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EVALUATING THE MULTIDIMENSIONALITY OF COMPOSITE INDICATORS OF DEVELOPMENT – SOME RECENT INDEX PROPOSALS

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Abstract

Development is a complex and multidimensional phenomenon. The quantification of such a phenomenon requires indicators that may capture its most relevant components. In this paper, we present an extensive list of composite indicators of development and assess whether these indicators reflect the multidimensionality underlying the phenomenon they seek to measure. One of the major findings from this analysis is the limited number of development dimensions incorporated in the majority of the indices and, thus, the partial vision of the phenomenon they provide as a result. Moreover, the dimensions most commonly considered in this context are education and health. Finally, we discuss in more detail five recent indices characterized by its comprehensiveness: (i) Regional Quality of Development Index (QUARS) of Sbilanci-amoci (2006); (ii) Wellbeing Index (WI) and Wellbeing/Stress Index (WSI) of Prescott-Allen (2001); (iii) Gross National Happiness (GNH) of the Centre for Bhutanese Studies; (iv) Bertelsmann Transformation Index (BTI) of Bertelsmann Stiftung (2008); (v) World competitiveness scoreboard of IMD (2008).

Key Words: development; composite indicators; measurement; multidimensionality.

1. Introduction

One of the most important messages emerging from the literature on development economics in recent years is about the complexity and multidimensionality of the concept of development. This makes it especially difficult for income per capita – the reference indicator for ranking countries at different levels of development – to provide, by itself, a sufficient indication of the disparities that exist between countries and over time. In this context, and mainly since the 1990s, the emergence of a wide range of composite indicators of development comes as no surprise (Booyesen, 2002; Saisana, 2008). The Human Development Index (HDI) is the most internationally known initiative attempting to overcome the narrow focus on income per capita.

The present paper seeks to present a broad set of composite indicators of development, highlighting the dimensions covered in each of the indices listed here. On the other hand, a much more limited group of indices is assembled for detailed discussion.

The paper is structured as follows. Section 2 proposes a disaggregation of the main dimensions of development, and presents an extensive list of indices as well as their coverage of the different dimensions of development identified here. Section 3 presents in detail five recent proposals whose multidimensional nature stands out. Section 4 presents some final remarks.

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2. The multidimensionality of the measurement of development – composite indicators

2.1. Development nomenclature

Development is now consensually recognized as a phenomenon eminently multidimensional. As a result, the adequate measurement of the phenomenon requires a quantitative assessment of its main constituent elements. The understanding of the phenomenon may vary in time, among countries or even among individuals. However, a range of dimensions transcending the material standard of living of individuals usually underlies the concept of development and its meaning, such as freedom, equity, health, education, and a healthy environment, among others.

The disaggregation of development into its main dimensions has been followed by many authors. In a survey of composite indicators of development, Booysen (2002) illustrates the multidimensionality of the indices, classifying them according to twelve different dimensions of development: (i) demographic dynamics; (ii) education, training, and knowledge; (iii) health, food, and nutrition; (iv) human settlement, infrastructure, and communication; (v) political and social stability; (vi) culture, social fabric, and family values; (vii) environmental resources and pressures; (viii) political and civil institutions; (ix) income and economic growth; (x) unemployment and labor utilization; (xi) poverty and inequality; (xii) economic freedom.

On the other hand, Boidin (2004) asserts that international indicators of well-being and development should integrate the different dimensions seen as consensual, namely, the economic dimension, the human dimension (in a broad sense), the environmental dimension, and the inequalities and poverty.

The development nomenclature proposed here encompasses structural dimensions that most directly affect a country's aggregate level of development. That nomenclature includes the following crucial dimensions: (i) income; (ii) income distribution; (iii) education; (iv) health; (v) employment; (vi) infrastructure; (vii) values; (viii) environment. The choice of those dimensions is driven by criteria of intrinsic importance of each dimension and their recurrent inclusion in alternative attempts of development disaggregation. In Table 1, the dimensions mentioned above are disaggregated into their most important sub-dimensions.

Table 1. Development nomenclature

Income	Income distribution	Education	Health
	Poverty	Knowledge	Longevity
	Inequality	Educational infrastructures	Health infrastructures
		Others	Others
Employment	Infrastructures	Values	Environment
Volume	Energy	Economic freedom	Atmosphere
Quality	Transport	Socio-political freedom	Land
	Communication		Water
	Housing		Nature and biodiversity
	Money and finance		Others
	Justice		
	Culture, sport, and recreation		
	Others		

2.2. Composite indicators of development

Composite indicators are mathematical combinations (or aggregations) of a set of indicators. Even though there are many conceptual and methodological arguments against the use of such indicators, there are also important elements in favor of composite indicators, among which are mainly the following: (i) composite indicators synthesize complex or multidimensional issues; (ii) they are easier to interpret than a battery of separate indicators; (iii) they facilitate the task of comparing the performance across countries and their progress over time and thereby attract public interest; (iv) they reduce the size of a list of indicators without losing basic information (Booyesen, 2002; Saisana and Tarantola, 2002).

Composite indicators constitute the most immediate approach in the quantification of a country's level of development. A number of index proposals are currently available in the development literature and connected domains.¹

The following procedure was adopted in order to undertake the evaluation that motivates this paper: (i) identification of ten surveys or other recent studies including lists of composite indicators of development; (ii) establishment of a selection criterion for the indicators mentioned in those studies; (iii) analysis of the selected indicators and corresponding classification according to the development nomenclature proposed in Section 2.1.

Regarding the inclusion criterion mentioned in (ii), the development indices presented here not only include at least two of the different dimensions proposed in the development nomenclature, but are also mentioned in at least two of the selected studies.

The end result is a selection of 54 multidimensional indices associated with the concept of development and other closely related concepts that can, thus, be interpreted as measures of development. Table 2 presents, in chronological order, these composite indicators of development.

Table 2. Composite indicators of development

Author/Organization ^(*)	Composite Indicators of Development ^(**)	Surveys and other similar studies including lists of indices and indicators									
		Singh <i>et al.</i> (2009)	Afsa <i>et al.</i> (2008)	Bandum (2008)	Eurostat (2008)	Saisana (2008)	Soares and Quintella (2008)	Gidrey and Jany-Catrice (2007)	Goossens <i>et al.</i> (2007)	Morse (2004)	Booyen (2002)
Bennett (1951)	Index of relative consumption levels						X				X
Beckerman and Bacon (1966)	Index of relative real consumption per head						X				X
McGannahan <i>et al.</i> (1972)	General index of development				X		X				X
Nonhaas and Tobin (1972)	Measure of Economic Welfare (MEW)	X	X					X	X	X	
Morris (1979)	Physical Quality of Life Index (PQLI)	X			X		X				X
Zolotas (1981)	Economic Aspects of Welfare (EAW)	X	X					X		X	
Ram (1982)	Indices of overall development	X					X				X
Commission of the European Communities (1984)	Relative intensity of regional problems in the community	X				X					
Ginsburg <i>et al.</i> (1986)	World standard distance scales						X				X
Camp and Speidel (1987)	International human suffering index				X	X	X				X
Stoltje (1991)	Aggregate indexes of quality of life						X				X
Diener (1995)	Quality of life indices		X		X		X	X			X
Eates (1998)	Weighted Index of Social Progress (WISP)	X		X		X	X	X			X
Goedkoop and Spriensma (2001)	Eco-indicator 99	X				X					
Prescott-Alken (2001)	Wellbeing Index (W) or Wellbeing/Stress Index (WSI)	X		X	X	X					
Randolph (2001)	G-Index			X		X					
UNDP (2001)	Technology Achievement Index (TAI)	X		X		X		X			
Tamntola <i>et al.</i> (2002)	Internal Market Index World (IMI)	X		X		X					
Smith (2003)	Index of Economic Well-Being (IEWB)		X		X			X			
Tsoukalas and Mackenzie (2003)	Personal Security Index (PSI)		X					X			
UN <i>et al.</i> (2003)	Green GDP or Environmentally adjusted NDP (eaNDP)	X						X	X	X	
Hagén (2004)	Welfare index			X	X	X					
NISTEP (2004)	General Indicator of Science and Technology (GST)	X				X					
Porter and Stern (2004)	National innovative capacity index	X		X		X					
The Economist (2004)	Quality-of-life index			X	X			X	X		
European Commission (2005)	Investment in the knowledge-based economy	X		X		X					
European Commission (2005)	Performance in the knowledge-based economy	X		X		X					
Marks <i>et al.</i> (2006)	Happy Planet Index (HPI)		X	X	X				X		
Sbihiannoci (2006)	Regional Quality of Development Index (QUARS)				X				X		
World Bank (2006)	Adjusted net saving or Genuine saving	X	X	X	X			X	X		
ATK/FP (2007)	A.T. Kearney/FOREIGN POLICY Globalization Index			X		X					
Quartey and Lawson (2007)	Economic Freedom of the World (EFW) index			X		X	X				X
Mimogoff and Opycke (2007)	Index of social health		X		X			X			
Talberth <i>et al.</i> (2007)	Genuine Progress Indicator (GPI)	X	X		X	X	X	X		X	
UNDP (2007)	Human Development Index (HDI)	X	X	X	X	X	X	X	X	X	X
UNDP (2007)	Human Poverty Index (HPI-1) for developing countries			X	X		X	X		X	X
UNDP (2007)	Human Poverty Index (HPI-2) for selected OECD countries			X	X		X	X		X	X
Bertelsmann Stiftung (2008)	Bertelsmann Transformation Index (BTI)			X		X					
Dreher <i>et al.</i> (2008)	KOF index of globalization			X		X					
EIU (2008)	E-readiness rankings			X		X					
Esty <i>et al.</i> (2008)	Environmental Performance Index (EPI)	X	X	X		X	X		X	X	
Holmes <i>et al.</i> (2008)	Index of economic freedom			X		X	X				X
IMD (2008)	World competitiveness scoreboard			X		X					
Porter and Schwab (2008)	Global Competitiveness Index (GCI)			X		X	X				X
Roodman (2008)	Commitment to Development Index (CDI)			X		X					
SiC (2008)	Mothers' index			X		X					
van de Kerk and Manuel (2008)	Sustainable Society Index (SSI)	X		X	X						
Dutta and Mia (2009)	Networked Readiness Index (NRI)			X		X					
EIU (2009)	Business environment rankings			X		X					
UNU-MERIT (2009)	Summary Innovation Index (SI)	X		X		X					
Centre for Bhutanese Studies - website	Gross National Happiness (GNH) index				X				X		
Friends of the Earth - website	Index of Sustainable Economic Welfare (ISEW)	X	X		X	X		X	X	X	
Réseau d'Alerte sur les Inégalités (RAI) - website	Baromètre des Inégalités et de la Pauvreté (BIP40)		X					X			
Social Indicators Department [s.d.]	Index of individual living conditions				X	X					

^(*) In the case of revised indices, the last revision available was used. In the case of indices periodically published, the last version available (at table construction date) was used. For some indices, the only information available is on the website, namely, the following: (i) GNH index - <http://www.grossnationalhappiness.com/>; (ii) ISEW - <http://www.foe.co.uk/community/tools/isew/>; (iii) BIP40 - <http://www.bip40.org/>.

^(**) The list encompasses indices that capture, at least, two dimensions of the development nomenclature (one of them might be the dimension "others") - and are, thus, multidimensional indices of development - and, in addition, are mentioned in, at least, two of the selected studies.

2.3. The multidimensionality of the development indices

Taking into consideration the 54 composite indicators of development identified in Table 2, the final task in the present analysis consists of classifying them according to the development nomenclature. Table

¹ Indices of development might be uni- or multidimensional in nature. The first type captures only a specific dimension of development (usually, sub-dimensions of it) as opposed to the second type of indices.

3 shows the result of this process, presenting the dimensions of development included in each indicator and, thus, allowing the evaluation of the multidimensional nature of the indices.

Table 3. Multidimensionality of composite indicators of development

Author/Organization	Composite indicators of Development	Number of Dimensions	Dimensions of Development								
			Income	Income Distribution	Education	Health	Employment	Infrastructure	Values	Environment	Others ^a
Bennett (1951)	Index of relative consumption levels	4			X	X		X			X
Beckerman and Bacon (1966)	Index of relative real consumption per head	3			X	X		X			X
McCumhan <i>et al.</i> (1972)	General index of development	5			X	X	X	X			X
Nordhaus and Tobin (1972)	Measure of Economic Welfare (MEW)	5			X	X	X	X			X
Morris (1979)	Physical Quality of Life Index (PQLI)	2			X	X	X	X			X
Zolotas (1981)	Economic Aspects of Welfare (EAW)	6			X	X	X	X		X	X
Ram (1982)	Indices of 'overall' development	3	X		X	X					
Commission of the European Communities (1984)	Relative intensity of regional problems in the community	2	X				X				
Gershburg <i>et al.</i> (1986)	World standard distance scales	3	X			X		X			
Camp and Speckel (1987)	International human suffering index	5	X		X	X		X			X
Skutty (1991)	Aggregate indices of quality of life	5	X		X	X		X			X
Diener (1995)	Quality of life indices	6	X	X	X	X		X		X	
Estes (1998)	Weighted Index of Social Progress (WISAP)	5	X		X	X		X			X
Großkopf and Spruiellmann (2001)	Eco indicator 99	2	X		X	X				X	
Prescott-Alten (2001)	Wellbeing Index (WBI) - Wellbeing/Stress Index (WSI)	9	X	X	X	X	X	X	X	X	X
Randolph (2001)	G-Index	2						X			X
UNDP (2001)	Technology Achievement Index (TAI)	2			X			X			X
Torvik <i>et al.</i> (2002)	Internal Market Index World (IMI)	3			X			X			X
Smith (2002)	Index of Economic Well-Being (IEWB)	7	X	X	X	X	X	X		X	X
Tsoulas and Machenzie (2003)	Personal Security Index (PSI)	5	X	X	X	X	X	X			X
UN <i>et al.</i> (2003)	Green GDP on Environmentally adjusted NDP (eaNDP)	2	X							X	
Hagen (2004)	Welfare index	3	X			X					X
NISTEP (2004)	General Indicator of Science and Technology (GIST)	2			X						X
Porter and Stern (2004)	National innovative capacity index	5	X		X				X		X
The Economist (2004)	Quality of life index	5	X		X	X	X		X		X
European Commission (2005)	Investment in the knowledge-based economy	2			X			X			X
European Commission (2005)	Performance in the knowledge-based economy	3	X		X			X			X
Minka <i>et al.</i> (2006)	Happy Planet Index (HPI)	3			X	X	X	X		X	X
Siljaković (2006)	Regional Quality of Development Index (RQDI)	8		X	X	X	X	X	X	X	X
World Bank (2006)	Adjusted net saving on Genuine saving	3			X					X	X
ATKFP (2007)	A.T. Kearney/FOREIGN POLICY Globalization Index	2						X			X
Gwartney and Lawson (2007)	Economic Freedom of the World (EFW) Index	2						X			X
Mifflin and Opycke (2007)	Index of social health	6	X	X	X	X	X	X			X
Talbot <i>et al.</i> (2007)	Genuine Progress Indicator (GPI)	7	X	X	X	X	X	X		X	X
UNDP (2007)	Human Development Index (HDI)	3	X		X	X					X
UNDP (2007)	Human Poverty Index (HPI-1) for developing countries	2			X	X					X
UNDP (2007)	Human Poverty Index (HPI-2) for selected OECD countries	4			X	X	X	X			X
Bertelsmann Stiftung (2008)	Bertelsmann Transformation Index (BTI)	9	X	X	X	X	X	X	X	X	X
Dehrer <i>et al.</i> (2008)	KOF index of globalisation	3			X			X			X
EU (2008)	E-readiness rankings	6	X		X		X	X	X		X
Ely <i>et al.</i> (2008)	Environmental Performance Index (EPI)	2				X				X	
Holmes <i>et al.</i> (2008)	Index of economic freedom	2						X			X
IMD (2008)	World competitiveness scoreboard	9	X	X	X	X	X	X	X	X	X
Porter and Schwab (2008)	Global Competitiveness Index (GCI)	6	X		X	X		X		X	X
Roodman (2008)	Commitment to Development Index (CDI)	3						X		X	X
SiC (2008)	Modern index	3			X	X					X
van de Kerk and Manuel (2008)	Sustainable Society Index (SSI)	7		X	X	X	X	X	X	X	X
Dutta and Mia (2009)	Networked Readiness Index (NRI)	4			X		X	X			X
EU (2009)	Business environment rankings	7	X		X	X	X	X	X		X
UNU-MERIT (2009)	Summary Innovation Index (SII)	4			X	X	X	X			X
Centre for Bhutanese Studies - website	Gross National Happiness (GNH) index	9	X	X	X	X	X	X	X	X	X
Friends of the Earth - website	Index of Sustainable Economic Welfare (ISEW)	7	X	X	X	X	X	X		X	X
Réseau d'Alerte sur les Inégalités (RAI) - website	Baromètre des Inégalités et de la Pauvreté (BIP40)	7	X	X	X	X	X	X		X	X
Social Indicators Department (n.a.)	Index of individual living conditions	7			X	X	X	X		X	
Total (number of indices per dimension)			24	14	37	35	22	27	26	19	33

^a "Others" is a residual dimension, including aspects of development not reflected in the previous dimensions such as gender equality, cultural diversity, macroeconomic context, and political and social stability.

A closer inspection of Table 3 reveals some important insight into the multidimensionality of composite indicators of development. First, many multidimensional indices of development are not as wide in terms of dimension coverage and, therefore, they provide a partial vision of the phenomenon. Indeed, almost half of the indices presented in Table 3 (26 out of 54) include only two (15 indices) or three (11 indices) of the different dimensions of development identified here. Only four indices (Wellbeing Index and Wellbeing/Stress Index, Bertelsmann Transformation Index, World Competitiveness Scoreboard, and Gross National Happiness Index) encompass the nine dimensions, while another (Regional Quality of Development Index) includes eight of them.

Second, apart from the residual dimension "others", education (present in 37 out of 54) and health (included in 35 indices) are among the dimensions more frequently considered in the available indicators. This finding highlights the social dimension of development, and both aspects of development, in addition to income, are reflected in the most popular indicator for measuring development in a composite nature – the Human Development Index (HDI).

Third, the income dimension, surprisingly, is represented in only 24 indices. One possible reason is that a number of composite indicators of development appear as a reaction to the reductive perspective, centered on the use of income per capita. However, insufficiency rather than irrelevance is the main criticism inherent in the assessment of development through income per capita. The finding of a large number of indicators excluding that dimension comes as a surprise.

Fourth, the infrequent inclusion of the dimension related to income distribution should also be pointed out (14 indices), given the undeniable importance of phenomena like unequal income distribution and poverty for the analysis of a country's development.

Fifth, the same applies to the environment dimension (present in 19 indices). This finding is surprising, because the importance of environment has been emphasized in the process of development, namely in the context of sustainable development. On the other hand, it may be due to the large number of one-dimensional indicators centered on this specific dimension of development, such as the ecological footprint (Wackernagel and Rees, 1996; Ewing *et al.*, 2009) and the living planet index (Hails *et al.*, 2008).

Sixth and last, even though many of the composite indicators of development presented here fall short of the desirable outcome in terms of multidimensionality, a few incorporate that characteristic. They thus constitute complementary measures to the indicators most frequently used in the assessment of development – the income per capita and the HDI. The next section discusses their main characteristics and quantification approach.

3. Some recent proposals of composite indicators of development

3.1. Regional Quality of Development Index (QUARS)

The QUARS is an initiative of a campaign entitled Sbilanciamoci!. This Italian campaign involves more than 40 associations and civil society networks sharing the purpose of suggesting alternatives to the Italian budgetary policies, highlighting environmental and social aspects. The Sbilanciamoci! campaign published its first report on the quality of regional development (Qualità Regionale dello Sviluppo – QUARS) in the year 2000. Sbilanciamoci!'s understanding of that concept is as follows: “a region in which the economic dimension (production, distribution, consumption) is sustainable and compatible with environmental and social factors, where the social and health services adequately meet the needs of all the citizens, where participation in cultural life is alive, where the conditions needed to guarantee economic, social and political rights and equal opportunities to all individuals regardless of income, sex or country of origin are present and where the environment and territory are protected” (Sbilanciamoci, 2006, p. 20).

Sbilanciamoci! (2006) proposes a synthetic index – the QUARS – to evaluate the development quality of the Italian regions, encompassing seven macro-indicators and 45 variables. Concerning the environmental dimension, 10 variables are identified to assess the environmental impact of production, distribution, and consumption, as well as proper steps taken to mitigate the negative effects on the environment. The macro-indicator on the economy and labor contains four variables that reflect the working conditions and income guaranteed by the economic system and redistribution policies. In the macro-indicator of rights and citizenship, Sbilanciamoci! analyzes the social inclusion of young people, the elderly, immigrants, and other underprivileged people. In the field of equal opportunities, gender equality in economic, political, and social life is at focus. At the cultural and educational level, the following aspects are taken into account: participation in the school system; quality of the service; educational level of the population; cultural demand and supply. The health macro-indicator encompasses such features as the quality and efficiency of the service, proximity, and general health of the population. Lastly, five indicators measure political and social participation of citizens.

The variables that make up the index are all standardized, and therefore differences in score represent the actual differences existing between regions in the various aspects considered in the index.¹ Positive (negative) values for the QUARS of each region represent a score above (below) the mean for the regions. The further away the values are from zero, the further away they are from the mean value.

After the normalization of the variables, the mean values of the macro-indicators are calculated and the QUARS corresponds to the simple average of these mean values:

$$QUARS = \frac{1}{7} \sum \text{macro-indicators} \quad (2)$$

The QUARS is computed to measure development quality and thus it questions, in the first place, GDP per capita as the conventional measure of the development level, and also alternative indicators to GDP such as the HDI or the Genuine Progress Indicator (GPI). According to Sbilanciamoci!, the measurement of the development quality goes beyond the simple consideration of the income level (measured by GDP/GNP per capita) or even other purely quantitative indicators. There is a considerable weight for variables that represent qualitative aspects of a given dimension in certain dimensions of the index proposed. A distinguishing characteristic of the QUARS is thus its evaluation of the quality of the work, the quality of the social services (education, health, and assistance), and the quality of the environment, among others.

¹ Standardization (or z-scores) means a replacement of the observed values of each indicator by the normalized values using the formula:

$$z = (\text{observed score} - \text{average}) / \text{standard deviation} \quad (1)$$

On the other hand, regarding the database, the QUARS is specifically conceived to be adopted in the economic planning of regional governments in Italy. Indeed, it is already a reference indicator in Lazio (the region of Rome). Goossens *et al.* (2007) also stress the limited availability of unconventional data such as political participation or a fair economy.

In relation to the indices methodology, Sbilanciamoci! (2006) emphasizes that the normalization method chosen (z-scores) does not allow determining the performance of a given region in absolute terms, but only in relation to the other regions taken into consideration. Subsequently, it is also not possible to have QUARS time series for a given region and follow over time only the rank position of that region. Moreover, Goossens *et al.* (2007) consider the lack of an explicit weighting method for the variables in the index to have been, in a certain way, arbitrary.

3.2. Wellbeing Index (WI) and Wellbeing/Stress Index (WSI)

Prescott-Allen (2001) proposes a new method to assess the sustainability of nations, given that "no country knows how to be green without going into the red" (Prescott-Allen, 2001, p. 2). According to this author, countries with a high standard of living impose excessive pressure on the environment, while nations with low demands on the ecosystem are poor. This dichotomy is more easily perceptible applying the well-being assessment method described in Prescott-Allen (2001) that, ultimately, allows the evaluation of countries' performance in four indices: (i) Human Wellbeing Index (HWI); (ii) Ecosystem Wellbeing Index (EWI); (iii) Wellbeing Index (WI); (iv) Wellbeing/Stress Index (WSI).¹

The 36 indicators of the HWI aim to give, in an aggregate way, a more realistic picture of the socio-economic conditions than the one resulting from conventional indicators like GDP or the HDI. This index is a simple average of the values of the following dimensions: (i) health and population; (ii) wealth; (iii) knowledge and culture; (iv) community; (v) equity. The equity dimension is excluded if the average is lower without it.

In the same way, the EWI synthesizes 51 indicators on the state of the environment with the purpose of being a broader measure than other global indices such as the Ecological Footprint (EF) or the Environmental Performance Index (EPI). This index is a simple average of the values of the following dimensions: (i) land; (ii) water; (iii) air; (iv) species and genes; (v) resource use. The resource use dimension is excluded if the average is lower without it.

The other two above indices are specific to the Prescott-Allen's (2001) well-being assessment method. The first – WI – juxtaposes the two previous indices so they can be compared, and the second one – WSI – measures the ecological cost of human well-being. Both measure people and the ecosystem together, in order to compare their status, verify the impact of one on the other, and stress improvements in both.

Apart from the dual focus present in the well-being assessment method of Prescott-Allen (2001) – human and ecosystem well-being – this method is distinguished from the others (at the sustainability assessment level) by the use of the so-called barometer of sustainability. This graphic instrument gathers information on the four indices mentioned above and corresponds to a visual representation of the results, allowing an easy interpretation of the sustainability of the system (Figure 1).

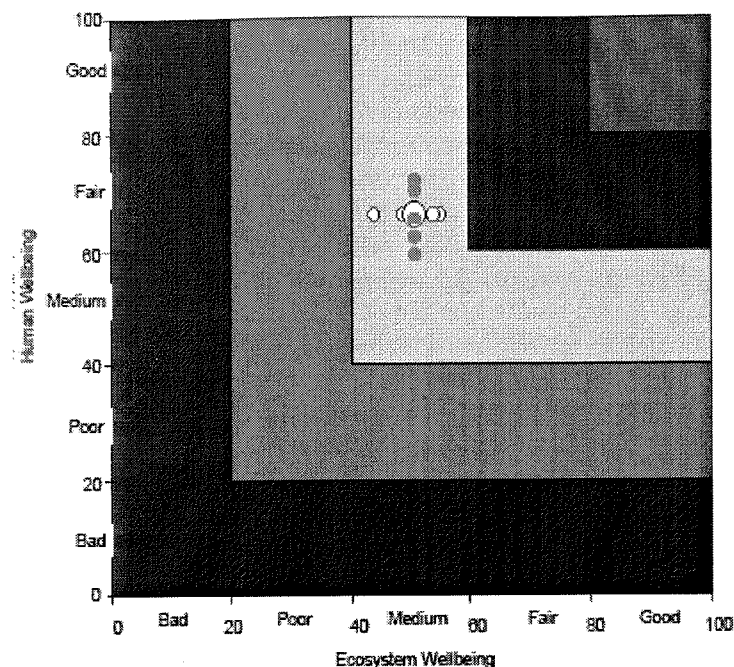
The WI is the arithmetic average of the HWI and the EWI, corresponding to the point on the barometer where both intersect:

$$WI = \frac{HWI + EWI}{2} \quad (3)$$

In turn, the WSI is given by the ratio of human well-being to ecosystem stress:

$$WSI = \frac{HWI}{100 - EWI} \quad (4)$$

¹ Prescott-Allen's (2001) well-being assessment method encompasses six stages: (i) definition of the system and its goals; (ii) identification of the elements for each of the sub-systems (human system and the ecosystem) and their respective objectives; (iii) choice of both indicators that best represent the elements of the system and performance criteria for each indicator; (iv) collection of data and normalization of the indicators; (v) calculation of the four indices (mentioned above); (vi) revision of the results and policy proposals.



Source: Adapted from Prescott-Allen (2001).

Figure 1. Barometer of sustainability

The dimensions of the indices that form both the WI and the WSI – HWI and EWI – are disaggregated in elements and/or sub-elements, represented by a single indicator whenever possible and, in some cases, by multiple indicators. Overall, there are 36 and 51 indicators, respectively.

The observed value of each indicator is transformed into a value that matches the performance scale on the barometer. The idea is as follows: (i) the barometer scale comprises five bands – bad, poor, medium, fair, and good – and the corresponding values range 20 points each on a scale of 0 to 100 (Figure 1); (ii) for each indicator minimum and maximum values of performance are previously defined to each of the above bands;¹ (iii) the observed value of a given indicator determines the minimum and maximum values (of a given band) to be used in the normalization of the indicator by employing the following formula:

$$\frac{((\text{observed value} - \text{min value}) / (\text{max value} - \text{min value})) \times 20}{\text{min point on the scale barometer}} \quad (5)$$

The next step is to aggregate scores in hierarchy: indicator scores into sub-element scores; sub-element scores into element scores; element scores into dimension scores; finally, dimension scores are combined into two indices – HWI and EWI. Dimensions are given equal weight, but elements, sub-elements, and indicators are sometimes given different weights.²

The depth and breadth of the work developed by Prescott-Allen (2001) is undeniable, even though some limitations are present. The choice of indicators that best represent the elements of the system as well as performance criteria for each indicator is a time consuming stage of the well-being assessment method. Some authors also raise the problem of data availability (Graymore, 2005) and treatment given to the equity and resource use dimensions (Eurostat, 2008).

3.3. Gross National Happiness (GNH) index

The GNH is a complex concept that includes a set of inter-related human happiness conditions that, until recently, had not been measured or aggregated into a GNH index. The origins of the concept can be traced back to the early 1970s and are attributable to King Singye of Bhutan, who coined the phrase

¹ Performance criteria are available in Prescott-Allen, 2001, pp. 300-6.

² Choices made for the different components of the indices at the weighting and aggregation level are summarized in Prescott-Allen, 2001, pp. 310-2.

"Gross National Happiness is more important than Gross Domestic Product". At the end of 2008, this Asian country officially adopted the GNH index developed by the non-governmental organization Centre for Bhutan Studies (CBS).

Measures of happiness available in the literature are subjective well-being measures such as the satisfaction with life index proposed by White (2007). In general, individuals respond to a question like "how happy are you?" on an ordinal scale, ranging from 1 (the worst result) to "n" (the best result). Indicators of subjective well-being are then defined based on the mean, the median, or the variance of the distribution. On the other hand, a number of conventional measures of progress and development are multi-dimensional in nature but objective measures of well-being that do not reflect the Bhutanese understandings of happiness adequately. Based on these arguments, the CBS proposes an index – the GNH index – aimed to be a deeper representation of well-being than existing indicators and, in particular, a reflection of the happiness and general well-being of the Bhutanese population.

The GNH index includes nine core dimensions of human well-being, from traditional areas of social concern such as standard of living, education, and health to less traditional ones such as time use (work vs. leisure), emotional well-being, and community vitality. The first dimension is measured by the psychological well-being index comprising emotional balance indicators, spiritual indicators, and an indicator of general psychological distress. The second dimension is assessed through an index of time use that includes two variables – sleeping hours and total working hours. The third dimension is measured by a community vitality index consisting of indicators of family vitality, safety, reciprocity, social support, trust, socialization, and kinship density. The fourth dimension is captured by an index culture that gathers indicators of value transmission, basic precepts, community festivals, dialect use, traditional sports, and artisan skills. The fifth dimension has a health index that evaluates the health status of the population, its health knowledge and the barriers to health care access. The sixth dimension is quantified through the education index, which analyze the educational level of the population, its understanding of the district language, and its knowledge of history and local traditions. The seventh dimension corresponds to ecological diversity and resilience, capturing ecological degradation and ecological knowledge of the population and its forestation practices. The standard of living index encompasses indicators linked to income, housing, food security, and hardship, and is the eighth dimension. Finally, the ninth component of happiness and well-being in Bhutan is good governance, which evaluates government performance, the degree of people's freedom and their level of institutional trust.

The indicators that comprise the sub-indices of the GNH index are estimated from survey questionnaire data; given that individuals are interested in their own well-being and are thus the ones that can best judge the subject. This inquiry was conducted in different districts of Bhutan between the end of 2007 and the beginning of 2008 and included a mixture of objective, subjective, and open-ended questions.

The methodological approach followed in the calculation of the GNH index also assumes an innovative character and can be disaggregated in two steps. In the first instance, one applies a sufficiency cut-off to each indicator of the index, assuming a meaning similar to the concept of poverty line in the poverty measurement context. The poverty line separates the poor from the non-poor and, correspondingly, this divider line of sufficiency distinguishes the individuals who attain a sufficient level of achievement in a given indicator from those whose attainments fall short of sufficiency. The establishment of sufficiency cut-offs involves value judgments, but it is possible to identify some sufficient level of achievement on the different indicators of the index, the attainment of which would reflect a sufficient quality of life. Achievements above that level would hardly contribute to an improvement of the individual's quality of life, and thus an individual is considered happy if that person achieves sufficiency in all nine dimensions of the GNH index.

The procedure to accomplish this first step consists in the attribution of the value of zero for the indicators in which the individual attains sufficiency or above sufficiency and the value of one otherwise. Subsequently, the latter values are replaced by the distances from the cut-offs applying the following formula:

$$(\text{cutoff of sufficiency} - \text{observed achievement}) / \text{cutoff of sufficiency} \quad (6)$$

The depth of the insufficiency levels is taken into account by dividing the shortfall from sufficiency by the sufficiency cut-off itself, that is, the further away from the cut-off, the greater the value obtained. Finally, the distances from the cut-offs are squared in order to take into account the severity of the insufficiency levels, and thus give more weight to poor achievements.

The second step to compute the GNH index is the aggregation of data (sample) population. Replicating the above procedure for all the individuals in the sample, one obtains, for each indicator, the simple average of the squared distances from the cut-offs. The difference between the value of one and a given average gives us the contribution of that indicator to the index. An equal weighting to these resulting values and their linear aggregation in the corresponding sub-index and a same procedure for the sub-indices and the final index determine the value of final index.

In brief:

$$GNH\ index = average\ (1 - squared\ distance\ from\ cutoff) \quad (7)$$

The GNH index has been computed for the different districts considered in the analysis of happiness and well-being in Bhutan. The decomposition of the GNH index by dimension (or indicator) reveals immediately those dimensions that present the largest shortfalls from sufficiency. Future surveys will allow an analysis of the index and inherent dimensions over time.

3.4. Bertelsmann Transformation Index (BTI)

The transformation index of Bertelsmann Stiftung is a German initiative that assesses the development and transformation processes of countries that have yet to achieve a fully consolidated democracy and market economy. Here the distinctive mark is on the evaluation of developing and transformation countries from two perspectives: on the one hand, the state of democracy and market liberalization; on the other, the performance of political leaders in the management of these changes. Therefore, Bertelsmann Stiftung produces world rankings on two indices: the status index and the management index. Both are computed on the basis of 17 criteria subdivided into 49 questions in total. The scores of the third survey are available in Bertelsmann Stiftung (2008).

The status index scores represent the mean value of the democracy and market economy scores:

$$Status\ index = \frac{1}{2} \left(\frac{1}{5} \sum democracy\ criteria + \frac{1}{7} \sum market - economy\ criteria \right) \quad (8)$$

The scores of the first dimension aggregate the scores of five equally weighted criteria: (i) *stateness*; (ii) political participation; (iii) rule of law; (iv) stability of democratic institutions; (v) political and social integration. The criteria scores, in turn, are the means of quality assessments by experts that respond on an ordinal scale ranging from 1 (worst) to 10 (best).

The scores of the market economy dimension are likewise the simple average of seven criteria scores – (i) the level of socio-economic development; (ii) the organization of the market and competition; (iii) currency and price stability; (iv) private property; (v) welfare regime; (vi) economic performance; (vii) sustainability – and the scores of each criterion, in turn, correspond to the mean of the scores for the respective individual questions.

On the other hand, the management index reveals the quality of political management under given structural conditions. The index takes into account structural difficulties such as high levels of poverty or a history of violent conflicts, given that good governance under difficult conditions should be appreciated more than an equivalent performance under promising conditions. Therefore, the management index scores represent the mean value of four management criteria weighted by a fifth criterion, the level of difficulty, which captures such difficult structural conditions:

$$Management\ index = \frac{1}{4} \sum management\ criteria \times \left[1 + (level\ of\ difficulty - 1) \times \frac{0.25}{9} \right] \times \frac{10}{12.5} \quad (9)$$

In other words, the experts evaluate through specific qualitative indicators the degree of accomplishment in the criteria of steering capability, resource efficiency, consensus-building, international cooperation and the level of difficulty. The qualitative indicators of the last criterion are combined with quantitative indicators that reflect a country's level of economic development and education. The resulting mean level of difficulty scores are multiplied by the mean management criteria scores (after being converted to an appropriate scale) to compute the final index (management index).

3.5. World competitiveness scoreboard

The World Competitiveness Scoreboard (WCS) is an overall ranking published in the world competitiveness yearbook and developed by the Institute for Management Development (IMD), a leading Swiss management school.

Similar to the Global Competitiveness Index (GCI) of the World Economic Forum (Porter and Schwab, 2008), the IMD produces an annual ranking on global competitiveness for various economies worldwide, from the most to the least competitive. According to the IMD (2008), the competitiveness of nations is their ability to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people.

On the basis of the global competitiveness ranking there are four competitiveness factors that, in turn, are disaggregated into five sub-factors each (subf): (i) economic performance (EP): domestic economy, international trade, international investment, employment, and prices; (ii) government efficiency (GE): public finance, fiscal policy, institutional framework, business legislation, and societal framework; (iii) business efficiency (BE): productivity, labor market, finance, management practices, and attitudes and values; (iv) infrastructure (IS): basic, technological, scientific, health and environment, and education. The criteria that form each sub-factor are a combination of hard and soft data. Hard data are quantitative data from regional and international organizations as well as private industries in a total of 131 criteria. Soft data are compiled from IMD's Executive Opinion Survey, which gathers 123 questions conceived to measure competitiveness as it is perceived by business executives.

The starting point in designing IMD's (2008) rankings is to compute the standardized value of each of the 254 criteria/indicators for the different economies under scrutiny.¹ The economies are then ranked by criterion, sub-factor, and factor and, finally, the global competitiveness ranking is calculated. Quantitative data and survey data are both weighted such that, overall, the former accounts for two-thirds in the determination of the global ranking and the latter one-third. The remaining components of the final index (factors and sub-factors) are equally weighted:

$$WCS = \frac{1}{4} \left(\frac{1}{5} \sum subf EP + \frac{1}{5} \sum subf GE + \frac{1}{5} \sum subf BE + \frac{1}{5} \sum subf IS \right) \quad (10)$$

4. Final Remarks

Development is described as a complex phenomenon with a multidimensional content. Consequently, indicators that capture that multidimensional nature are needed for a quantitative evaluation of the domain. In this context, composite indicators in the assessment of development gain greater importance. These indicators share the most important advantage of summarizing an extensive volume of information on the different dimensions that characterize a given complex phenomenon.

In this study, we have focused on multidimensional indices of development. Based on a sample of 54 composite indicators of development, we have evaluated their dimension coverage. We conclude that, in general, the indices of development include only a restricted number of development dimensions. We have also found that education and health are among the dimensions most frequently present in composite indicators of development.

The five indicators discussed in this paper should be stressed, as they constitute complementary measures to the most frequently used indicators in development assessment – the income per capita and the widely-used composite indicator, the HDI. Nonetheless, the development of new indicators that, in addition to their comprehensiveness, have a more universal application – facilitating more direct comparisons at the international level – is still to come.

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¹ Please recall footnote 2, above.

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