES, 2009).

The advantage of the integrated approach is that it brings the two aspects of the distributional justice, the inter-generational and the intra-generational, together. The disadvantage is that the integrated approach can easily become a "theory of everything".

The advantage of the future-oriented approach is that, by limiting the scope of sustainable development, the concept can offer policy direction. There are many policies aimed at the current well-being and official statistics to measure the success of these policies. Therefore, more efforts are needed to develop policies and statistics on the long-term sustainable development. There also exists a conceptually robust theory to guide the long-term measurement of sustainable development. The disadvantage is that the approach is not in line with the Brundtland Commission's definition of sustainable development and with its interpretation given by most governments. It is difficult to concentrate policy attention on indicators that focus on future needs while there are many urgent problems that require attention here and now.

In case an integrated approached is followed, the Stiglitz-Sen-Fitoussi Report stresses that the current and future aspects of well-being should be distinguished. Stiglitz et al maintain that "the assessment of sustainability is complementary to the question of current well-being or economic performance, but must be examined separately". They argue that many studies of sustainable development which do not make this distinction send out unclear and confusing signals. "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" (Stiglitz et al., 2009, p. 17).

2.4 Monetisation

A third debate focuses on the question as to whether it is advisable to present capital indicators in a monetised form. Monetary estimates of economic capital, parts of natural capital and R&D are nowadays quite common, but for human and social capital they are rare or even absent. The only estimates combining all types of capital are the national wealth estimates provided by the World Bank (2003, 2006 and 2011). It should be noted that the use of monetary estimates of capital is not undisputed, because of the strong assumptions on which they are based (a more elaborate discussion on monetisation is presented in Annex II).

A summary estimate of the total stock of capital (national wealth) does not allow distinguishing between the various dimensions of well-being ('here and now', 'later' and 'elsewhere'). This approach is also too one-dimensional to provide policy

makers with detailed information concerning the trade-offs between the different dimensions of sustainable development.

One of the problems with aggregate measures of wealth (summing up the total value of economic, natural, human and social capital) is that the monetisation is based on market prices. Underlying this approach is the assumption that the market price reflects a perfectly functioning market. [9]

The use of market prices also implies that there is perfect substitutability between the various stocks of capital. Their relative scarcity is simply reflected in their prices. This perspective is known as weak sustainability. Many observers, however, advocate strong sustainability which assumes that the possibilities for substitution between different capital stocks are limited. This is a powerful argument against calculating (monetary) aggregate measures for total capital or wealth, when some parts of natural capital stocks are deemed to be irreplaceable (CES 2009, page 56-57). Measures in which these declining stocks of *critical* capital are offset by rising levels of *non-critical* capital may be misleading from the perspective of sustainable development.

Furthermore, the Stiglitz-Sen-Fitoussi report discusses the ethical problems associated with discounting over generations: 'Discounting is unavoidable from a practical point of view (to avoid infinite sums), but is ethically problematic: in principle all people should be treated equally, irrespective of their date of birth …anyway, whatever we do, practical indexes of welfare requiring intertemporal aggregation until the end of times are both hard to build, and clearly hard to communicate upon' (Stiglitz et al 2009, p. 251-252; see also Samuelson 1961 and Fleurbaey 2008).

2.5 Composite indicator versus SDI sets

In the discussion of the history of measuring sustainable development, one of the core differences is the choice between composite indicators and SDI sets. At present, nearly all international organisations and national statistical offices use indicator sets. The World Bank is an exception to the rule: it uses composite indicators

[9] The WGSSD report notes that the functioning markets rarely achieve the ideal conditions economists impose upon them in their valuation methods (CES 2009, pages 54-55, box 3). The Stiglitz report also acknowledges that the right valuation of the stocks of capital is often problematic, in particular "when market prices for assets are not available or subject to bubbles and bursts" (Stiglitz report, recommendation 3, §24). It states that "The monetary approach requires imputations and modelling which raise informal difficulties" (Stiglitz et al, 2009, recommendation 11, §38).

(genuine savings/comprehensive wealth) in its research on sustainable development (World Bank 2011). Composite indicators are more popular in academia and also in environmentalist groups that find it easier to communicate their message using a single indicator. Policy makers can be found on both sides of the debate, with some preferring indicator sets to an overall indicator to guide their policies and others preferring a single composite indicator.

3. A conceptual framework to measure human well-being and sustainable development

The Brundtland definition of sustainable development states that 'it is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. It implies that the well-being of future generations must be safeguarded by making sure that these generations have sufficient resources at their disposal, while at the same time securing the well-being of the current generation. The issue of sustainable development thereby becomes a matter of intergenerational equity determined by the distribution of resources over time. The same applies to the intra-generational aspects. The Brundtland report emphasises the fairness of societal developments on a global scale.

The core of the debate concerns the trade-offs between the present generation pursuing its well-being goals in the 'here and now', yet leaving enough assets for future generations, as well as people living elsewhere on this planet to pursue their goals. Fairness of distribution is therefore a vital part of the discussion on sustainable development.

The well-being of present and future generations crucially depends on how society uses its resources. These resources are at the core of the capital approach. Capital here is understood in the broad sense comprising not only the economic capital that is covered by the System of National Accounts, but also natural capital, human capital and social capital.

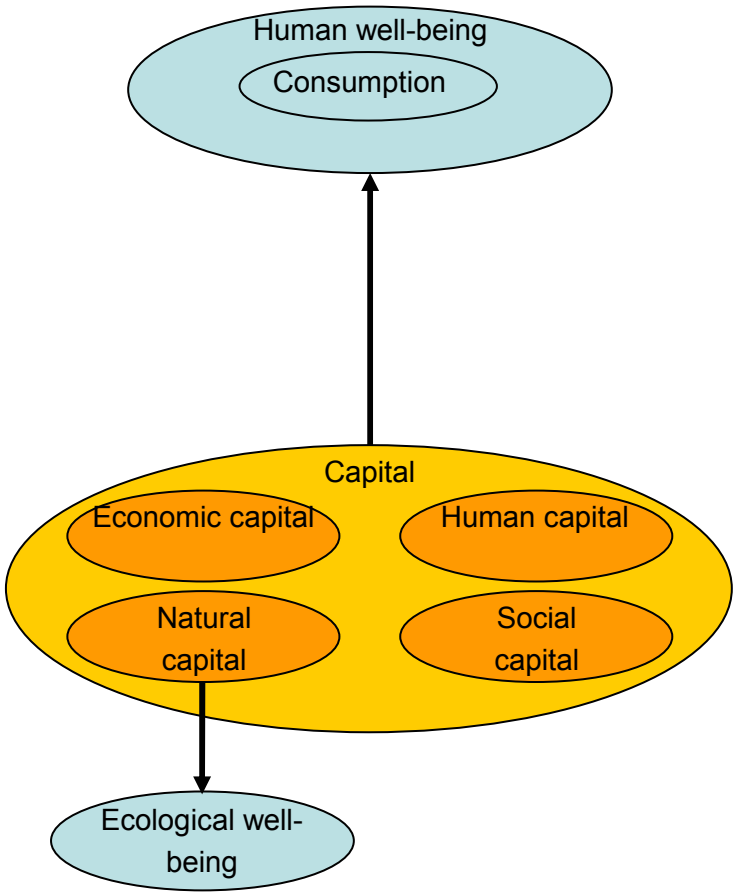

Figure 1 Capital and human well-being

The following definitions are used:

Human well-being: A broad concept which is not confined to the utility derived from the consumption of goods and services, but which is also related to people's functioning and capabilities (i.e. the freedom and possibilities they have to satisfy their needs).

Consumption: Represents the utility that consumers derive from the use of goods and services, in the system of national accounts this is usually measured in terms of final household consumer expenditures.

Ecological well-being: A concept which focuses on the intrinsic value of nature and its ecosystems, not necessarily reflected in the value these systems have for human beings.

Sustainable Development: A development that meets the needs of the present without compromising the ability of future generations to meet their own needs (=Brundtland definition)

Human well-being is thus seen as the overarching concept reflecting all those issues which shape the quality of life of human beings. Consumption can be seen as a sub-set within this overall concept of human well-being.[10]

Human well-being is a much broader concept than consumption. Consumption exclusively focuses on the command that people have over commodities. Economists often focus on consumption as it represents the utility people derive from the consumption of goods and services. Human well-being is broader in the sense that having certain commodities at one's disposal is not enough to generate well-being. People need to be free and able to use these commodities in such a way that they truly help to satisfy their needs. This perspective relates to the 'functioning and capabilities' which are stressed by Amartya Sen. In Sen's approach, the freedom and possibilities that people have to satisfy their needs are taken into account. Human well-being can also be determined by factors other than the command over commodities. For example, psychological, biophysical and socially-related phenomena are of paramount importance for people's sense of well-being.

Society has a number of available resources: economic and financial, natural, human and social capital. These resources are necessary to maintain human well-being over time. The discussion on sustainable development has often emphasised that natural capital is a special type of resource. Without it, humans could not exist. This approach to natural capital is anthropocentric: natural capital is only of value to society if it provides ecological services that benefit humans. In the literature, many authors argue that certain types of natural capital, such as biodiversity, have an existence value, irrespective of their use by society. This aspect is represented by introducing the term "ecological well-being" in Figure 1.

Figure 1 is a static representation of human well-being. It does not show whether well-being can be maintained in the future. From an inter-generational perspective, sustainable development is development that ensures non-declining per capita wealth by replacing or conserving the elements of that wealth; that is, stock of produced, human, social and natural capital. This definition only refers to the *potential* for sustainable development. There is no guarantee that future generations will manage the capital stocks in an appropriate manner. The state of technology and social organization could also allow for efficiency gains in the use of resources,

[10] Note that human well-being is the overarching concept, and that consumption and other common concepts such as subjective well-being and material well-being can all be regarded as narrower subdomains. For the sake of clarity, we have restricted the figure to the broadest concepts.

implying that even declining per capita welath could be consistent with unchanged levels of human well-being in the future if efficiency gains are large enough.

The starting point of the framework for measuring sustainable development is shown in Figure 2. The central notion in the figure is "human well-being". As the Stiglitz-Sen-Fitoussi report acknowledges, this concept has many connotations. It is covered under different terms in many different academic fields such as economics, social sciences, psychology, etc. In general, human well-being refers to the living conditions of humans. It should be noted that, apart from the anthropocentric concept of well-being, ecological well-being should be identified as a separate category. This figure clearly shows how the system of national accounts is taken as a starting point, but also how new insights from happiness and social science literature are added.

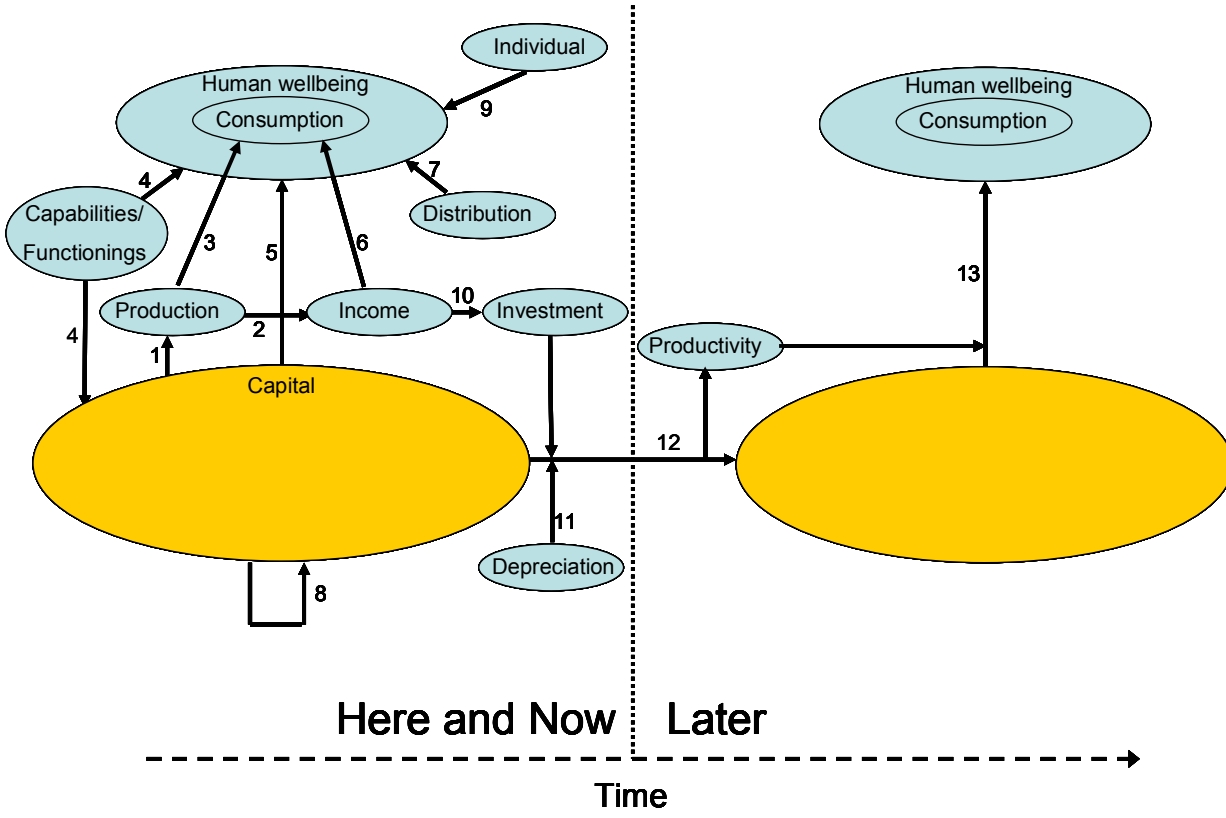

Figure 2. Sustainable development: "Now" versus "later"

Figure 2 identifies the main determinants of human well-being and sustainable development and also takes the time perspective into account:

[1] Goods and services are produced in production processes which use resources (or capital). In economics this is known as the production function.

[2] In the production process, the factors of production are rewarded, thereby providing income.

[3] The produced goods and services are consumed, which provides "utility". The sum of the utility from consumption of all persons is referred to as "welfare" in economics (note that this report uses a broader notion). In economics, it is common to model the preferences of individuals using a utility function.

The first three steps are common to the standard model in economics, but the model needs to be expanded in a number of ways:

[4] Functioning/capabilities: Having command over certain commodities may not necessarily lead to higher levels of well-being. People need to have the freedom to access these commodities (capital as well as consumer products) and to use them properly. Amartya Sen in his work strongly emphasises the importance of such capabilities.

[5] Capital also has a direct effect on human well-being (as opposed to the indirect effect through the production of goods and services). For example, individuals with a high level of human capital (either a high education level or good health) exhibit higher levels of well-being, even when controlling for income and other factors (Lomas, 1998; Healy, 2001).

[6] Human well-being is also correlated to income. However, there is also evidence that income relative to peer and family members is more important than absolute income per se (see [7]).

[7] As the Stiglitz-Sen-Fitoussi-report stresses, the distribution of capital, income and other well-being achievements is an important cross-cutting issue. National averages can hide large differences within society. High inequality can also affect social cohesion, and thereby human well-being.

Happiness literature and experimental economics have shown that the well-being of a person is affected by his/her relative income with respect to other persons in his/her social circles (Helson, 1964; Smith et al, 1989; Lucas and Diener, 2000 and Hagerly, 2000). Happiness literature also shows that well-being is dependent on the time elapsed. Reaching a certain goal in life

provides a temporary spike in well-being, but this effect wears off soon afterwards (Stiglitz and Becker, 1977; Becker, 1996 and Bowles, 1998).

[8] The different capital stocks are interrelated. Growth of one capital stock can lead to more productive use of other types of capital for example. This is particularly true for social capital, which is an enabler of other resources. However, there are also complementarities between physical and human capital: new machines will also require new skills in the population (see Goldin and Katz, 1999).

[9] Finally, well-being is not only affected by scarce resources, but also by individual psychological characteristics and information availability (Zajonc, 1980; Argyle 1987; Kahneman et al., 1994; Bradburn, 1996; Lewin, 1996; Deneve and Cooper, 1998).

[10] Part of the income is used for consumption [3], while the other portion can be invested in capital stocks. Since this other portion can be used in future production processes, it is often referred to as "delayed consumption".

[11] The new level of a capital stock is determined by investments but also by depreciation and other changes (for example, discoveries of new oil fields).

[12] The resulting level of capital stock can be used by future generations for their own well-being. For economic and natural capital, it is easy to see that capital stocks can be transmitted to future generations. But how about human and social capital, assets that are intrinsically 'linked' to the peoples of this generation? For knowledge capital (such as R&D), as well as human and social capital this link is provided by the mechanisms of path dependency. Choices that societies make have long-running effects. Due to the huge investments which are made in building up institutional frameworks (relating to different areas such as the knowledge system – national system of innovation – or civil society structures, etc.), high transaction costs may make it hard for societies to break away from the existing structures and move to new ones. Such regime shifts are rare, at least in the western world. Therefore, investments in human and social capital are not only relevant for the current generation, but also impact on the well-being of the next generation.

[13] The effect of productivity should be mentioned. Due to efficiency gains, less capital may be needed in the future to generate the same amount of well-being.

Figure 3 shows the relationships between capital and human well-being in a global context. It is visualised in a similar way as Figure 2. Apart from national capital stocks, it also contains the concept of global capital, of which the climate system is probably the best example. No country "owns" the atmospheric system, but each country contributes to climate change through emissions of greenhouse gas emissions.

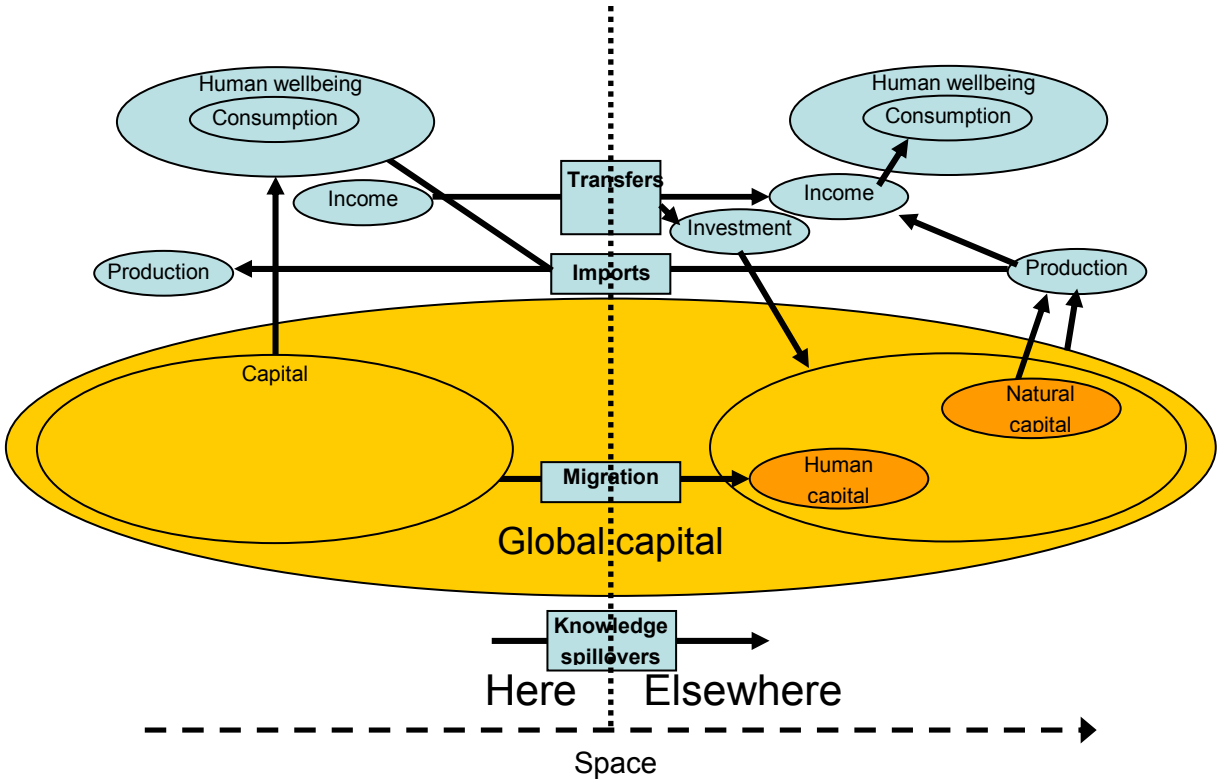

Figure 3. Sustainable development: "Here" versus "Elsewhere"

Figure 3 identifies a number of ways in which a country may affect the rest of the world:

- *Financial flows/income transfers.* For a variety of reasons, money may be transferred from one nation to the other. The reasons may be humanitarian or developmental (Official Development Aid: ODA) or may simply refer to the repatriation of income of foreign nationals to their home country (remittances). A country might also grant loans to foreign countries or to invest through foreign direct investment. All these financial transfers have varying impacts on the current and future well-being of the receiving country and the donating country.

- *Imports of goods and services.* Probably the most important link between countries is international trade in goods and services. Importing commodities (for consumption or to be used in the production process) provides the exporting country with income (and therefore consumption possibilities). The importance of international trade for economic prosperity has been subject to academic research for many centuries (Ricardo, Hecksher-Ohlin, Krugman). However, in the context of sustainable development, it is important to notice that the production of the goods and services is associated with the use of capital stocks, and in particular the use of natural capital. Through these imports, "here" has an impact on capital stocks such as natural resources "elsewhere".
- *Migration.* When people migrate or relocate temporarily to other countries, their human capital (education, health) is also transferred. Some developing countries are confronted by the so-called "brain-drain", whereby young, well-educated members of the work force seek employment in other countries.
- *Knowledge transfers.* Technological progress is vitally important for economic growth. Knowledge "spillovers" from one country to another may occur through a variety of channels, such as the technology-embodiment in imported capital goods, the knowledge embodied in persons, or the cooperation in international R&D and patenting. International takeovers, mergers and foreign direct investments can be useful catalysts of the above effects.

Although these are all important mechanisms, the literature on the international dimension of sustainable development has mainly focussed on two aspects: the depletion of natural capital and the impact of high income countries on the well-being of the developing countries. This is partly because these aspects are obviously important dimensions of the sustainable development debate and partly because there are indicators available for these topics.

Impact on natural capital

There is a growing literature exploring the international dimension of natural capital flows. Some countries may be "exporting" their environmental pressures: their domestic emissions are staying stable or reducing, but are being compensated by greenhouse gas- intensive imports. These countries are therefore affecting the global climate system through emissions abroad.

Impact on developing countries

The problem of global poverty, which was stressed in the Brundtland report, is one of the most important issues in the international dimension of sustainable development. The relationship of rich developed countries with developing countries is, however, a complex one. Ideally, one would want to measure whether the net impact on the (current and future) human well-being of the developing countries is positive or negative: only then could one reach a conclusion that a country is not building up its own human well-being at the expense of other countries. It is not possible to calculate the overall impact on the well-being of other countries.

It is useful to make a distinction between current and future well-being of the population in developing countries. One of the ways to stimulate current human well-being in developing countries is through economic development. Developed countries may affect these through "trade and aid", although in some cases institutional support may be even more effective. Development assistance, the existence of trade barriers and the total trade with developing countries are therefore good indicators regarding the effects of trade on the current welfare of developing countries.[11]

4. A new measurement system to go "beyond GDP"

A measurement system based on the conceptual framework provided in the previous section goes "beyond GDP", but at the same time still uses certain concepts from the national accounting system. Besides, this new measurement system takes into account the consensus that is developing in the statistical on a number of debates:

- Sustainable development is defined as a broad concept, not just focusing on environmental, but also on social and economic aspects.
- In order to focus on all these aspects, and also to make the distinction between human well-being "here and now", "later" and "elsewhere", an indicator set should be developed instead of using a composite indicator

[11] There are however two caveats. Firstly, these measures do not say anything about where the benefits of trade and aid will end up. In some, often institutionally weak, societies a sizeable portion of the profits may accrue to a small minority of the population or go to large multinationals. These distribution effects have a negative impact on the broad concept of human well-being. Secondly, the trade of goods and services can be unsustainable, from an intergenerational point of view, because the developing countries are depleting their capital stocks beyond regenerative or critical limits.

- Even though monetary indicators can be part of the indicator set, they are often quite far removed from the realm of official statistics due to the strong assumptions on which these monetary estimates are based.
- The measurement system is flexible in order to cater the needs of different kinds of users as will be described in this section.

Before delving deeper into the structuring of the indicator set and the actual choice of indicators, first the most important themes for human well-being "here and now". "later" and "elsewhere" should be identified.

Human well-being "here and now". There is no theoretical consensus on how to measure the human well-being of the present generation. Essentially human well-being is determined by what people regard as important for their quality of life. Following the recommendations of the Stiglitz-Sen-Fitoussi report, both the measurement of both objective and subjective well-being should be part of a dataset on sustainable development. Therefore, the list of themes on human well-being, presented at the end of this chapter, will include a theme on subjective well-being. From a more welfarist approach, the inclusion of the theme consumption and income (in the line of the recommendations of Stiglitz-Sen-Fitoussi) is justified. Apart from these more general, overall themes of human-wellbeing also more specific themes are distinguished, on the basis of a number of important studies in this field: the Human Development Report, the Stiglitz-Sen-Fitoussi report, Layard's research on the "Big Seven" (Layard 2005), Eurostat's "Well-being report" and OECD's "How is life?".

The measurement of human well-being 'here and now' distinguishes the following themes: **subjective well-being, consumption and income, health, housing, air quality, education, leisure, labour, physical safety, trust and institutions**.

Human well-being 'later'. The well-being of future generations is dependent on the resources that the current generation leaves behind. The abundant literature on capital measurement, which is also extensively discussed in the 2009 WGSSD report, makes it relatively easy to distinguish the main themes of this dimension. The WGSSD agreed that the assets that are important to be preserved for future generations fall under four main types of capital: economic and financial, natural,

human and social capital. The measurement system estimates the current levels of capital and their increase/decrease to show *how* choices of the present generation impact future generations. It does not attempt to forecast the well-being levels that may be attained by future generations.

For economic and financial- as well as natural capital the choice is based on the themes which are identified in handbooks such as the System of National Accounts (SNA) and the System of Economic and Environmental Accounts (SEEA). There are no international standards yet on the measurement of human and social capital, even though the WGSSD report did identify a tendency towards consensus on how to measure these two types of capital. In the present report, human capital is defined as the quality of labour in terms of educational attainment and health status. Social capital is defined in terms of the generalised trust that is being built through the repeated interactions between citizens. A second theme related to social capital concerns the quality of society's institutions.

Human well-being 'later' distinguishes the following forms of capital and themes:

- **Economic and financial capital**: physical capital, knowledge capital and financial assets.
- **Natural capital**: energy reserves, non-energy reserves, land and ecosystems, water, air quality and climate.
- **Human capital**: labour, education and health.
- **Social capital**: trust, institutions.

Human well-being "elsewhere". The 'elsewhere' dimension captures the ways in which countries affect the human well-being of the rest of the world. Firstly, the themes include indicators on the impact of developed countries on least developed countries (e.g. official development assistance). Secondly, the extent to which one country may deplete the resources of other countries is examined by the so-called footprint indicators. These indicators calculate the environmental pressures that are attributable to consumption in one country on resources abroad.

Human well-being 'elsewhere' distinguishes the following themes: **consumption and income, energy reserves, non-energy reserves, land and ecosystems, water and climate.** Themes that are related to human, social, economic

and financial capital are also relevant here. However, no robust indicators are available for these themes at present.

Based on these dimension and themes, Table 1 shows the structure of the indicator set. The table shows that for each theme aggregate indicators (averages or total per capita) can be proposed and also –if available- indicators on distribution (by gender, by age group, etc.). This is because the issue of distribution and inequality is a core cross-cutting issue in the measurement of sustainable development.

Table 1. Sustainable development indicators: conceptual categorisation

Dimension	**Sub-dimension**	**Theme**	**Aggregate indicator**	**Indicators showing distribution (inequality)**
Human well-being ("Here and now")		HWB1. Subjective well-being		
		HWB2. Consumption and income		
		HWB3. Health		
		HWB4. Housing		
		HWB5. Air quality		
		HWB6. Education		
		HWB7. Leisure		
		HWB8. Labour		
		HWB9. Physical safety		
		HWB10. Trust		
		HWB11. Institutions		
Capital ("Later")	Economic and financial capital	EC1. Physical capital		
		EC2. Knowledge capital		
		FC1. Financial capital		
		EFC-M. Economic and financial capital		
	Natural capital	NC1. Energy resources		
		NC2. Non-energy resources		
		NC3. Land and ecosystems		
		NC4. Water		
		NC5. Air quality		
		NC6. Climate		
		NC-M. Natural capital		
	Human capital	HC1. Labour		
		HC2. Education		

		HC3. Health		
		HC-M Human capital		
	Social capital	SC1. Trust		
		SC2. Institutions		
		SC-M. Social capital		
International dimension ("Elsewhere")	Consumption and income	INT1. Consumption and income		
	Natural capital	INT2. Energy reserves		
		INT3. Non-energy reserves		
		INT4. Land and ecosystems		
		INT5. Water		
		INT6. Climate		

Note: The lightly shaded areas denote non-monetary capital indicators (physical indicators) and the dark shaded areas indicate monetary capital indicators.

The report does not aim at a "one size fits all" approach, but rather presents a flexible framework that can cater to a variety of needs. Those users who want to stress the current as well as the future aspects of human well-being (the 'integrated approach') may use the entire table. Users who want to emphasise the inter-generational aspects of sustainable development (the 'future-oriented approach' or the 'capital approach') may restrict themselves to the use of capital indicators in table 1. Within the future-oriented approach, some users may prefer to use monetised capital indicators (the 'monetary capital approach') shown in the darkest shading in table 1. The 'hybrid capital approach', which uses both monetary and physical indicators for capital stocks, is presented in lighter shading in table 1. The measurement system is therefore flexible as it caters to a variety of viewpoints on the measurement of sustainable development.

Selection and communication sustainable development indicators

There are two examples, where this system is currently being adopted: the task force for measuring sustainable development (TFSD) and the Sustainability Monitor for the Netherlands (2011). In both cases a slightly different approach is adopted to select the indicators.

The TFSD has not yet produced a definitive list of SDI indicators, but a preliminary set does exist. In Annex II this list is provided and the data availability of these indicators is also shown.

The 55 indicators shown have been selected on the basis of three criteria: conceptual grounds; how common they are in the SDI sets of ten institutes; and the data availability in the international databases of the UN, OECD and Eurostat. Annex II shows that more than half of the indicators are readily available in international databases.

For the Sustainability Monitor for the Netherlands there are 56 indicators. Apart from conceptual reasons, the availability of time series (starting from 2000) as well as the availability for data for the 27 countries of the European Union were important criteria.

It must be noted that it is difficult to communicate such a relatively large set. For the Dutch Sustainability Monitor a special web-based visualisation was developed in order to communicate the main conclusions of the indicator set. A screen shot of the visualisation is provided in Figure 4.

The three dimensions of the dashboards ("here and now", "later" and "elsewhere") are distinguished. And for each dimension the main themes are mentioned. The left side of the visualisation pictures the main trends over time. The right side shows how the Netherlands rank within the EU-27.

As far as the developments over time are concerned, indicators get a red colour when developments are negative (from the perspective of sustainable development) and green when favourable. In case that no clear trend can be discerned, the colour yellow is used. The pie charts indicate how many of the underlying indicators for each category are red, green or yellow (so essentially, an unweighted average is used). The same procedure was applied to the place the Netherlands occupies on the EU ranking list. In case indicators are in the top 1/3d of the list they are coloured green, for the bottom part of the list they are coloured red etcetera.

Figure 4. Communication of indicators of the Sustainability monitor for the Netherlands

This visualisation shows that the Netherlands is doing quite well in terms of its human well-being "here and now". But part of this well-being is generated at the expense of future generations (see the depletion of natural and to some extent also human capital; the Netherlands also display quite low scores on the EU ranking list) and at the expense of the rest of the world (in per capita terms the Dutch import relatively large amounts of non-renewable natural resources, especially from the least developed countries). This way of presenting the data proved to be successful and triggered quite some debate.

5. Empirical application

The aim of this new SDI set is to go "beyond GDP". But to what extent does this measurement system shed a different light on international differences in human well-being? This section gives a short empirical investigation, based on the scarce

data which are available for the large range of countries, from high-income countries to the least developed ones. The data are derived from the World Bank's World Development Indicators.

Table 3 compares the levels of certain indicators of well-being of four regions as a percentage of well-being in the high-income countries. First, international differences in GDP per head of population are compared to the international variation of a number of well-being indicators. Unfortunately, the data availability for the period under investigation (1970-2008) is quite limited. For the moment, this analysis is restricted to final household consumer expenditures (an indicator recommended by Stiglitz et al), health status (measured by average life expectancy at birth), educational attainment (literacy rate) and economic distribution (percentage of population living above the poverty line of one $ a day).

Table 3. Levels of well-being in different regions of the world as a percentage of well-being level of high-income countries, 1970/80-2008 (in % of level in high-income countries)

	1970/80	**2008**
GDP/caput		
East Asia and Pacific	1,4	6,1
South Asia	1,7	2,4
Latin America	20,7	16,6
Sub Saharan Africa	4,2	2,2
% population > 1 $ a day		
East Asia and Pacific	--	61,4
South Asia	--	26,1
Latin America	--	82,9
Sub Saharan Africa	--	27,2
% population with enough food		
East Asia and Pacific	--	93,3
South Asia	--	82,4
Latin America	--	95,6
Sub Saharan Africa	--	75,1
Life expectancy		
East Asia and Pacific	83,6	90,7
South Asia	69,2	81,5
Latin America	85,3	92,2
Sub Saharan Africa	63,9	64,9
Literacy rate		
East Asia and Pacific	97,3	93,7

South Asia	47,4	63,9
Latin America	71,3	91,9
Sub Saharan Africa	54,5	62,8

Source: World Bank, World Development Indicators; in case that no data were available were available for 1970, data for 1980 were used.

This table presents data for 2008, the most recent year for which all data are available. The results show the great disparities in GDP per caput across the globe. In South Asia and sub Saharan Africa the income stands at a level of circa 2% of that of the high-income countries. This share is higher in East Asia and Pacific and Latin American and Carribean countries at 6.1% respectively 16.6%, but still much lower than the income level in the rich countries. The Stiglitz-Sen-Fitoussi Report argues that household consumer expenditures are a better indicator for well-being than GDP. However, the international disparities in household expenditures closely correspond to the spread in GDP per head of population.

If a number of the suggested well-being indicators is considered, a different picture emerges. There is a less divergence between the different regions, even though it should be noted that GDP and household expenditures are measured on an unlimited scale, whereas the other variables are limited as they are measured in percentages, whereas life expectation is limited for biological reasons.

Especially for health status and educational attainment there are marked differences between various regions of the world, but they are much less drastic than conventional economic measures suggest. It can be noted that the indicator for poverty, which is essentially a distributional measure, shows more marked inter-regional differences. Especially the relative levels of poverty are quite low in South Asia and sub Saharan Africa, compared to the other well-being measures such as educational attainment and health status.

The trends over time show a similar picture. Also here, the developments of GDP per caput are much stronger than the well-being indicators suggest. The development of sub Saharan Africa may serve as a good example. This region lagged behind the high-income countries in terms of its relative income in the period 1970-2008. However, there was a (quite mild) catching-up in terms of life expectancy and literacy rates.

In other words, this very limited set of indicators suggests that proper measures of well-being may shed quite a different light on international differences in well-being and their changes over time, than the conventional GDP measure

suggests. Of course, compiling a proper global dataset with the indicators as suggested in Annex II, may lead to a more refined picture.

The international differences in human well-being ("here and now") are quite large. But how is this well-being built up? Which types of assets are used? And more important, are certain capital stocks being depleted? Again, there are quite serious data limitations. We do not have the disposal of capital stocks, but rather of savings rates for different types of assets. The tables 4 and 5 present data on international differences in savings rates for economic, human and natural capital for the years 1970 and 2008.

Table 4: Adjusted saving rates in five regions of the world, by type of asset, 1970 (in % of GDP)

	High income	East Asia	South Asia	Latin America	Sub Saharan Afr
Economic capital	19,2	19,5	8,0	11,4	--
Human capital	10,4	5,7	7,0	9,0	8,2
Natural capital	1,3	3,0	2,1	2,5	4,3
-of which:					
-CO2 damage	0,6	1,2	0,5	0,5	0,6
-Energy depletion	0,5	1,1	0,1	1,0	0,5
-Mineral depletion	0,2	0,5	0,2	1,0	2,6
-Net forest depletion	0,0	0,2	1,3	0,0	0,6
-Particulate emission damage	--	--	--	--	--

Source: World Bank, World Development Indicators.

Table 5: Adjusted saving rates in five regions of the world, by type of asset, 2008 (in % of GDP)

	High income	East Asia	South Asia	Latin America	Sub Saharan Afr
Economic capital	8,8	31,9	24,7	7,1	-4,7
Human capital	14,5	10,7	9,5	12,6	11,1
Natural capital	2,2	8,8	6,0	8,0	14,9
-of which:					
-CO2 damage	0,3	1,3	1,0	0,3	0,7
-Energy depletion	1,5	4,9	2,7	5,4	11,8
-Mineral depletion	0,1	1,3	0,6	1,9	1,5
-Net forest depletion	0,0	0,0	0,9	0,0	0,5
-Particulate emission damage	0,3	1,3	0,8	0,4	0,4

Source: World Bank, World Development Indicators.

The international differences in savings rates are largest for economic capital. Especially the negative savings rate for sub Saharan Africa in 2008 is quite striking. For human capital, which becomes more and more important across the globe, these differences are less marked. Also for natural capital, where the inter-regional variations in (dis) savings are related to the patterns of natural endowments.

If the changes in savings rates between 2008 and 1970 are compared, these have declined for economic capital in the high-income countries, East Asia and Latin America. This decline should not necessarily be interpreted in terms of a depletion of capital as especially in the industrialised countries the technological systems underlying the economic changes which occurred from the 1960s onwards, shifted to a knowledge economy in which intangible assets such as human capital gained importance relative to tangible assets such as machinery and equipment. In the period 1970-2008 the human capital savings increased in all regions.

The data on natural capital point at an increasing rate of depletion, as the assets under investigation are largely of a non-renewable nature. The bulk of the dissavings of natural capital are concentrated in energy resources, and this tendency is most apparent in the low income regions of the world, most notably sub Saharan Africa.

Proper data on social capital are not available, at least not in terms of direct measures. The World Bank has presented estimates on wealth from human resources, of which social capital is a part (see also Annex 2). It is quite unfortunate that proper measures are still lacking, as the World Bank has labeled social capital as "the missing link" in explaining international differences in the well-being of countries **(**Grootaert**,** 1997). Economic literature also strongly focuses in the importance of differences in the quality of institutions (Acemoglu et al**,** 2004**;** Rodrik et al**,** 2002**)**. Following De Soto **(**2000**),** social capital of institutions is measured in terms of the time or financial resources that are needed to start-up business of to enforce property rights.

Table 6: Measures of institutional quality across the globe, 2008

	High income	East Asia	South Asia	Latin America	Sub Saharan Africa
Cost of business startup	7,4	38,5	31,9	47,4	117,2
Time to enforce contract	522,8	590,7	1052,9	713,8	658,8

Time to register property	49,3	112,5	105,9	66,2	93,4

Units: Cost of business startups measures in terms of % of GNI per capita; time to enforce contracts and register property rights measured in the number of days necessary to finish the paper work.

Source: World Bank, World Development Indicators.

These data show the strong differences in institutional quality across the globe. The time as well as costs to do transactions are much lower in the high-income countries than in the rest of the world. Especially the institutional quality in South Asia and sub Saharan Africa are much lower. In fact, only these institutional measures seem to match the international differences in well-being. The international differences in economic, human and –to a lesser extent- natural capital- seem too small to account for the differences in well-being.

6. Conclusion

This paper proposes a framework for measuring sustainable development. The measurement system is inspired by the Brundtland definition of sustainable development and distinguishes human well-being "here and now", "later" and "elsewehere". A lot of the data is already available, even within the realm of official statistics. This measurement system is in line with a number of other important international statistical initiatives and can be seen as an important step in the process of harmonising SDI sets.

Annex I. Limits of monetisation

The capital approach is based on a rich body of literature, spanning a period of more than half a century. Still, capital measurements have their drawbacks. Some words of caution are needed when using capital estimates in a sustainable development framework, especially where the monetisation of capital is concerned.

Monetisation techniques often rely on strong assumptions, which may be acceptable from an academic perspective, but which may appear arbitrary from the perspective of official statistics. This section will first deal with some general issues regarding monetisation and its underlying assumptions. The second part deals with a specific methodology developed by the World Bank, aimed at making monetary estimates of the total wealth of nations.

Most monetisation techniques used in the measurement of capital depend on four types of assumptions:

- *Market prices and the functioning of markets*. In most cases, market prices are used as a proxy in the valuation of capital stocks. Underlying this approach is the assumption that the market price is reflective of a perfectly functioning market. [12]
- *Weak sustainability*. The use of market prices implies that there is perfect substitutability between the various stocks of capital, and that their relative scarcity is reflected in their prices. This weak sustainability perspective is, however, objected by those who argue that the possibilities for substitution between different capital stocks are limited. Some categories of natural capital stocks are often regarded as irreplaceable (CES, 2009, page 56-57). In that case, summing up all types of capital in one indicator may yield results which are difficult to evaluate from a sustainable development perspective. For example, this overall indicator may show growth because a decline of critical capital is compensated for by increases in non-critical assets (see also the discussion ion section 2.3.4 of this Report).

[12] The WGSSD report notes that the functioning markets rarely achieve the ideal conditions economists impose upon them in their valuation methods (CES, 2009, pages 54-55, box 3). The Stiglitz report also acknowledges that the right valuation of the stocks of capital is often problematic, in particular "when market prices for assets are not available or subject to bubbles and bursts" (Stiglitz report, recommendation 3, §24). It states that "The monetary approach requires imputations and modelling which raise informal difficulties" (Stiglitz report, recommendation 11, §38).

- *Discount rates*. To value capital, future income streams must be discounted and than summed-up. Debate over the appropriate discount rate has a long history. The Stiglitz report discusses the ethical aspects of discounting over the generational boundaries. This assumption is empirically important because small differences in discount rate can make a large difference to the monetary value of the capital stock.
- *Technical progress*. To estimate future income streams, assumptions are commonly made about productivity growth in the coming years or even decades. Assumptions also have to be made about the lifetime and efficiency profiles of the capital stocks in future. These predictions are difficult make and sometimes arbitrary.

These points show that monetisation techniques often depend on arbitrary assumptions. While these assumptions are not unique to the monetisation of non-market capital (national accounts measures of the stock of economic capital are critically shaped by them), not all NSI's will be equally at ease when applying them to non-market items.

The World Bank approach

In order to chart the potential of future generations to pursue their well-being, information is needed on the changes in the stocks of economic, natural, human and social capital. When these stocks are measured based on a common metric and are depending on assumptions made on the degree of sustainability between these various stocks, changes in the total stock of wealth (per capita) will provide information on the sustainability of the development path of each country. The statistical approaches described earlier in this chapter aim to improve the measurement of each of the types of capital that make up the total wealth of each country.

Unfortunately, there is no dataset covering all these types of assets for a large group of countries where all the different types of assets are measured through a common metric (i.e. in monetary terms). The only dataset which comes close to this ideal is the one compiled by the World Bank (2003, 2006 and 2011). For approximately 150 countries the World Bank has estimated monetary measures of total wealth, with additional information on economic and natural capital, for the period from 1970 to the present.

The World Bank relies on these monetary estimates of total wealth to compute so-called genuine saving rates – a summary measure of sustainability. Genuine saving rates show the extent to which society is depleting its total resources (when negative) or adding to them (when positive).

The term 'genuine' was coined by Hamilton to stress that the relevant flows include investments not just in the conventional economic capital, but also in natural, human, social and institutional capital (Hamilton 1994). In the World Bank accounting framework, total wealth is defined as follows:

> **Total wealth = economic capital minus net depreciation of natural capital plus investments in capital from human resources (where this last term captures human, institutional and social capital).**

One important difference between the World Bank approach and that of this Task Force is that the World Bank measures total wealth as the discounted sum of consumption expenditures in the future. Given that well-being is a much broader concept than consumption, it follows logically that the monetary of *total* wealth by the World Bank excludes *all* the non-economic benefits of the different types of capital.

The intellectual roots of the genuine or adjusted savings approach go back to Fisher (1906) who argued that income can be seen as a return to wealth. Building on this tradition, Solow (1974) and Hartwick (1977) developed a model for an economy that exploits non-renewable resources, looking at the conditions needed to maximise the present value of peoples' well-being (or, as economists often put it, social welfare) over time, given a set of simplifying assumptions. In this model, non-declining well-being requires that society invests in renewable resources an amount equivalent to the depletion of its non-renewable resources.

Early empirical estimates of genuine or adjusted savings rates were presented by Pearce and Atkinson (1993) for 18 countries. In the course of time, the number of countries for which these estimates have been made available has increased substantially.

The World Bank estimates provide some fascinating insights into the changes in the total wealth of nations, and interesting measures to chart the inter-generational aspects of sustainable development. However, these estimates also raise a number of methodological issues, which are discussed in more detail below.

The World Bank dataset distinguishes several types of assets. These assets are produced capital (machinery, structures and equipment); natural capital (agricultural land, protected areas, forests, minerals and energy); and intangible capital. This intangible capital (also labelled as "wealth from human resources") is calculated as a residual and implicitly includes measures of human, social and institutional capital, e.g. the rule of law and governance. In most of the analysis, net foreign assets, i.e. the balance of a country's net financial assets and liabilities are also implicitly included in intangible capital.

While ingenious, the measurement technique used by the World Bank implies that estimates of intangible capital include (i) those assets that were not (properly) taken into account in the measurement of economic and natural capital (such as diamonds, platinum, fisheries and ground water, which are not included in the estimates of natural capital); (ii) any error in the measurement of (tangible) economic capital; and (iii) specific assumptions made when estimating total wealth.

These factors imply that the empirical underpinning of these residual measures of intangible wealth is still weak. In countries where direct measures of human capital are available, these estimates are not always in line with those based on the residual approach of the World Bank. In other cases, these estimates would imply that social capital provides no (economic) benefits, even though empirical literature stresses its importance for economic growth (Knack and Keefer, 1997).

The limits of the World Bank methodology mentioned above all relate to the incomplete nature of some of the capital stocks considered and to the assumptions on which the measures are based. Some more fundamental criticisms are put forward by Dietz and Neumayer (1999).

First of all, these authors stress that the World Bank approach is based on a model of an inter-temporal efficient economy developing along an optimal path. This model is based on some very strong assumptions, such as the existence of a complete set of property rights (and hence the absence of externalities), perfect functioning of markets, complete information, rational agents and uses a social discount rate (World Bank 2006, p. 144). In the real world, however, natural resources are affected by important market failures and negative externalities (e.g. due to a lack of property rights). In the presence of these factors, an economy may follow a non-sustainable path of development. Following Pearce and Turner (1989), Dietz and Neumayer (1999) maintain that, as a result of market failures for natural assets, positive genuine savings can be associated with non-optimal resource prices to such an extent that these assets are being used in a non-sustainable way.

A second problem is related to the fact that the model is vulnerable to external technology shocks and terms of trade shocks, as well as to changes in discount rates. These shocks will imply that the market prices that existed at the outset will no longer be optimal after a shock, i.e. they will no longer adequately reflect economic scarcities (Neumayer, 1999). Under these circumstances, trends in genuine savings will not give reliable information on whether societies are on a sustainable growth path or not (Dietz and Neumayer, 1999). The only way to avoid the effects of exogenous shocks would be by re-estimating prices, an idea which Hamilton (1995) has rejected as being impractical.

Another problematic issue concerns how the total wealth estimates should be interpreted. Hamilton and Ruta (2006) argued that while stable or growing total wealth per capita is no guarantee of sustainable development, the opposite is a guarantee of its impossibility. That is, in the face of a declining stock of total wealth per capita, well-being will in the long run deteriorate and sustainable development will not be possible (CES, 2009, p. 5). However, this conclusion depends on the assumption of 'weak sustainability', i.e. on the view that the decline in the stock of one type of asset, measured at currently prevailing prices, could be compensated for by the rise of another one.

As underscored by both the WGSSD and the SSF reports, in the presence of 'critical' types of capital (i.e. capital types that are not deemed to be substitutable, at the margin, with other assets), meeting this 'weak sustainability' criterion is no guarantee of sustainability. For example, the effects on people's well-being of higher concentrations of greenhouse gases in the atmosphere (which could lead to irreversible climate change) or of losses in biodiversity may not be adequately compensated by increases in economic, human or social capital valued at today's prices. Therefore, the WGSSD Report argued for the need to supplement monetary estimates of total wealth with physical measures of the various types of critical capital.

Overall, it can be concluded that the World Bank estimates are of great importance. A lot of data has been gathered, and this project has given a stimulus to the research into capital measurement. However, much remains to be done to make these residual estimates more reliable (Ferreira, Hamilton and Vincent, 2008). There are still doubts as to whether the genuine or adjusted saving rates give us reliable information on whether countries are on a sustainable growth path or not. Ferreira and Vincent (page 750) argue that trends in consumption in OECD countries cannot be explained by capital accumulation alone, even when a broad definition of capital is used. This finding points at the importance of technology, or Multi Factor

Productivity (MFP), as an explanatory factor. This suggestion follows earlier observations of Weitzman and Löfgren (1997) that the omission of technical progress from empirical net investment measures causes measures of net national product to understate future consumption. More research efforts are hence needed to improve some of the capital estimates and/or to introduce technology in the model.

Annex II. Preliminary indicators of the TFSD and their data availability for a selection of countries

In table II, the preliminary list of indicators that is proposed by the TFSD is provided. Also their data availability in the databases of the UN, OECD and Eurostat are provided.

Table II.1. The preliminary indicators of the TFSD and their availability in international databases

Theme	Sub-theme	Indicator	Data ava	
			UN	OECD
Subjective Well-being	Life satisfaction	Life satisfaction		
Consumption and income	Consumption	Final consumption expenditure	X	X
	Gross Domestic Product	Gross Domestic Product	X	X
	Productivity	Labour productivity		X
	Official Development Assistance	Official Development Assistance	X	X
	Imports from developing countries	Imports from developing countries	X	X
	Distribution-Income-Total	Income inequality		X
	Distribution-Income-Gender	Gender pay gap		X
Health	Life expectancy	Life expectancy at birth	X	X
	Healthy life expectancy	Healthy life expectancy at birth	X	
	Mental health	Suicide death rate		X
	Health expenditures	Health expenditures	X	X
	Smoking	Prevalence of tobacco use	X	
	Nutrition/Obesity	Proportion of obese people		X
	Distribution-Health	Place holder		
Housing	Housing stock	Place holder		
	Investments in housing	Place holder		
	Quality of housing	Living without housing deprivation		
	Housing affordability	Place holder		
	Distribution-Housing	Place holder		
Education	Educational attainment	Educational attainment level of adults	X	X
	Basic competencies	Scores (PISA)	X	X
	Education expenditures	Education expenditures		X
	Participation in education	Early school leavers	X	
	Life long learning	Life long learning		
	Distribution-Education	Place holder		
Leisure	Time use	Leisure time		
Labour	Employment rate	Employment rate	X	X
	Hours worked	Hours worked	X	X
	Retirement	Average exit age labour market		
	Distribution-Labour-Gender	Female employment rate	X	X
	Distribution-Labour-Age	Youth employment rate		
Physical safety	Crime	Death by assault/homicide rate	X	X
	Safety expenditures	Place holder		
Trust	Generalised trust	Generalised trust		
	Bridging social capital	Place holder		
	Family/Friends	Contact with friends/family		
	Voluntary work	Participation in voluntary work		
Institutions	Voter turnout	Voter turnout		
	Trust in institutions	Trust in institutions		
	Distribution-Institutions-Gender	Number of women in parliament	X	
Energy resources	Resources	Place holder		
	Consumption	Energy consumption	X	X
	Intensity/Productivity	Energy intensity	X	
	Renewable energy	Share of renewable energy	X	X
	Imports	Import of energy	X	X

	Energy dependence	Energy dependence		
Non-energy resources	Resources	Place holder		
	Consumption	Domestic Material Consumption		X
	Intensity/Productivity	Resource productivity		X
	Waste	Municipal waste generation	X	X
	Recycling	Waste recycling rate		
	Imports	Import of non-energy resources	X	X
Land and ecosystems	Land	Place holder		
	Protected areas	Protected areas	X	
	Soil quality	Nutrient balance		X
	Emissions to soil	Place holder		
	Species/Ecosystems	Bird index		
	Threatened species	Number of threatened species		X
	Footprint	Place holder		
Water	Resources	Water resources		X
	Abstraction	Water abstractions	X	
	Water quality	Place holder		
	Emissions to water	Place holder		
	Footprint	Place holder		
Air quality	PM concentration	Urban exposure to particulate matter	X	
	PM emissions	Emissions of particulate matter		X
	Ozone concentration	Urban exposure to ozone		
	Ozone emissions	Place holder		
	Acidifying emissions	Emission of acidifying substances	X	X
Climate	State of the climate	Global COX concentration		
	Historical COX-emissions	Place holder		
	GHG emissions	GHG-Emissions	X	X
	GHG intensity	GHG-Intensity		
	Footprint	Place holder		
	Carbon trade balance	Place holder		
	State of the ozone layer	State of the ozone layer		
	Ozone depleting emissions	CFC emissions		
Physical Capital	Capital stock	Capital stock		X
	Investment	Gross fixed capital formation	X	
	Exports	Exports of capital goods	X	X
Knowledge Capital	Capital stock	Place holder		
	R&D expenditures	R&D expenditures	X	X
	Knowledge spillovers	Knowledge spillovers		
Financial capital	Net assets/liabilities	Net foreign assets/liabilities		X
	Government debt	Government debt		X
	Deficit/Surplus	Current deficit/surplus	X	
	Pensions	Pension reserves		
Monetary aggregates	Economic and financial capital	*Place holder*		
	Natural capital	*Place holder*		
	Human capital	*Place holder*		
	Social capital	*Place holder*		

References

-ABS (Australian Bureau of Statistics), 2010. Measures of Australia's Progress: Is life in Australia getting better?

-Acemoglu, D., S. Johnson and J. Robinson (2004). 'Institutions as the Fundamental Cause of Long-Run Growth', *NBER Working Paper*, no. 10481

-Ahmad, N. and A. Wyckoff, 2003. *Carbon dioxide emissions embodied in international trade of goods*. OECD Science, Technology and Industry Working Papers, 2003/15, OECD Publishing.

-Alderfer, C.P. (1969). 'An empirical test of a new theory of human needs', *Organizational Behavior and Human Performance* 4 (2), pp. 142-175.

-Alesina, A. and E. La Ferrara (2002). 'Who Trusts Others?', *Journal of Public Economics* 85, 207-234.

-Andrews, F.M. and J.P. Robinson (1991). 'Measures of Subjective Well-Being', in: J.P. Robinson, P.R. Shaver and L.S. Wrightsman, red., *Measurement of Personality and Social Psychological Attitudes* (San Diego: Academic Press), pp. 61-114.

-Anielski, M. (2007). *The economic of happiness. Building Genuine Wealth* .

-Argyle, M. (1987). *The Psychology of Happiness* (London: Methuen)

-Ark, B. van (2002). 'Productiviteit, technologie and groei: een zaak van investeren?', *Tijdschrift voor Politieke Economie* 23 (3), pp. 3-21.

-Arrow, K. (2000). 'Observations on Social Capital', in: P. Dasgupta and I. Serageldin red., *Social Capital a Multi Faceted Perspective*

-Atkinson, G., S. Dietz and E. Neumayer (eds), 2007. *Handbook of Sustainable Development*. Edward Elgar, Cheltenham (UK), Northampton (US).

-Aulin-Ahmavaara P. (2004). 'Moving Human Capital Inside the Production Boundary' *Review of Income and Wealth* 50 (2), pp. 213-228 .

-Ayres, R.U. and A. Kneese (1969). 'Production, Consumption and Externality', *American Economic Reviewi.*

-Babiker, M.H., 2005. Climate change policy, market structure, and carbon leakage. *Journal of International Economics* 65 (2005) 421– 445

-Barro, R.J. (2001). 'Human Capital and Growth', *American Economic Review* 91 (2) pp. 12-17

-Barry, B. (1977). 'Justice Between Generations', in: P. Hacer and J. Raz, red., *Law, Morality and Society*

-Becker, G. (1964). *Human Capital* (New York: Colombia University Press)

-Becker, G. (1974). 'A Theory of Social Interactions', *Journal of Political Economy* 82(6), pp. 1063-1093.

-Becker, G. (1975). *Human Capital- A Theoretical and Empirical Analysis with Special Reference to Education* 2nd edition (New York: NBER)

-Becker, G. (1996). *Accounting for Tastes* (Cambridge-Ma: Harvard University Press)

-Berger-Schmitt, R. (2002). 'Considering Social Cohesion in Quality of Life Assessments: Concepts and Measurement', *Social Indicators Research* 58, 403-428

-Boehm-Bahwerk, E. von (1891). The Positive Theory of Capital

-van den Bergh, J.C.J.M., and H. Verbruggen (1999). "Spatial sustainability, trade and indicators: an evaluation of the 'ecological footprint'". *Ecological Economics* 29 (1): 63–74.

-Van den Bergh, J.C.J.M., 2009. The GDP Paradox. *Journal of Economic Psychology* 30 (2009) 117–135

-Bos, F., 2003. The National Accounts as a tool for analysis and policy; past, present and future. Phd Thesis. University of Twente.

-Botzen, W.J.W., J.M. Gowdy and J.C.J.M. van den Bergh. Cumulative CO2 emissions: shifting international responsibilities for climate debt. *Climate policy*, vol 8(2008), pp 569-576.

Bourdieu, P. (1986). 'The Forms of Capital', in: S. Baron, J. Field and T. Schuller, red., *Social Capital-Critical Perspectives*

-Bowles, S. (1998).'Endogenous Preferences: The Cultural Consequences of Markets and Other Economic Institutions', *Journal of Economic Literature* 36, pp. 75-111.

-Bradburn, N.M. (1969). *The Structure of Psycological Well-Being* (Chicago: Adin)

-Brickman,P. and D.T. Campbell (1971). 'Hedonic relativism and Planning the Good Society', in: M.H. Apley, red., *Adaptation-Level Theory: A Symposion* (New York: Academic Press), pp. 287-302.

-Bruni, L. and P.L. Porta (2005). *Economics and Happiness. Framing the Analysis* (Oxford: Oxford University Press)

-Buss, D.M. (1996).'The Evolutionary Psychology of Human Strategies', in: E.T. Higgins and A.W. Kruglansi, red., *Social Psychology: Handbook of Basic Principles* (New York: Guilford Press), pp. 3-38

-Carson, R., 1962. Silent Spring. Houghton Mifflin

-Cavea, L.A., G.C. Blomquist, 2008. Environmental policy in the European Union: Fostering the development of pollution havens? *Ecological economics* 65 (2008) 253–261

-CBS, 2011. *Green growth in the Netherlands*, Statistics Netherlands, The Hague/ Heerlen.

-CBS/CPB/PBL/SCP, 2009. *Sustainability monitor for the Netherlands 2009*.

-CBS/CPB/PBL/SCP, 2011. *Sustainability monitor for the Netherlands 2011*.

-CES (2009).*WGSSD Report. Measuring Sustainable Development*. United Nations Economic Commissionm for Europe in cooperation with the Organisation for Economic Co-operation and Development and the Statistical Office of the European Communities (Eurostat).

-Charness, G. and B. Grosskopf (2001). 'Relative Payoffs and Happiness: An Experimental Study', *Journa of Economic Behaviour Org* 45 (3) 301-328.

-Chen, 2009. Does a regional greenhouse gas policy make sense? A case study of carbon leakage and emissions spillover. Energy Economics.

-Coase, R. (1960). 'The Problem of Social Costs', *Journal of Law and Economics*.

-Cole, M.A., 2004. Trade, the pollution haven hypothesis and the environmental Kuznets curve: examining the linkages. *Ecological Economics* 48 (2004) 71– 81

-Coleman, J. (1988). 'Social Capital in the Creation of Human Capital', *American Journal of Sociology* 94, 95-121.

-Coleman, J. (1990). *The Foundations of Social Theory*

-Conference of European Statisticians (CES) (2008), *Statistics for Sustainable Development Commonalities between Current Practice and Theory*, Report of the Joint UNECE/OECD/Eurostat Working Group on Statistics for Sustainable Development, ECE/CES/2008/29, Geneva.

-Copeland, B.R. and M.S. Taylor, 2005. Free trade and global warming: a trade theory view of the Kyoto protocol. *Journal of Environmental Economics and Management* 49 (2005) 205–234

-Corrado, Carol A., Hulten, Charles R. and Sichel, Daniel E., Intangible Capital and Economic Growth (January 2006). NBER Working Paper Series, Vol. w11948, pp. - , 2006.

-Cote S. and T. Healy (2001). The Well-Being of Nations. The Role of Human and Social Capital

-Daly, H. (1980). *Economics, Ecology, Ethics: Essays Towards a Steady-State Economy*

-Daly H. and J.B. Cobb (1989). *For the Common Good: Redirecting the Economy Toward Community, the Environment and a Sustainable Future*

-Dam, L., B. Scholtens. Environmental regulation and MNEs location: Does CSR matter? *Ecological economics* 67 (2008) 55–6 5

-Darity, W. and A.H. Goldsmith (1996). 'Social Psychology, Unemployment and Macro-economics', *Journal of Economic Perspectives* 10 (1), pp. 121-140.

-Dasgupta, P. and G.M. Heal (1974). 'The Optimal Depletion of Exhaustible Resources', *Review of Economic Studies*, pp. 3-28.

-Dasgupta, P. and I. Serageldin (red) (2000). *Social Capital: A Multifaceted Perspective*.

-Dasgupta, P. (2000). 'Economic Progress and the Idea of Social Capital", in: P. Dasgupta and I. Serageldin, red., *Social Capital: A Multifaceted Perspective*.

-Dasgupta, P. (2002). *Social Capital and Economic Performance: Analytics* (http://www.econ.cam.ac.uk/faculty/dasgupta/soccap.pdf)

-Deci, R.M. and E.L. Ryan (2001). 'On Happiness and Human Potentials: A Review of Research on Hedonic and Eudaimonic Well-Being', *Annual review of Psychology* 52, pp. 141-166.

-DEFRA (Department for Environmental, Food and Agriculture), 2010. Measuring progress: Sustainable development indicators

-DeNeve, K.M. and H. Cooper (1998). 'The Happy Personality: A Meta Analysis of 137 Personality Traits and Subjective Well-Being', *Psychological Bulletin,* 124 (2), pp. 197-229.

-Denison, E. (1953).'Theoretical Aspects of Quality Change, Capital Consumption and Net Capital Formation', *Problems of Capital Formation, Studies in Income and Wealth* 19, pp. 215-261.

-Diener, E. (1984). 'Subjective Well-Being', *Psychological Bulletin* 95 (3), pp. 542-575.

-Diener. E., M. Diener and C. Diener (1995). 'Factors Predicting the Subjective Well-Being of Nations', *Journal Personality Social Psychology* 69 (5), pp. 851-864.

-Diener, E. and S. Oishi (2000).'Money and Happiness: Income and Subjective Well-Being Across Nations', in: E. Diener and E.M.Suh, red., *Culture and Subjective Well-Being* (Cambridge: MIT Press), pp. 185-218.

-Diener, E., E.M. Suh, R.E. Lucas and H.L. Smith (1999). 'Subjective Well-Being: Three Decades of Progress', *Psychology Bulletin* 125 (2), pp. 276-303.

-Diener,E. and M.E.P. Seligman (2003). 'Beyond Money: Toward an Economy of Well-Being', *Psychological Science in the Public Interest* 51, pp. 1-31.

-Durlauf, S. and M. Fafchamps (2004). 'Social capital', *NBER Working Paper Series 10485*.

-Easterlin, R.A. (2001). 'Income and Happiness: Towards a Unified Theory', *Economic Journal* 111 (473), pp. 465-484.

-Edwards B. and M.W. Foley (1998). Social capital and civil society beyond Putnam. In: *American Behavioral Scientist* 42/1

-Ehrhart, J.J., W.E. Saris and R. Veenhoven (2000). 'Stability of Life Satisfaction over Time', *Journal of Happiness Studies* 1 (2), pp. 177-205.

-Ehrlich, P., 1968. *The Population Bomb*. A Sierra Club-Ballantine Book, N.Y.

-Elster, J. (1998). 'Emotions and Economic Theory', *Journal of Economic Literature* 36 (1), pp. 41-74.

-Eurostat, 2009. Sustainable development in the European Union 2009 monitoring report of the EU sustainable development strategy.

-Evans, P. (1996). 'Government action, Social Capital and Development: Reviewing the Evidence on Synergy', *World Development* 24 (6), 1119-1132

-Fæhn and Bruvoll, 2009. Richer and cleaner—At others' expense? Resource and Energy Economics 31 (2009) 103–122

-Ferrer-i-Carbonell, A. (2002). 'Income and Well-Being: An Empirical analysis of the Comparison Income Effect', Tinbergen Institute Discussion Paper no 19.1 (Amsterdam)

-Fordyce, M.A. (1998). 'A Review of Research on Happiness Measures: A Sixty Second Index of Happiness and Mental Health', *Social Indicators Research* 20, pp. 355-381.

-Freeman, R. (1978). 'Job Satisfaction as an Economic Variable', *American Economic Review* 74, pp. 549-571

-Frey, B.(1997). *Not Just for the Money* (Cheltenham and Brookfield-VT: Edward Elgar).

-Frey, B.S. and A. Stutzer (2000). 'Happiness, Economy and Institutions', *Economic Journal* 110(446), pp. 918-938

-Frey, B.S. and A. Stutzer (2002a). 'What Can Economists Learn from Happiness Research?', *Journal of Economic Literature* vol. XL, pp. 402-435.

-Frey, B.S. and A. Stutzer (2002b). *Happiness and Economics: How the Economy and Institutions Affect Human Well-Being* (Princeton: Princeton University Press)

-FSOG (Federal Statistical Office of Germany), 2010. Sustainable Development in Germany. Indicator Report 2010, Statistisches Bundesamt, Wiesbaden 2010

-FSOS (Federal Statistical office of Switzerland), 2009. Sustainable Development. Pocket Statistics 2009. In conjunction with Federal Office for Spatial Development; Federal Office for the Environment; Swiss Agency for Development and Cooperation.

-Fukuyama, F. (1995). *Trust: The Social Values and the Creation of Prosperity*

-Fukuyama, F. (2000). 'Social Capital and Civil Society' *IMF Working Paper* WP/00/74.

-GAO (United States Government Accountability Office), 2011. Key indicator systems: Experiences of other national and sub national systems offer insights for the United States. GAO-11-396.

-Gardner, J. and A. Oswald (2001). 'Does Money Buy Happiness? A Longitudinal Study Using Data on Windfalls'(mimeo, University of Warwick)

-GCEE/CAE (German Council of Economic Experts/Conseil d'Analyse Économique), 2010. Monitoring economic performance, quality of life and sustainability. German council of economic experts, Conseil d'analyse économique. Joint report as requested by the Franco-German Ministerial council December 2010

-Gitell, R. and A. Vidal (1998) *Community Organizing: Building Social Capital as a Development Strategy.*

-Goldin C. and L. Katz (1999), 'Human Capital and Social Capital: The Rise of Secondary Schooling in America. 1910 to 1940', *Journal of Interdisciplinary History* 29, 683-723.

-Granovetter, M. (1973). 'The Strength of Weak Ties', *American Journal of Sociology* 78 (6) 1360-1380.

-Granovetter, M. (1975). *Getting a Job: A Study of Contacts and Careers*

-Granovetter, M. (1985). 'Economic Action and Social Structure: The Problem of Embededness', *American Journal of* Sociology 91 (3), 481-510.l

-Grootaert, C. (1997). 'Social Capital: The Missing Link?', in: *Expanding the Measure of Welath: Indicators of Environmentally Sustainable Development*

-Grootaert, C. and T. Van Bastelaer (2001). 'Understanding and Measuring Social Capital: A Synthesis of Findings and Recommendations from the Social Capital Initiative', *Social Capital Initiative Working Paper* 24

-Haan M. de and S. Keuning (1996). 'Taking the Environment into Account: The NAMEA Approach' *Review of Income and Wealth* 42(2), pp. 131-148.

-De Haan, M., 2004, Accounting for goods and for bads: measuring environmental

pressure in a national accounts framework; Statistics Netherlands.

-Hagerty, M.R. and R. Veenhoven (2003). 'Wealth and Happiness revisited-Growing National Income *Does* go with Greater Happiness, *Social Indicators Research* 64, pp. 1-27.

-Hagerty, M.R. (2000). 'Social Comparisons of Income in One's Community: Evidence from National Surveys of Income and Happiness', *Journal of Personality and Social Psychology* 78 (4), pp. 764-771.

-Halpern, D. (1999). 'Social Capital: The New Golden Goose', unpublished research memorandum

-Halpern, D. (2001). 'Moral Values, Social Trust and Inequality. Can Values Explain Crime?', *British Journal Criminology* 41, 236-251.

-Hamermesh, D.S. and G.A. Pfann (2005). 'Time use data in economics', *European Economic Review* vol 49, pp. 1-7.

-Hamilton, K. and G. Ruta, *Measuring Social Welfare and Sustainability*, working paper no. 4, WGSSD, Luxemburg, 3-4 april 2006.

-Hardin, G. (1968). 'The Tragedy of the Commons', *Science*

-Hartwick, J.M. (1977). 'Intergenerational Equity and the Investing of Rents from Exhaustible Resources', *American Economic Review* 66, pp. 972-974.

-Hartwick, J.M. (1990). 'National Accounting and Economic Depreciation', *Journal of Public Economics* 43, pp. 291-304.

-Heady, B. and A. Wearing (1991).'Subjective Well-Being: A Stocks and Flows Framework', in: F. Strack, M. Argyle and N. Schwartz, red., (1991). *Subjective Well-Being: An Interdisciplinary Perspective* (Oxford: Pergamom Press)

-Healy T. (2001). 'Health Promotion and Social Capital', *Conference on International Evidence for the Impact of Social Capital on Well Being.*

-Heertje, A. (2006) *Echte economie. Een verhandeling over schaarste en welvaart en over het geloof in leermeesters en lernen*.

-Helliwel. J.F. (2001). 'How's Life? Combining Individual and National Variables to Explain Subjective Well-Being' (mimeo, University of British Columbia)

-Hennipman, P. (1977). *Welvaartstheorie and Economische Politiek* (Alphen aan de Rijn: Samson). Translated and published in 1995: *Welfare economics and the theory of economic policy*.

-Hicks, J.R. (1939). *Value and Capital*

-Hicks, J.R. (1939a). 'The Foundations of Welfare Economics', *Economic Journal* (49), pp. 696-712.

-Hirsch, F. (1976). *The Social Limits to Growth* (Cambridge-MA: Harvard University Press)

-Hoekstra, R., J.P. Smits and T. de Jonge. The Stiglitz-Sen-Fitoussi report: Comments by Statistics Netherlands. Statistics Netherlands. 2010-129-KOO

-Hueting, R. 1974. *Nieuwe schaarste en economische groei*.

-ICSD (Interministerial Committee for Sustainable Development), 2010. National sustainable development strategy 2010-2013 : Towards a green and fair economy, 10 mars 2011, Commissariat general au developpement durable

-Inglehart, R. (1999). 'Trust, Well-Being and Democracy", in: M.E. Warren, red., *Democracy and Trust* (Cambridge-UK: Cambridge University Press), pp. 88-120.

-Ingelehart, R. et al (2000). *World Values Surveys and European Values Surveys*, 1981-1984, 1990-1993, 1995-1997 (Ann Arbor: Institute for Social Research).

-Jorgenson, D. and B. M. Fraumeni (1995). 'The Accumulation of Human and Nonhuman Capital', in: R.E. Lipsey and H.S. Tice, red., *The Measurement of Savings, Investment and Wealth* 52 (Chicago-Il: Chicago University Press)

-Jorgenson, D. (2005). 'Accounting for Growth in the Information Age', in: P. Aghion and S. Durlauf red., *Handbook of Economic Growth* vol. 1A (Amsterdam: North-Holland).

-Kahneman, D., E. Diener and N. Schwarz, red.(1999). *Well-Being: The Foundations of Hedonic Psychology* (New York: Russel Sage Foundation).

-Kahneman D. (1999). 'Objective Happiness', in: D. Kahneman, E. Diener and N. Schwarz, red.(1999). *Well-Being: The Foundations of Hedonic Psychology* (New York: Russel Sage Foundation), pp. 3-25.

-Kahneman, D., P.P. Wakker and R. Sarin (1997). 'Back to Bentham? Explorations of Experienced Utility', *Quarterly Journal of Economics* 112 (2), pp. 375-405.

-Kasser, T. and R.M. Ryan (2001). 'Be Careful What You Wish For: Optimal Functioning and the Relative Attainment of Intrinsic and Extrinsic Goals",, in: P. Schmuck and K.M. Shledon, red. *Life Goals and Well-Being: Towards a Positive Psychology of Human Striving* (Krikland-WA: Hogrefe and Huber),, pp. 116-131.

-Kenny, Ch. (1999). 'Does Growth Cause Happiness, or Does Happiness Cause Growth?', *Kyklos* 52 (1), pp.3-26.

-van der Kerk, G., 2008. A comprehensive index for a sustainable society: The SSI – the sustainable society index. Ecological Economics, pp. 228-242.

-van der Kerk, G. 2010. Short survey of relevant indexes and sets of indicators concerning development towards sustainability, Survey for AMSDE, Annual Meeting of Sustainable Development Experts of the OECD, on behalf of ANPED, 5 February 2010.

-Kitayama, S. and H.R. Marus, 'The Pursuit of Happiness and the Realization of Sympathy: Cultural Patterns of Self, Social Relations, and Well-Being', in: E. Diener and E.M. Suh, red., *Culture and Subjective Well-Being* (Cambridge-Ma: MIT Press)

-Knack, S. and P. Keefer (1997). 'Does Social Capital Have an Economic Impact? A Cross-Country Investigation', *Quarterly Journal of Economics* 112, 1252-1288.

-Kulig, A., H. Kolfoort and R. Hoekstra, 'The case for the hybrid capital approach for the measurement of welfare and sustainability', *Ecological Indicators* (29 augustus 2009)

-Kumar, P. (ed), 2010. *The economics of ecosystems and biodiversity: Ecological and economic foundations*. Earthscan.

-Kunte, A., K. Hamilton, J. Dixon and M. Clemens (1998). 'Estimating National Wealth: Methodology and Results' *Environmental Department Papers* 57.

-Lane, R.E. (2000). *The Loss of Happiness in Market Economies* (New Haven and Londen : Yale University Press).

-LaPorta, R., F. Lopez-de-Silanes, A. Schleifer and R. Vishny (1997). 'Trust in Large Organizations', *American Economic Review* 87, 333-338.

-Layard, R. (1980).'Human Satisfactions and Public Policy', *Economic Journal* 90 (363), pp. 737-750.

-Layard, R. (2011). *Happiness: Lessons from a new science*.

-Lenglart, F., C. Lesieur, J-L Pasquier, 2010. CO2 emissions from the economic circuit in France. *French Economy*.

-Lenzen, M. and J. Murray, 2010. Conceptualising environmental responsibility. *Ecological Economics*. Vol. 70. pp. 261-270.

-Lenzen, M., K. Kanemoto, A. Geschke, D. Moran, P. Muñoz, J. Ugon, R. Wood and T. Yu, 2010. A global multi-region input-output time series at high country and sector detail. 18th International Input-Output Conference, Sydney, Australia.

-Lewin, S.B. (1996). 'Economics and Psychology: Lessons for Our Own Day from the Eary Twentieth Century', *Journalof Economic Literature* 34 (3), pp.1292-1323

-Lucas, R.E., A.E. Clark, Y. Georgellis and E. Diener (2002). 'Unemployment Alter the Set-Point for Life Satisfaction', working Paper 2002/17 (Parijs: Delta)

-Lin, N. (2001). *Social Capital. A Theory of Social Structure and Action*.

-Lin N., K. Cook and R.S.Burt, red. (2001). *Social Capital: Theory and Research*

-Lind, R. red. (1986). *Discounting for Time and Risk in Energy Policy*

-Lindenberg, S. (1989). 'Social Production Functions, Deficits and Social Revolutions: Pre Revolutionary France and Russia', *Rationality and Society* 1, 51-77.

-Lintott, J., 1996. Environmental accounting: useful to whom and for what? Ecological Economics. Vol. 16, pp. 179-190.

-Lomas, J. (1998). 'Social Capital and Health: Implications for Public Health and Epidemiology', *Social Science and Medicine* 47(9), 1181-1188.

-Lucas, R.E. and E. Diener (2000). 'Explaining Differences in Societal Levels of Happiness: Relative Standards, Need Fulfillment, Culture and Evaluation Theory', *Journal of Happiness Studies* 1, pp. 41-78.

-Maddison, A. (2001). *The World Economy. A millenial perspective*.

-Mankiw N.G., D. Romer and D.N. Weil (1992). 'A Contribution to the Empirics of Economic Growth', *Quarterly Journal of Economics* vol. 107-2, 407-437.

-Margolis, H. (1982). *Selfishness, Altruism and Rationality: A Theory of Social Choice* (Cambrdige: Cambridge University Press)

-Maslow, A. (1943). 'A theory of human motivation', in: *Psychological review* 50 (4), pp. 370-396.

-Meadows, D.H., D.L. Meadows, J. Randers and W.W. Behrens (1972). *The Limits to Growth*

-Meadows, D.H., D.L. Meadows and J. Randers (1992). *Beyond the Limits: Global Collapse or a Sustainable Future?*

-Mebratu, D., 1998. Sustainability and sustainable development: Historical and conceptual review. *Environmental Impact Assessment Review*. Vol. 18, pp. 493-520.

-Michida, E. K. Nishikimi, 2007. North–South trade and industry-specific pollutants. Journal of Environmental Economics and Management 54 (2007) 229–243

-Michalos, A.C., B.D. Zumbo and A. Hubley (2000). 'Health and the Quality of Life', *Social Indicators Research* 51, pp. 245-286.

-Nakano, S., A. Okamura, N. Sakurai, M. Suzuki, Y. Tojo and N. Yamano, 2009. *The measurement of CO_2 embodiments in international trade: Evidence from the harmonised input-output and bilateral trade database*. OECD Science, Technology and Industry Working Papers, 2009/3, OECD Publishing.

-Narayan, D. (1999). 'Bonds and Bridges: Social Capital and Poverty', *Policy Research Working Paper 2167*. Poverty Reduction and Economic Management Network (World Bank)

-Narayan, D. and L. Pritchett (1999). 'Cents and Sociability: Household Income and Social Capital in Rural Tanzania', *Economic Development and Cultural Change* 47 (4), 871-897.

-New Economics Foundation (NEF). *National accounts for wellbeing.*

-Ng Y.-K. (1996). 'Happiness Surveys: Some Comparability Issues and Exploratory Survey Based on Just Perceivable Increments', *Social Indicators Research* 38 (1), pp. 1-27.

-Ng Y.-K. (2001). 'From Preference to Happiness: Towards a More Complete Welfare Economics' (mimeo, Monash University)

-North, D. (1990). *Institutions, Institutional Change and Economic Performance*.

-Nussbaum, M. (1986/20010. *The Fragility of Goodness: Luck and ethics in Greek Tragedy and Philosophy* (Cambridge: Cambridge University Press)

-OECD (2001). *Measuring Capital – Measurement of capital stocks, consumption of fixed capital and capital services*. OECD manual.

-OECD, 2009. *A framework for measuring the progress of societies*.

-Offer, A. (2003). 'Economic Welfare Measurements and Human Well-Being', in: P.A. David and M. Thomas, red., *The Economic Future in Historical Perspective* (Oxford: Oxford University Press)

-Ogburn, W.F. (1935). 'Indexes of Social Trends and Their Fluctuations', *American Journal of Sociology* 40, pp. 822-828.

-Olson, M. and M. Bailey (1981). 'Positive Time Preference', *Journal of Political Economy*

-Olson, M. (1982). *The Rise and Decline of Nations: Economic Growth, Stagflation and Social Rigidities*.

-Ormel J., N. Steverink, N. von Korff and S.M. Lindenberg (1997). 'Quality of Life and Social Production Functions; A Framework for Understanding Health Effects', *Social Science and Medicine* 45, 1051-1063.

-Ostrom, E. and T. Ahn (2001). 'A Social Science Perspective on Social Capital: Social Capital and Collective Action', *Workshop in Political Theory and Policy Analysis*.

-Oswald, A.J. (1997). 'Happiness and Economic Performance', *Economic Journal* 107 (445), pp.1815-1831.

-Peters, G. P., 2008. From production-based to consumption-based national emission inventories. Ecological economics 65 (2008) 13–23

-Portes, A. (1998a). 'Social Capital: Its Origins and Applications in Modern Sociology' *Annual Review of Sociology* 24, 1-24.

-Portes A. and P. Landolt (1996). 'The Downside of Social Capital', *The American Prospect* 26, 18-21.

-Pigou, A.C. (1932). *The Economics of Welfare* (London: MacMillan)

-Praag, B.M.S. (1968). *Individual Welfare Functions and Consumer Behavior: A Theory of Rational Irrationality* (Amsterdam: North Holland Publishing Company)

-Praag B.M.S. van and A. Kapteyn (1973). 'Further Evidence on the Individual Welfare Function of Income: An Empirical Investigation in the Netherlands', *European Economic Review* 4 (1), pp. 33-62.

-Praag, B.M.S. van (1991). 'Ordinal and Cardinal Utility. An Integration of the Two Dimensions of Welfare Concept', *Journal of Econometrics* 50, pp. 69-89.

-Praag, B.M.S. van (1993). 'The Relativity of the Welfare Concept' in: M. Nussbaum and A. Sen red., *The Quality of Life* (Oxford: Clarendon), pp. 362-416

-Praag, B.M.S. van and P. Frijters (1999). ' The Measurement of Welfare and Well-Being: The Leyden Approach', in: Kahneman, D., E. Diener and N. Schwarz, red.(1999). *Well-Being: The Foundations of Hedonic Psychology* (New York: Russel Sage Foundation), pp. 413-433.

-Praag, B.M.S. van, P. Frijters and A. Ferrer-i-Carbonell (2003). 'The Anatomy of Subjective Well-Being', *Journal of Economic Behavior and Organization* 51 (1), pp. 29-49.

-Putnam R. (1993). 'The Prosperous Community-Social Capital and Public Life', *American Prospect* 13, 35-42.

-Putnam, R., R. Leonardi and R. Nanetti (1993). *Making Democracy Work: Civic Traditions in Modern Italy*

-Putnam, R. (1995). 'Bowling Alone: America's Declining Social Capital', *Journal of Democracy* 6(1): 65-78.

-Putnam, R. (2000). *Bowling Alone: The Collapse and Revival of American Community*.

Quesnay, F. (1766), 'Analyse du Tableau Économique', *Journal d'Agriculture*, *du commerce et des finance*.

-Quibria, M.G. (2003). 'The Puzzle of Social Capital: A Critical Review', *Asian Development Bank, ERD Working Paper Series, no. 40.*

-Ravalion M. and M. Lokshin (2001). 'Identifying Welfare Effects from Subjective Questions', *Economica* 68 9271) pp. 335-357.

-Rees, W. E. and M. Wackernagel (1994) Ecological footprints and appropriated carrying capacity: Measuring the natural capital requirements of the human economy, in Jansson, A. et al.. *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Washington D.C.:Island Press. ISBN 1-55963-316-6

-Rockström, J. et al, 2009. A safe operating space for humanity. *Nature* Vol 46 (24 setember 2009) pp 472-475.

-Romer P. (1986). 'Increasing Returns and Long-Run Growth', *Journal of Political Economy* 94-5, 1002-1037.

-Romer, P. (1994). 'The Origins of Endogenous Growth', *Journal of Economic Perspectives* 8-1, 3-22.

-Rosenfeld, E. (1997). *Social Support and Health Status: A Literature Review*

-Ryan R.M. and E.L. Deci (2001). 'To Be Happy or To Be Self-Fulfilled: A Review Research on Hedonic and Eudaimonic Well-Being', *Annual Review of Psychology* 52, pp. 141-166.

-Ryff, C.D. (1995). 'Psychological Well-Being in Adult Life', *Current Directory of Psychological Science* 4, pp. 99-104.

-Schwarz, N. and F. Strack (1999). 'Reports of Subjective Well-Being: Judgmental Processes and Their Methodological Implications', in: D. Kahneman, E. Diener and N. Schwarz, red.(1999). *Well-Being: The Foundations of Hedonic Psychology* (New York: Russel Sage Foundation), pp. 61-84.

-Scitovsky, T. (1976). *The Joyless Economy: An Inquiry into Human Satisfaction and Dissatisfaction* (Oxford: Oxford University Press)

-Scitovsky, T. (1996). 'My Own Criticism of the *Joyless Economy*', *Critical Review* 10, pp. 595-605.

-SEEA, 2003. 'Integrated Environmental and Economic Accounting 2003'. Final draft circulated for information prior to official editing

-Seidl, C.(1994). 'How Sensible is the Leyden Individual Welfare Function of Income?', *European Economic Review* 38 (8), pp. 1633-1659.

-Seligman, A.B. (1992). *The idea of civil society*

-Seligman, A.B. (1997)*The problem of trust*

-Sen, A.K. (1977). 'Rational Fools', *Philosophy and Public Affairs* 6, pp. 317-344.

-Sen, A.K. (1993). *Capability and Well-Being*, in: M. Nussbaum and A. Sen, red., *The Quality of Life* (Oxford: Clarendon Press)

-Sen, A.K. (1995). 'Rationality and Social Choice', *American Economic Review* 85(1), pp. 1-24.

-Sen, A.K. (1996). 'Rationality, Joy and Freedom', *Critical Review* 10, pp. 481-494.

-Sen, A.K. (2000). *Development as Freedom* (New York: A. Alfred Knopp)

-Sen, A.K. (2002). *Rationality and Freedom* (Cambridge-Ma: Belknap Press of Harvard University)

-Serageldin, I. (1996). 'Sustainability as Opportunity and the Problem of Social Capital' *Brown Journal of World Affairs* 3(2): 187-203

-Smith, A. (1984/1759). *The Theory of Moral Sentiments* (red. D.D. Raphael and A.L. Macfie) (Indianapolis: Liberty Fund)

-Smith, A. (1904/1776). *An Inquiry into the Nature and the Causes of the Wealth of Nations*, 2 delen (Londen: Methuen)

-Smith, R.H., E. Diener and D.H. Wedell (1989). 'Intrapersonal and Social Comparison Determinants of Happiness: A Range-Frequency Analysis' *Journal of Personality and Social Psychology* 56 (3), pp. 317-325.

-Smits, J.P. (2007). 'Capital and Sustainability: Some Thoughts on the Operationalisation of Social Capital', Written comments on the draft report (dated October 26th 2007) of the WGSSD

-Soete, L. and Ch. Freeman (1997). *The Economics of Industrial Innovation*.

-Solow, R.M. (1956). 'A Contribution to the Theory of Economic Growth', *Quarterly Journal of Economics* vol. 70, 65-94.

-Solow, R. (1974). 'The Economics of Resources and the Resources of Economics', *American Economic Review*

-Solow, R. (1974a). 'Intergenerational Equity and Exhaustible Resources', *Review of Economic Studies*.

-Solow, R. (1986). 'On the Intergenerational Allocation of Natural Resources', *Scandinavian Journal of Economics* 88, pp. 141-149.

-Statistics New Zealand (2009). Measuring New Zealand's Progress Using a Sustainable Development Approach: 2008. Wellington: Statistics New Zealand

-Stigler, G. and G. Becker (1977). 'De Gustibus Non Est Disputandum', *American Economic Review* 67 (1), pp. 76-90.

-Stiglitz, J.E., A. Sen and J.-P. Fitoussi, *Report by the Commission on the Measurement of Economic Performance and Social Progress* (Parijs 2009)

-Stutzer, A. (2004). 'The Role of Income Aspirations in Individual Happiness', *Journal of Economic Behavior and Organization* 54 (1), pp. 89-109.

-Sugden, R. (1993). 'Welfare, Resources and Capabilities: A Review of Inequality Reexamined by Amartya Sen', *Journal of Economic Literature* 31, pp. 1947-1962.

-Teachman, J.D., K. Paasch & K. Carver (1997). 'Social Capital and the Generation of Human Capital', *Social Forces* 75-4, 1343-1359.

-Tinbergen, J. and R. Hueting (1992). 'GNP and Market Prices: Wrong Signals for Sustainable Economic Success that Mask Environment Destruction', in: -Goodland, R., H. Daly, S. El Serafy and B. von Droste red. (1992). *Environmentally Sustainable Economic Development: Building on Brundtland*, pp. 51-57.

-Tversky, A. and D. Griffin (1991). 'Endowments and Contracts in Judgments of Well-Being', in: R.J. Zechauser, red., *Strategy and Choice* (Cambridge-Ma and Londen: MIT Press), pp. 297-318

-UN (United Nations), 2007. Indicators of Sustainable Development: Guidelines and Methodologies Third Edition, October 2007, United Nations, New York

UN, 2008. *The System of National Accounts*.

-Uslaner, E. (1999). 'Democracy and Social Capital', in: M. Warren, red., *Democracy and Trust*, hoofstuk 5.

-Van Bruggen, A. (2001). *Individual Production Function of Social Well-Being: An Explanatory Study*

-Van der Gaag M. and T. Snijders (2004). 'Proposals for the Measurement of Individual Social Capital', in: H. Flap and B. Voelker, red. *Creation and Returns of Social Capital. A New Research Program*, 199-218

-Van der Gaag M. and Snijders T. (2004a). 'The Resource Generator: Social Capital Quantification with Concrete Items'

-Van der Ploeg, F., 2011. Natural Resources: Cruse or Blessing. Journal of Economic Literature, Vol 49, No. 2, pp. 366-420.

-Van Rooijen-Horsten, M., D. van den Bergen and M. Tanriseven (2008). Intangible capital in the Netherlands: A benchmark. Statistics Netherlands Discussion paper (08001)

-Van Schuur W.H. and H.A.L. Kiers, 'Why Factor Analysis Often is the Incorrect Mode for Analyzing Bipolar Concepts and What Model to Use Instead', *Applied Psychological Measurement* 18, 97-110.

-Veenhoven R. (1993). *Happiness in Nations: Subjective Appreciation of Life in 56 Nations 1946-1992* (Rotterdam: Erasmus University Press).

-Veenhoven R. (1996). 'Happy Life-Expectancy. A Comprehensive Quality-of-Life in Nations', *Social Indicators Research* 39, 1-58

-Veenhoven, R. (2000a). 'The Four Qualities of Life. Ordering Concepts and Measures of the Good Life, *Journal of Happiness Studies* 1, 1-39

-Veenhoven, R. (2000b. 'Freedom and Happiness: A Comparative Study in Forty-four Nations in the Early 1990s', in: E. Diener and E.M. Suh red. *Culture and Subjective Well-Being* (Cambridge-MA: MIT Press), pp. 257-288.

-WDH (2003). 'World Database of happiness: Continuous Register of Research on Subjective Appreciation of Life', Erasmus Universiteit, Rotterdam, www.eur.nl/fsw/research/happiness

-WGSSD report, see: CES (2009).

-Wiedmann, T., H.C. Wilting, M. Lenzen, S. Lutter and V. Palm, 2011. Quo vadis MRIO? Methodological, data and institutional requirements for multi-region input-output anlaysis. Ecological Economics. Vol. 70, pp. 1937-1945.

-Woolcock, M., 2001. 'The place of social capital in Understanding Social and Economic

Outcomes'*, ISUMA Canadian Journal of Policy Research*, 2 (1), 11-17.

-World Bank, 1997. 'Measuring the Wealth of Nations', in: *Expanding the Measure of Wealth: Indicators of Environmental Sustainable Development*.

-World Bank, 2003. *World Development Report 2003: Sustainable Development in a Dynamic World*, The World Bank: Washington DC

-World Bank, 2006. *'Where is the Wealth of Nations?*', The World Bank, Washington D.C.

-World Bank, 2011. The changing wealth of nations: Measuring sustainable development in the new millennium. Washington, United States.

-Woolcock M. (1998). 'Social Capital and Economic Development: Towards a Theoretical Synthesis and Poicy Framework', *Theory and Society* 27: 151-208.

-WWF (World Wildlife Fund), 2010. *The Living Planet report. Biodiversity, biocapacity and development*.

-World Commission on Environment and Development (1987). *Our Common Future*

-Yang, K. (2007). 'Individual Social Capital and Its Measurement in Social Surveys', *Survey Research Methods* 1, 19-27.

-Zajonc, R.B.(1980). 'Feeling and Thinking: Preference Needs no Interference', *American Psychologist* 35, pp. 151-175.

-Zak, P. and S. Knack (2001). 'Trust and Growth', *Economic Journal* 111, 295-321.