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## Assessing the Performance of the Least Developed Countries in Terms of the Millennium Development Goals

### 1. Introduction

Since the 1970s, poverty has been recognised as the most serious socioeconomic problem facing the world. Although thousands of solutions have been proposed, inequality and poverty persist. Many of the so-called solutions do not deal with the root cause (Banerjee & Duflo, 2015). Billions of human beings and many countries in the world are still condemned to lifelong severe poverty, with low life expectancy, lack of food and water, social exclusion, poor health, illiteracy and dependency. The situation is worse in the group of the least developed countries (LDCs) (UNCTAD, 2016b).

The Millennium Development Goals (MDGs) were set out by the United Nations (UN) for the period 2000–2015 to promote development and eradicate poverty worldwide. The MDGs have successfully focused world attention on a broad-based development framework and, together with the Sustainable Development Goals (which replaced the MDGs in 2015), are likely one of the most important global development initiatives (Briant Carant, 2017). The MDGs were an initiative developed under the increasingly accepted conception of measuring social performance on the basis of a large list of indicators rather than relying solely on economic growth. Specifically, the MDGs set eight goals in different dimensions of development which are intrinsically interlinked, feed each other and are monitored through quantifiable indicators to measure the progress made. In this regard, the MDGs constituted an international initiative for the promotion of development and the eradication of poverty which, in its conception, took into account the multidimensional nature of these two concepts (Sessa, 2016; Vandemoortele, 2011).

Having reached the end of the MDG period, it is time to assess its achievements, especially in the poorest countries, which deserve special attention from the scientific community. To this end, we use composite indices to analyse, in an integrated manner, the performance of the LDCs in terms of the eight goals of the MDG initiative from 2000 to 2015. The evaluation of what has been achieved may be relevant not only for monitoring progress, but also for informing policy design of the 2030 Agenda for Sustainable Development. Unlike other studies in this same line (see, for instance, Cuenca et al., 2010; Luque et al., 2017), our study covers the entire period of validity of the MDGs and presents an overview of their evolution for the period 2000–2015, makes a comparison with the global average, and takes into account the mutually reinforcing eight Millennium goals. Another key aspect of our work is the geographical area under study, namely the LDCs. Despite being the countries in the world that could potentially benefit the most from the poverty reduction strategy of the MDGs, their study as a group with different economic and social characteristics is rare, largely due to the scarcity of relevant data.

The composite indices built in this work allow us to empirically assess achievements in many dimensions, analyse the progress of territories over time and perform spatial comparisons. Our results show that all the LDCs have improved their

situation in terms of the MDGs over the period 2000–2015 and the gap between the first and the last country has also narrowed substantially. However, given the initial level, only Tuvalu is above the world average in achieving the MDGs in 2000; thus, much work remains to be done with a view to the 2030 Agenda.

The paper is structured as follows. In section 2 we study the MDGs focusing on the LDCs. For this purpose, we review which countries are considered LDCs, what the MDGs consist of and their underlying theoretical framework. In sections 3 and 4 we present the empirical strategy and the statistical information used to construct the composite indices for assessing the performance of the LDCs in terms of the MDGs from 2000 to 2015. In section 5 we report the empirical results and main conclusions. Finally, in section 6 we discuss the principal policy implications, particularly international cooperation in terms of aid and trade.

## **2. The Least Developed Countries and the Millennium Development Goals**

Since our study focuses on the LDCs, talking about the MDGs means talking about human development and poverty reduction. Briefly, we analyse how, over time, the global community has been moving towards conceiving development as the organised pursuit of human well-being. This has involved broadening the notion of development and poverty from a narrow economic conception to encompassing human development and wider ideals such as participation and freedom. In such a context, the purpose of development policies should be to work to establish the conditions where all people are able to achieve well-being (Gough et al., 2007). With these ideas in mind, we review the development and poverty reduction strategy of the MDGs. Before proceeding, it is necessary to define more explicitly the concept of LDCs, our object of study.

### **2.1. What are the Least Developed Countries?**

The concept of LDCs originated in the late 1960s. Since 1971, the UN has recognised as LDCs those states deemed most highly disadvantaged in the development process, and as facing the greatest risk of failing to overcome poverty (LDC IV Monitor, 2014). In 1971, the UN Conference on Trade and Development (UNCTAD)<sup>1</sup> designated 24 countries as LDCs. The list is reviewed and updated every three years by the Committee for Development Policy (CDP), which may recommend countries for inclusion in or graduation from the list of LDCs.

Currently, the CDP follows three different criteria for categorising a country as a LDC: gross national income (GNI) per capita<sup>2</sup>, the Human Assets Index<sup>3</sup> and the Economic Vulnerability Index<sup>4</sup>, with an additional requirement in place since 1991 that countries with populations exceeding 75 million should not be taken into account. That is, the LDCs exhibit the lowest indicators of socioeconomic development in the world. In the review of March 2015, 48 countries were designated by the UN as LDCs belonging to four regions (see Appendix 1), which represented 13% of the world population in that same year. There are 33 LDCs in Sub-Saharan Africa, eight in East Asia and the Pacific, four countries in South Asia, two located in the Middle East and North Africa, and Haiti, which is the only LDC country located in the western hemisphere (Latin America and Caribbean UN region) (UNCTAD, 2016b). A country will normally qualify for graduation from LDC status if it has met graduation thresholds under at least two of the three criteria in at least two consecutive triennial reviews.

## 2.2. The Multidimensional Perspective of Development and Poverty

The dominant conception of well-being in the second post-war development period has been an economic one. The conditions determining the development of countries were defined on the basis of production in the highest possible monetary terms and the modification of productive activities when they were harmful for citizens. Welfare economies comprise the material resources people control, can utilise and dispose of, measured by income and at aggregate levels by national income per head (Gough et al., 2007). Under this conceptual framework, the solutions for reducing poverty in developing countries and worldwide have been economically based, mainly to foster the growth in GDP per capita and in agriculture and service sectors (Akobeng, 2016). For years, there has been a certain dissatisfaction with this macroeconomic approach to the eradication of poverty and, above all, with the inability of many existing models to explain the situation in which the LDCs find themselves (Leftwich, 1995).

In the last decades of the twentieth century, there have been diverse contributions to debates across the social science disciplines over development (Gough et al., 2007). Specifically, from the seventies, the Social Indicators Movement (Andrews & Withey, 1976) argued in favour of measuring social performance on the basis of a large list of indicators, rather than relying on a single one – income or GDP per capita. This approach is applied to both development and access to resources, as well as poverty due to a lack of both. However, its main limitation lay in the absence of a theoretical foundation, which was provided by the capability approach (Sessa, 2016).

In 1980, Sen (1980) introduced the capability approach as a general approach to evaluating the human condition. This approach broke with traditional welfare economics (Gough et al., 2007; Robeyns, 2005). The capability approach is a broad normative framework for the evaluation and assessment of individual well-being or the average well-being of the members of a group and the design of policies (Robeyns, 2005, p. 94). The capabilities approach focuses on the plural or multidimensional aspects of development and claims that income and resources do not provide a sufficient or satisfactory indicator of well-being as they measure means instead of ends. It is necessary to take into consideration what individuals are able to do not only with the instruments they have, but also, most importantly, with the capabilities they have (Sen, 1980, 1992). The capability approach has also provided the theoretical foundations of the human development paradigm (Fukuda-Parr & Shiva Kumar, 2003). Since 1990, the United Nations Development Programme calculates the Human Development Index (HDI) on an annual basis. The HDI is used universally as a synthetic measurement of human development for showing the average achievements of a country.

Recent decades have witnessed a growing demand for new methods to measure citizens' well-being, given that GDP on its own appears to be unsatisfactory to describe and compare the well-being and progress of societies. A single economic measure does not account for the social cost of economic development, such as the cost of urbanisation or pollution, among others; and nor does it take into account income distribution or significant assets, such as educational opportunities, employment opportunities, personal safety, and political freedoms (OECD, 2013; Neumayer, 2003; Nussbaum, 2011; Stiglitz et al., 2011; Van den Bergh, 2009). Within this framework, several international initiatives have been undertaken to improve the mapping of well-being or quality of life (for a revision see Sánchez et al., 2018). Among them, one of the most important is the Social Progress Index, which is calculated from 2013 and includes information for 50 exclusively social and environmental indicators across three broad dimensions of social progress: basic human needs, foundations of well-being, and opportunity.

In this context, poverty is seen in terms of deprivation of some minimum fulfilment of elementary capabilities. Poverty is not only the lack of money, but the inability to develop the full potential of the person as a human being (Sen, 1992). Taking into account that in addition to goods, the social, economic, family and political environment determines the creation or expansion of capabilities (Robeyns, 2005), poverty must be analysed taking into account the society in which poverty is assessed (Banerjee & Duflo, 2015). That is, it is necessary to study the conditions of life of the population through the different fields of social concern: population, family, education, work, income, distribution and consumption, social protection, health, the physical environment, culture and leisure and social cohesion and participation (Clark, 2003). In short, poverty is a complex multidimensional concept that could be understood as the product of unequal social, political and economic relationships (Davis, 2017).

In light of these findings, new methods should be used for measuring poverty and detecting its determining factors in developing countries. Specifically, the absolute and relative poverty lines method,<sup>5</sup> which is widely used by the majority of countries and international institutions (World Bank, OECD, the Economic Commission for Latin America and the Caribbean, etc.), does not fit in this conceptual context.

### **2.3. The Millennium Development Goals**

In 2000, leaders from around the world adopted the United Nations Millennium Declaration and established the MDGs to foster a 'more peaceful, prosperous and just world' (United Nations, 2000, p. 1). Countries decided to spare no effort to combat the dehumanising conditions of extreme poverty in some parts of the world and recognised that special measures would be required for the weakest members of the international community (Fosu, 2010). With that aim, the MDGs set eight goals to be achieved by 2015 consisting in eradicating extreme poverty and hunger, fighting infant and maternal mortality, stopping the spread of diseases (mainly HIV), promoting universal access to primary education, reducing the gender gap and articulating economic growth with environmental sustainability (see Table 1). For each of the eight goals, three to eight indicators (a total of 46) were chosen to monitor and evaluate the results. The international community deems these variables fundamental in order to move forward in the fight against poverty, as they represent the basic needs and rights that all human beings ought to enjoy (Unwin, 2007). To implement the MDGs, the UN commits rich countries to allow greater access to trade, reduce debts and increase aid (Clemens et al., 2007; Fritz & Menocal, 2007).

The underlying assumption of MDGs is that the different goals are mutually reinforcing. For instance, several of the proposals to eradicate extreme poverty (goal 1) are a clear example of these synergies. These proposals, in turn, also contribute to other MDGs, namely by expanding nutrition programmes that target children under two years of age (goal 4), universalising education (goal 2), promoting gender equality (goal 3) and protecting vulnerable countries during crisis (goal 8). As Sessa (2016) has pointed out, these synergies illustrate how the MDG framework is intended to reflect to the highest possible degree the foundation of the human development approach that inspired it. The goals are intrinsically linked, they are both ends in themselves and a means of development. In this sense, it could be considered that the human development of the people of a country is a summary of the population's achieved functioning or capabilities (Kuklys, 2005; Robeyns, 2006; Sen, 1987). The MDG indicators inform us about the functioning achieved by the people of a country in a given period of time.

Despite the purpose and good intentions of the international community, there have been strong criticisms concerning the definition, viability, financial commitments and the difficulties of achieving some of these goals in certain countries. Moreover, the MDGs were created without the adequate involvement of developing countries and with unachievable and simplistic development objectives that were not adapted to national needs. Although each of these goals is certainly commendable to reduce poverty or improve health, their definition is often extremely vague and the conditions required to reach the goals are often omitted (see, for instance, Davis, 2011; Pogge, 2004; Vandemoortele, 2011). Furthermore, it is assumed without question that liberalism and globalisation are perfectly compatible with the achievement of the goals (Briant Carant, 2017). In spite of this, the MDGs represented a way forward for the developing countries and offered eight practical strategies to improve human development by 2015. Improving the quality of life in these countries would save millions of lives, stabilise political systems, improve health, and promote peace, human rights, gender equality and environmental sustainability.

Table 1. Selection of Millennium Development Goal indicators

	Indicator	Relation <sup>a</sup>
<b>Goal 1: Eradicate extreme poverty and hunger</b>		
1	Prevalence of underweight, weight for age (% of children under 5)	negative
2	Real PPP GNI per capita	positive
<b>Goal 2: Achieve universal primary education</b>		
3	Primary completion rate, total (% of relevant age group)	positive
4	Adjusted net enrolment rate, primary (% of primary school age children)	positive
<b>Goal 3: Promote gender equality and empower women</b>		
5	Proportion of seats held by women in national parliaments (%)	positive
6	School enrolment, primary (gross). Gender parity index (GPI)	positive
<b>Goal 4: Reduce child mortality</b>		
7	Immunisation, measles (% of children ages 12-23 months)	positive
8	Mortality rate, under-five (per 1.000 live births)	negative
<b>Goal 5: Improve maternal health</b>		
9	Adolescent fertility rate (births per 1,000 women ages 15-19)	negative
10	Maternal mortality ratio (modelled estimate, per 100,000 live births)	negative
<b>Goal 6: Combat HIV/AIDS. Tuberculosis and other diseases</b>		
11	Incidence of tuberculosis (per 100,000 people)	negative
12	Tuberculosis death rate (per 100,000 people)	negative
<b>Goal 7: Ensure environmental sustainability</b>		
13	Improved sanitation facilities (% of population with access)	positive
14	Improved water source (% of population with access)	positive
<b>Goal 8: Develop a global partnership for development</b>		
15	Net ODA received (% of GNI)	positive
16	Internet users (per 100 people)	positive

Note. Adapted from the World Bank, Millennium Development Goals.

<sup>a</sup> Relation between the indicator and the Millennium Development Goals; how the increase/decrease in the indicator affects the fulfilment of these goals.

### 3. Empirical Strategy

The analysis of the extent to which countries have achieved the MDGs may be approached by means of two methods. One of the methods involves analysing the evolution of each of the indicators separately. This is the method used on the World Bank's

Millennium Development Goals website, where it is possible to see each country's progress towards the goals. The other method provides an integrated measure of progress towards the eight goals by building a composite index of each country.

The use of composite indices has both advantages and disadvantages (Booyesen, 2002; OECD et al., 2008; Michalos et al., 2011; Permanyer, 2011). The main pros are that they summarise complex and multi-dimensional realities and are thus easier to interpret than a battery of many separate indicators. Composite indices make it easier to measure and visually represent overall trends in several distinct indicators over time and across geographic regions. A single composite index yielding a single numerical value promotes accountability and facilitates communication with the general public. Increases in the comparability of phenomena -promoted by composite indices- lead to increases in the capacity to make holistic assessments and balanced judgements about them, all of which is a key factor for supporting policy decision-makers. The most troubling issues of composite indices are the treatment of measurement units (how to aggregate variables expressed in different units) and the allocation of weights among the variables in the composite index (how to aggregate the variables into a single index).

In order to build the Country Performance Index (CPI), which allows us to evaluate the evolution of the LDCs in terms of the MDGs, we rely on the P2 Distance method developed by Pena Trapero (1977) and applied in several studies (see, for instance, Cuenca et al., 2010; Sánchez et al., 2018). The P2 Distance Method solves problems related to the measurement units and weights, as we review below. Moreover, according to Zarzosa Espina and Somarriba Arechavala (2013), the index calculated using the P2 Distance verifies the mathematical properties required to provide an acceptable measure: existence and determination, monotony, uniqueness, quantification, invariance, homogeneity, transitivity, exhaustiveness, additivity and invariance compared to the baseline. The composite index calculated by the P2 Distance method is a cardinal measure, and on the basis of the additive property it is also capable of analysing disparities between countries. More specifically, from the results, countries can be ranked from a high to low level of development, factors which are more correlated to development can be identified, and the changes over the period 2000–2015 can be studied. However, the disadvantages are that the investigator has to define variables with a positive/negative impact on the model and only linear relationships between variables are analysed.

### 3.1. The P2 Distance Formula

The point of departure of the whole process is a matrix X of order (n, m) where n is the number of countries and m is the number of indicators. Each element of the matrix,  $X_{ij}$ , represents the state of indicator j in country i.

The formula for calculating the CPI for a country i using the P2 Distance method is defined as follows:

$$CPI_i = \sum_{j=1}^m (d_j(i,*) / SD_j) (1 - R_{j,j-1,\dots,1}^2) \quad (1)$$

subject to the standard deviation of indicator j ( $SD_j$ ) being different from 0,

and where:

- m is the number of indicators;
- $d_j(i,*) = |X_{ij} - X_{*j}|$  is the absolute value of the difference between the value taken by the j-th indicator in the i-th country and the j-th value in the baseline  $X_* = \{X_{*1}, X_{*2}, \dots, X_{*m}\}$ ;

- $R^2_{j,j-1, \dots, 1}$  is the coefficient of determination in the multiple linear regression of  $x_j$  over  $x_{j-1}, x_{j-2}, \dots, x_1$ , already included; and
- $R_1^2 = 0$ .

The CPI built with the P2 Distance method solves both the treatment of measurement units and the weighting attached to each observable variable. By dividing the distance by  $SD_j$  (i.e.  $d_j/SD_j$ ), each indicator is simultaneously expressed in abstract units and weighted by the inverse of the standard deviation. In doing so, the distances corresponding to the indicators with a higher dispersion to the mean are less important in determining the composite index. In addition, the weights of the indicators are also determined by the correction factor  $(1-R^2_{j,j-1, \dots, 1})$ .

### 3.2. The Baseline

Given that our objective is to analyse how the LDCs have evolved in achieving the MDGs from 2000 to 2015, it is necessary to choose a common baseline that allows us to compare the distances between countries for two different years. Since most of the indicators established by the UN to assess fulfilment of the MDGs have not been quantified, we consider as baseline ( $X_*$ ) the worst values for all the indicators of an imaginary country which reflects the worst possible scenario in the two years studied. Therefore, our proposal is to estimate the distance that separates each of the countries analysed from a hypothetical country that ranks in the worst position in the LDCs for all the MDG indicators analysed. Thus, a higher CPI value indicates a better evolution or better progress towards the MDGs as it represents a greater distance from the 'least desirable' theoretical situation (see Cuenca et al., 2010; Sánchez et al., 2018; Zarzosa Espina & Somarriba Arechavala, 2013).

### 3.3. Hierarchy of Indicators

The coefficient of determination ( $R^2_{j,j-1, \dots, 1}$ ) measures the percentage of variance of each indicator explained by the linear regression estimated using the preceding variables ( $x_{j-1}, x_{j-2}, \dots, x_1$ ) in the summation of the calculation formula (Equation 1). As a result, the correction factor  $(1-R^2_{j,j-1, \dots, 1})$  avoids data duplication by eliminating the information contained in the preceding indicators. That is, if  $(1-R^2_{j,j-1, \dots, 1})$  expresses the part of the variance of indicator  $x_j$  not explained by  $x_{j-1}, x_{j-2}, \dots, x_1$ , the part already explained by the preceding indicators is obtained by multiplying each indicator by the corresponding coefficient of determination,  $R^2_{j,j-1, \dots, 1}$ . In other words, the correction factor indicates the proportion of new information attributable to each indicator.

As regards the coefficients of determination, it is important to take into account that the entry order of the indicators in the composite index formula will determine different values for  $R^2$  and will therefore affect the values of the composite index. An iterative method is required to determine the order. We start from the Fréchet Distance (DF) where all the coefficients of determination  $R^2$  are set to zero:

$$FD_i = \sum_{j=1}^m (d_j(i,*) / SD_j) = \sum_{j=1}^m (|x_{ij} - x_{*j}| / SD_j) ; \quad i = 1, 2, \dots, n \quad (2)$$

We then estimate the pairwise correlation coefficients  $r$  between each indicator and the Fréchet distance and sort the indicators from highest to lowest according to the absolute values of the pairwise correlation coefficient. Next, we calculate the first CPI for each country using the P2 Distance method and incorporate the indicators in the resulting

order. The indicators are then classified by ordering them from highest to lowest in terms of the absolute value of the pairwise correlation coefficient between each component and the CPI. The process continues iteratively until the difference between two adjacent CPIs is zero.

### 3.4. Comparison with Other Composite Indices

The use of multi-criteria decision-making techniques could be an appropriate complement to the P2 Distance method as a way to deal with the problem of the substitutability of indicators (Luque et al., 2017).<sup>6</sup> To do so, in a complementary way, we build three composite indices, namely a Weak Index (WI), a Strong Index (SI) and a Mixed Index (MI) using a multi-criterion approach with a double reference point: ambition and reservation values. The ambition level is the target value to be reached. The reservation value is a minimum threshold below which the level is considered undesirable in the event of an indicator that must be maximised (for instance, primary completion rate), and a maximum threshold above which the level is considered undesirable in the case of an indicator that must be minimised (for instance, prevalence of underweight). These three indices focus on one year (2015) and provide complementary information to the CPIs (over 2000-2015), so that in conjunction they provide greater robustness to the results.

The first step is to calculate the new normalised values of the indicators  $z_{ij}$ , where  $i$  denotes the countries and  $j$  the indicators. To do so,  $x_j^a$  denotes the ambition level of indicator  $j$ ,  $x_j^r$  denotes the reservation level, and  $x_j^{\min}$  and  $x_j^{\max}$  are the minimum and maximum values of the indicator  $j$ , respectively.

For an indicator that must be maximised, the normalised value is:

If  $x_{ij} \leq x_j^r$ , then  $z_{ij} = (x_{ij} - x_j^r) / (x_j^r - x_j^{\min})$ ; where the minimum is different from the reservation level.

If  $x_j^r \leq x_{ij} \leq x_j^a$ , then  $z_{ij} = (x_{ij} - x_j^r) / (x_j^a - x_j^r)$  (3)

If  $x_j^a \leq x_{ij}$ , then  $z_{ij} = 1 + (x_{ij} - x_j^a) / (x_j^{\max} - x_j^a)$ ; where the maximum is different from the ambition level.

For an indicator that must be minimised, the normalised value is:

If  $x_j^r \leq x_{ij}$ , then  $z_{ij} = (x_{ij} - x_j^r) / (x_j^r - x_j^{\max})$

If  $x_j^a \leq x_{ij} \leq x_j^r$ , then  $z_{ij} = (x_{ij} - x_j^r) / (x_j^a - x_j^r)$  (4)

If  $x_{ij} \leq x_j^a$ , then  $z_{ij} = 1 + (x_{ij} - x_j^a) / (x_j^{\min} - x_j^a)$

This normalisation implies that if  $z_{ij}$  is between -1 and 0, the value of country  $i$  for indicator  $j$  is worse than the reservation value; if  $z_{ij}$  is between 0 and 1, it is between the reservation and ambition values, and if  $z_{ij}$  is between 1 and 2, it is better than the ambition value.

The second step is to build the WI as the weighted arithmetic mean of the normalised indicators ( $z_{ij}$ ) obtained with the previous method (3) or (4):

$$WI_i = \sum_{j=1}^m w_j z_{ij} \quad (5)$$

where  $w_j$  denotes the correction factors obtained with the P2 Distance method which have been normalised so they add the unit.

The third step is to calculate the SI that reflects the minimum of all values. This index is built in such a way that if it takes values lower than 0 in any country, it means that at least



one indicator does not reach its corresponding reservation value. If it takes values above 1, it means that all the indicators have been reached and even exceeded the corresponding ambition values. Values between 0 and 1 indicate that a country has met the reservation values in all the indicators, but no indicator reaches the ambition value. Since all the studied countries register values below the reservation threshold in at least one indicator (as we will see below), and for the sake of simplicity, the SI can be calculated as follows<sup>7</sup>:

$$SI_i = \min_{j=1,\dots,m} w_j z_{ij} \quad (6)$$

Finally, in order to balance the total substitutability (WI) and no substitutability (SI), we build the MI as a linear combination of the previous ones:

$$MI_i = \lambda WI_i + \lambda SI_i; \text{ with } \lambda \in (0,1) \quad (7)$$

#### 4. Data and Indicators

To build the Country Performance Index for 2000 (CPI<sub>2000</sub>) and 2015 (CPI<sub>2015</sub>), which allows us to assess the LDCs' performance in terms of the MDGs, we use official statistics from several international databases facilitated by the World Bank Millennium Development Goals databank. Following a long review process, we have selected 16 indicators: two for each Millennium goal in order to present a balanced proposal (Table 1). The selection of these indicators has been guided firstly by those items for which the UN has placed greater emphasis in the various MDG monitoring reports and has quantified the levels to be reached. Secondly, we have tried to choose those indicators that were well defined and measured accurately. These two aspects have been very important in the choice of indicators, as they are essential to establish the reservation and ambition thresholds in the double reference point indices. Nevertheless, our selection has been determined by the availability of statistical information, especially since not all indicators proposed by the UN are available for the countries analysed. In this regard, it is important to note the lack of key indicators in some Millennium goals. For example, in goal 1 Eradicate extreme poverty and hunger, there is no information for the income distribution indicator, the extreme poverty indicators are not developed in eight countries, the indicators are only calculated for one year in four countries and no information is provided on a regular basis for the rest of the countries in the time period analysed.

The definitions of the selected indicators are provided in Appendix 2. To approximate the progress of countries towards the MDGs, we consider 10 indicators that are positively associated with human development or must be maximised (i.e. indicators whose increases contribute to achieving the MDGs) and six indicators that are negatively associated with human development or must be minimised (i.e. indicators whose increases distance the country from fulfilment of the MDGs).

Additionally, to check from a statistical point of view whether the selected indicators are sufficiently related to ensure inclusion in a composite index, the KMO test was performed. The results show that the 16 selected indicators passed the suitability test for 2000 and 2015 (KMO measure of sampling adequacy equal to 0.716 in 2000 and 0.590 in 2015, n = 48) (see Kaiser, 1970).

Taking into account the advantages of the P2 Distance as a method to construct composite indices that measure distances, to build the CPI<sub>2000</sub> and CPI<sub>2015</sub> we have also included 'World' as an additional country. World captures the average value of the indicators analysed in all the countries of the world (the world average). Thus, we work with a sample size equal to 49 (48 LDCs plus the world average). The inclusion of world allows us to analyse the evolution of countries over time compared to the world average. This

empirical strategy enables us to answer questions such as: Which countries are above the world average? Which countries have made the highest progress over time compared to the world average? Have LDCs reduced the gap with respect to the world average?

## 5. Results and Conclusions

### 5.1. Descriptive Analysis

Table 2 presents the descriptive statistics of the indicators for the 48 LDCs over the period 2000–2015. Except for *Real PPP GNI per capita* and *Net ODA received* as a consequence of the economic crisis, the progress has been positive, with a declining trend in the mean value of indicators with a higher negative impact on development and an improvement in those that contribute positively to development. Table 2 also shows Pearson's coefficient of variation, whose values indicate that the largest territorial differences arose in *Internet users*, *Real PPP GNI per capita*, *Net ODA received*, *Proportion of seats held by woman*, *Incidence of tuberculosis* and *Tuberculosis death rate*. Moreover, disparities between the 48 countries have been reduced in 10 of the 16 indicators.

Table 2. Descriptive statistics of the Millennium Development Goal indicators for the least developed countries (n = 48)

Indicator (goal number)	2000					2015				
	M	SD	Min	Max	CV	M	SD	Min	Max	CV
Prevalence of underweight (1)	26.76	10.77	1.60	47.60	40.26	21.40	9.66	1.60	45.30	45.13
Real PPP GNI per capita (1)	3,114.36	2,314.25	659.15	13,376.54	74.31	2,275.73	2,628.73	430.61	18,008.23	115.51
Primary completion rate (2)	49.41	22.21	16.27	101.69	44.95	69.70	20.77	29.55	112.36	29.80
Adjusted net enrolment rate (2)	63.72	21.82	25.89	99.32	34.24	78.20	18.57	28.65	98.06	23.75
Proportion of seats held by women (3)	9.46	7.79	0.00	30.00	82.33	19.65	13.24	0.00	63.80	67.38
School enrolment. gender parity (3)	0.82	0.17	0.08	1.05	20.90	0.94	0.12	0.55	1.12	12.47
Immunisation, measles (4)	59.92	17.46	24.00	91.00	29.14	75.65	18.06	20.00	99.00	23.88
Mortality rate, under-five (4)	133.69	49.59	28.70	233.90	37.09	70.58	28.39	26.20	136.70	40.22
Adolescent fertility rate (5)	114.58	48.93	25.24	218.89	42.70	87.45	44.00	18.16	196.03	50.31
Maternal mortality ratio (5)	732.94	413.50	144.00	2,650.00	56.42	426.35	252.54	78.00	1,360.00	59.23
Incidence of tuberculosis (6)	301.83	222.47	39.00	1,073.00	73.71	224.19	160.33	35.00	788.00	71.52
Tuberculosis death rate (6)	55.08	39.35	5.10	169.00	71.44	32.41	24.45	4.00	106.00	75.44
Improved sanitation facilities (7)	27.47	18.14	6.60	80.20	66.03	34.22	18.53	6.70	79.60	54.16
Improved water source (7)	59.06	16.25	23.50	94.00	27.51	70.89	16.02	31.70	100.00	22.60
Net ODA received (8)	13.60	10.81	0.68	55.53	79.45	11.73	13.27	0.09	69.02	113.12
Internet users (8)	0.58	1.40	0.00	7.00	240.65	13.96	9.22	1.08	42.70	66.05

Note. M: mean; SD: standard deviation; Min: minimum; Max: maximum; CV: Pearson's coefficient of variation (SD/M\*100). Adapted from the World Bank, Millennium Development Goals databank.

Table 3 shows the mean of the analysed indicators for all the countries of the world, that is, the world average. When comparing tables 2 and 3, it can be seen that, in average terms, the group of the 48 LDCs registers worse results than the world average in both 2000 and 2015. That is, in the indicators that have a negative impact on development, the LDCs register higher values than the world average, while in the indicators that contribute positively to development, this group registers lower values than the world average. For obvious reasons, *Net ODA received* is an exception as these countries are the largest recipients of this type of aid.

Table 3. Millennium Development Goal indicators for the world average (2000 and 2015) and baseline

Indicator (goal number)	World average 2000	World average 2015	Baseline	Country (year)
Prevalence of underweight (1)	20.73	14.32	47.60	Yemen, Republic (2000)
Real PPP GNI per capita (1)	12,473.07	13,250.01	430.61	Burundi (2015)
Primary completion rate (2)	81.84	90.10	16.27	Mozambique (2000)
Adjusted net enrolment rate (2)	85.22	91.20	25.89	Djibouti (2000)
Proportion of seats for women (3)	13.91	22.90	0.00	Comoros, Djibouti, Tuvalu, Vanuatu (2000)
School enrolment, gender parity (3)	0.92	1.00	0.08	Afghanistan (2000)
Immunisation, measles (4)	72.29	84.70	20.00	South Sudan (2015)
Mortality rate, under-five (4)	77.50	42.20	233.90	Sierra Leone (2000)
Adolescent fertility rate (5)	55.97	44.10	218.89	Niger (2000)
Maternal mortality ratio (5)	341.00	216.00	2,650.00	Sierra Leone (2000)
Incidence of tuberculosis (6)	172.00	142.00	1,073.00	Central African Republic (2000)
Tuberculosis death rate (6)	26.00	18.00	169.00	Central African Republic(2000)
Improved sanitation facilities (7)	58.79	67.50	6.60	Timor-Leste (2000)
Improved water source (7)	82.50	91.00	23.50	Somalia (2000)
Net ODA received (8)	0.15	0.20	0.09	Equatorial Guinea (2015)
Internet users (8)	6.77	43.20	0.00	Timor-Leste (2000)

Note. The baseline shows the worst values a hypothetical country would register in all the Millennium Development Goal indicators, taking into account 2000 and 2015. Adapted from the World Bank, Millennium Development Goals. The 'Country (year)' column indicates the country (and the year) that registered the worst value in each of the indicators analysed.

## 5.2. Country Performance Indices

From Table 2 we can estimate the vector of reference to calculate the CPIs; a key aspect in our proposal. In order to analyse the LDCs' progress towards the MDGs from 2000 to 2015, we build a hypothetical country (Baseline column in Table 3) that occupies the worst position of the LDCs in all MDGs indicators for both 2000 and 2015. More specifically, we have chosen the highest value of the maximum values in 2000 and 2015 for indicators with a negative impact on development and the lowest value of the minimum values in 2000 and 2015 for indicators with a positive impact on development. The last column in Table 3 indicates which countries register the worse situation with regard to the indicators and the year. As can be seen, most of these countries are located in the region of Sub-Saharan Africa.

Table 4 shows the 16 indicators ranked by entry order in the calculation formula of the CPIs according to their absolute linear correlation with the CPIs and the correction factor  $(1-R^2)$  for 2000 and 2015. Regarding the values of the correction factors  $(1-R^2)$ , it could be argued that all the indicators provide relevant information for determining performance in terms of MDGs, that is, no indicator is redundant and none is eliminated by the selection criteria implicit in the P2 Distance method. When an indicator did not provide different information to the CPI from that provided by the previous indicators, its correction factor is equal to zero (that is, the corresponding coefficient of determination  $R^2_{j,j-1, \dots, 1}$  is equal to one). For example, in Table 4, the *Primary completion rate* indicator, which ranks first in explaining the LDCs' performance in terms of MDGs in 2000, contributes 100% of its

information to construct the  $CPI_{2000}$  (correction factor 1). A correction factor of 0.54 is applied to *Immunisation, measles* in 2000 (in fourth place) because approximately 46% of the information for this indicator was already explained by the three previous indicators in the ranking. In 2015, *Net ODA received* is the indicator that correlated least with the  $CPI_{2015}$  and therefore ranks in the last position. However, the correction factor of 0.40 shows that this indicator contributed a very high percentage of new information that was not contributed by the 15 previous indicators. With respect to the pairwise correlation values between the indicators and the composite indices, *Primary completion rate* and *Improved water source* are the two indicators that correlate most strongly with the  $CPI_{2000}$ , and *Mortality rate, under-five* and *Maternal mortality rate* with the  $CPI_{2015}$ .

Table 4. Correction factors and absolute pairwise correlation between the indicators and Country Performance Indices in the least developed countries and the world average for 2000 and 2015 (n = 49)

Ranking 2000	Indicator	Correction factor (1-R <sup>2</sup> )	Pairwise correlation  r	Ranking 2015	Indicator	Correction factor (1-R <sup>2</sup> )	Pairwise correlation  r
1	Primary completion rate	1	0.74	1	Mortality rate, under-five	1	0.84
2	Improved water source	0.82	0.71	2	Maternal mortality ratio	0.38	0.74
3	Mortality rate, under-five	0.55	0.68	3	Internet users	0.66	0.73
4	Immunisation, measles	0.54	0.67	4	Primary completion rate	0.62	0.69
5	Adjusted net enrolment rate	0.38	0.64	5	School enrolment, gender parity	0.61	0.68
6	Improved sanitation facilities	0.70	0.63	6	Improved water source	0.55	0.67
7	Internet users	0.82	0.60	7	Adolescent fertility rate	0.53	0.65
8	Adolescent fertility rate	0.43	0.59	8	Improved sanitation facilities	0.69	0.61
9	School enrolment, gender parity	0.49	0.58	9	Immunisation, measles	0.55	0.58
10	Prevalence of underweight	0.65	0.57	10	Adjusted net enrolment rate	0.42	0.48
11	Maternal mortality ratio	0.38	0.52	11	Tuberculosis death rate	0.68	0.47
12	Real PPP GNI per capita	0.50	0.50	12	Prevalence of underweight	0.70	0.40
13	Tuberculosis death rate	0.76	0.45	13	Real PPP GNI per capita	0.36	0.39
14	Net ODA received	0.72	0.34	14	Incidence of tuberculosis	0.49	0.29
15	Incidence of tuberculosis	0.53	0.17	15	Proportion of seats held by women	0.65	0.11
16	Proportion of seats held by women	0.62	0.14	16	Net ODA received	0.40	0.10

Table 5 displays the results of  $CPI_{2000}$  and  $CPI_{2015}$ , the ranking of countries according to the degree to which the MDGs have been met, the percentage of variation in the CPI and the variation in the ranking of countries over the period 2000–2015.

Table 5. Comparisons of the least developed countries and the world average in terms of Millennium Development Goals, 2000 and 2015

Country	Ranking 2000	CPI <sub>2000</sub>	Ranking 2015	CPI <sub>2015</sub>	Variation <sup>a</sup>	Variation Rank <sup>b</sup>
Tuvalu	1	35.04	3	40.20	14.72	-2
World average <sup>c</sup>		31.85		47.63	49.55	
Sao Tome and Principe	2	30.09	4	38.53	28.03	-2
Vanuatu	3	28.88	5	38.30	32.59	-2
Kiribati	4	27.73	14	35.81	29.14	-10
Solomon Islands	5	26.55	8	36.48	37.39	-3
Timor-Leste	6	25.21	23	32.19	27.70	-17
Gambia, The	7	24.95	15	35.12	40.76	-8
Rwanda	8	23.44	1	40.82	74.17	7
Equatorial Guinea	9	23.37	22	32.63	39.62	-13
Bhutan	10	23.13	2	40.70	75.92	8
Myanmar	11	22.94	12	36.15	57.57	-1
Comoros	12	22.63	19	34.05	50.47	-7
Malawi	13	22.45	16	34.30	52.79	-3
Bangladesh	14	22.21	9	36.36	63.68	5
Zambia	15	21.85	18	34.12	56.16	-3
Nepal	16	21.39	6	37.95	77.41	10
Senegal	17	21.04	7	37.26	77.12	10
Haiti	18	21.00	32	31.06	47.93	-14
Lesotho	19	20.88	30	31.53	51.02	-11
South Sudan	20	20.82	45	24.57	18.02	-25
Eritrea	21	20.75	34	28.94	39.46	-13
Yemen, Rep.	22	20.04	29	31.73	58.32	-7
Togo	23	19.68	13	36.06	83.27	10
Sudan	24	19.67	25	32.00	62.71	-1
Djibouti	25	19.64	28	31.77	61.80	-3
Uganda	26	19.63	24	32.01	63.05	2
Lao PDR	27	19.45	11	36.17	85.96	16
Benin	28	19.39	26	31.97	64.84	2
Burundi	29	18.97	17	34.28	80.66	12
Mauritania	30	18.80	21	32.75	74.14	9
Tanzania	31	18.61	20	33.46	79.80	11
Liberia	32	17.97	36	28.60	59.19	-4
Sierra Leone	33	16.93	41	27.01	59.50	-8
Guinea-Bissau	34	16.82	38	28.17	67.47	-4
Madagascar	35	16.32	37	28.36	73.79	-2
Burkina Faso	36	16.21	31	31.47	94.08	5
Mali	37	15.91	40	27.92	75.45	-3
Mozambique	38	15.74	33	29.25	85.78	5
Cambodia	39	15.67	10	36.23	131.23	29
Guinea	40	15.65	35	28.92	84.83	5
Angola	41	15.16	39	28.00	84.66	2
Somalia	42	15.14	48	22.65	49.63	-6
Congo, Dem. Rep.	43	14.88	43	26.78	79.92	0
Afghanistan	44	12.94	42	26.95	108.32	2
Chad	45	12.58	47	23.68	88.31	-2

Ethiopia	46	11.26	27	31.93	183.46	19
Central African Republic	47	11.01	46	24.37	121.39	1
Niger	48	10.81	44	25.81	138.82	4
Average CPIs <sup>d</sup>		19.82		32.19		

Notes. CPI: Country Performance Index.

<sup>a</sup>Percentage of variation of CPI<sub>2015</sub> with respect to CPI<sub>2000</sub>. <sup>b</sup>Rank 2000-rank 2015. <sup>c</sup>Refers to the average value of each indicator calculated with all the countries of the world. <sup>d</sup>Average CPI for the 48 least developed countries.

Focusing on the ranking, four countries of East Asia and the Pacific region, as well as Sao Tome and Principe in Sub-Saharan Africa reached the five best positions in 2000. In 2015, Rwanda in Sub-Saharan Africa and Bhutan in South Asia joined the group with the best performance. Of the 20 countries that ranked highest in 2000 and 2015 in terms of progress towards the MDGs, only 10 of them were African, although they are a majority among the LDCs (accounting for 71% of the countries and 63.62% of population). In both years, two countries of Sub-Saharan Africa occupied the last positions in the rankings: Niger and the Central African Republic in 2000 and Somalia and Chad in 2015. The rankings of 48 LDCs resulting from both the CPI<sub>2000</sub> and the CPI<sub>2015</sub> are quite similar, as shown by Spearman's rank correlation coefficient ( $\rho = 0.76$ ,  $p < .001$ ,  $n = 48$ ) although some countries exhibit major changes in the ranking. Taking the world average of the CPI<sub>2000</sub> and CPI<sub>2015</sub> as a reference, the results indicate that only Tuvalu is above the average in 2000. However, the column of variation in CPI growth rates (sixth column Table 5) shows that all the countries studied, except 11 of them, have performed better than the world average in achieving the Millennium goals over 2000–2015. On the positive side, Cambodia and Ethiopia have risen 29 and 19 positions, respectively, from 2000 to 2015 (last column Table 5). On the other hand, South Sudan and Timor-Leste have fallen most in the ranking over the period; specifically, 25 and 17 positions, respectively.

A remarkable finding is that the average value of CPI<sub>2000</sub> for the 48 LDCs (19.82) is lower than the average value of CPI<sub>2015</sub> (32.19) for the same countries (last row in Table 5), and that this difference is statistically significant ( $t[94] = 12.58$ ,  $p < 0.001$ ,  $n = 96$ ) with an effect size equal to 2.57 (Cohen's  $d$ ), thus indicating that the magnitude of the difference is very large (Rosenthal, 1996). A comparison of the CPI<sub>2000</sub> and CPI<sub>2015</sub> values confirms that all the countries analysed have improved their performance in terms of the MDGs from 2000 to 2015: all countries have moved away from that hypothetical country that would represent the worst value in all the indicators. Likewise, there has also been a substantial narrowing of the gap between the first and the last country. Based on the P2 Distance additivity property (see Zarzosa Espina & Somarriba Arechavala, 2013), it can be inferred that the country which achieved the highest performance in 2000 (Tuvalu with CPI<sub>2000</sub> = 35.04) reached a 3.2 times higher level of development in terms of MDGs than that of the country with the lowest CPI value (10.81 in Niger). From 2000 to 2015, the differences were smaller because the country with the highest performance in 2015 (Rwanda with CPI<sub>2015</sub> = 40.82) reached a CPI value that was only 1.8 times greater than the country with the worse performance (Somalia with CPI<sub>2015</sub> = 22.65).

Figure 1 shows the mean value of CPI<sub>2000</sub> and CPI<sub>2015</sub> for the LDCs grouped by the UN regions compared to the world average. In both years, the average CPI values in all regions were below that of the world. East Asia and the Pacific and South Asia show the best CPI in 2015, although they represented eight countries with 8.43% of the LDC population and four countries with 23.87%, respectively. It is worth noting that, in terms of the Millennium goals, the Sub-Saharan Africa countries, which account for 63.62% of the total LDC population,

registered practically the same performance in 2015 ( $CPI_{2015} = 30.83$ ) as the world average at the beginning of the MDG strategy in 2000 ( $CPI_{2000} = 31.85$ ).

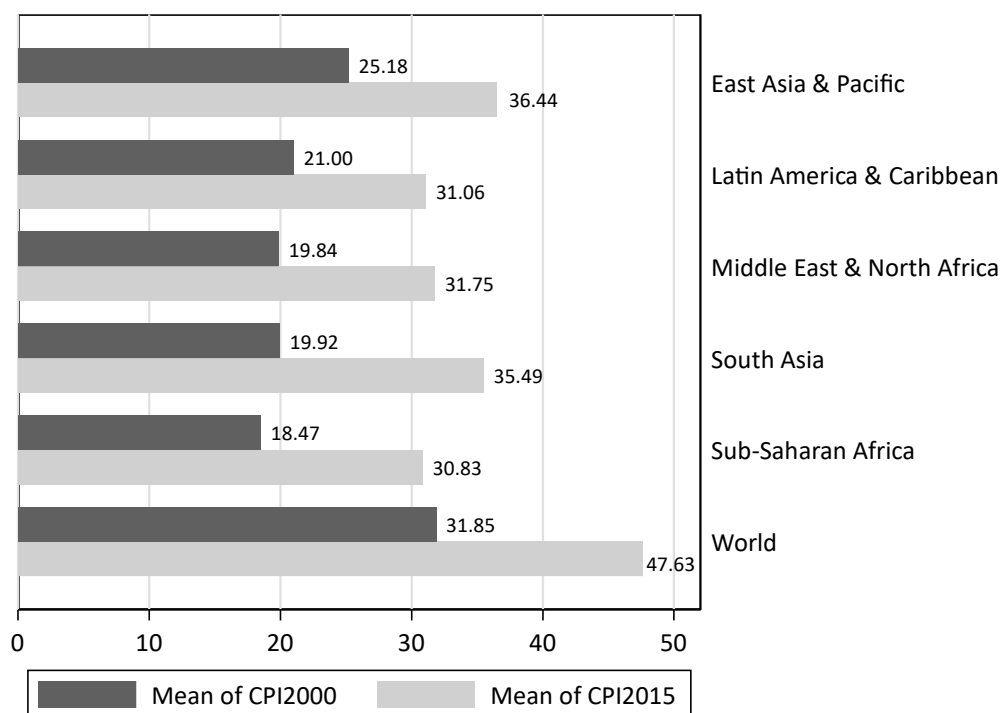


Figure 1. World average and mean of Country Performance Index for 2000 ( $CPI_{2000}$ ) and 2015 ( $CPI_{2015}$ ) in the five regions established by United Nations for the least developed countries.

### 5.3. Double Reference Point Indices

In spite of the fact that defining the minimum and maximum thresholds for the MDGs is beyond the scope of this paper, in order to apply the proposed normalisation (equations 3 and 4) of the indicators under the multi-criteria approach with a double reference point, a reservation and ambition level have to be defined for each indicator. Table 6 indicates the reservation and ambition values of the 16 indicators, as well as the weight ( $w_i$ ) or normalised correction factors obtained with the P2 Distance method and used to calculate the WI, SI and MI.

As level of reservation, we consider the mean values of the group of the LDCs in 2000 for the respective indicators. As level of ambition, whenever possible, we take into consideration the MDG goals. More specifically, for indicator 1 we adopt the reduction by half of the percentage of people who suffered from hunger between 2000 and 2015 (MDG goal 1), that is, since the mean prevalence of underweight in the LDCs was 26.76 in 2000, the ambition level in 2015 would be 13.38. For indicators 3 and 4, the goal of achieving universal primary education by 2015 (MDG goal 2), we establish an ambition level of 100% for both indicators. Eliminate gender disparity in primary and secondary education and in all levels of education no later than 2015 (MDG goal 3) means an ambition level for indicator 6 equal to 1. As regards reduce by two thirds, between 1990 and 2015, the under-five mortality rate (MDG target 4), we fix the reduction by two-thirds in that indicator from 175.82 in 1990 to 58.61 as the ambition level for 2015. Similarly, taking into account the reduction by three quarters of the maternal mortality ratio between 1990 and 2015 (MDG goal 5), we establish the ambition value for indicator 10 at 301. MDG goal 7 set out to halve, by 2015,

the proportion of the population without sustainable access to safe drinking water and basic sanitation. With reference to indicator 13 this means that if 24.47% of people had access to sanitation facilities in 2000, 75.53% (100-24.47) of the population did not have access in 2000. The ambition value will be to reduce the people without access to 37.77% in 2015, or to put it another way, to improve access to sanitation facilities for 62.23% of the population (100-37.77). Similarly, we fit the ambition value for indicator 14. Finally, the UN target for ODA to LDCs under the framework of the MDGs (goal 8) is 0.15-0.20% of donor GNI provided as aid to LDCs, which is equivalent to \$67 billion–\$89 billion (in 2014 dollars). Taking the average as a reference (\$78 billion), in terms of GNI (\$921.36 billion in 2014 dollars), the ambition level would be 8.47%.

Table 6. Reservation and ambition values and weights of Millennium Development Goals indicators for the least developed countries, 2015 (n = 48)

Indicator (goal number)	Reservation level	Ambition level	Weight <sup>a</sup>
1. Prevalence of underweight (1)	26.76	13.38	0.074
2. Real PPP GNI per capita (1)	3,305.35	4,957.31	0.032
3. Primary completion rate (2)	47.22	100	0.058
4. Adjusted net enrolment rate (2)	60.56	100	0.044
5. Proportion of seats for women (3)	9.92	50	0.067
6. School enrolment, gender parity (3)	0.85	1	0.071
7. Immunisation, measles (4)	57.36	100	0.057
8. Mortality rate, under-five (4)	138.94	58.61	0.105
9. Adolescent fertility rate (5)	119.98	34.75	0.065
10. Maternal mortality ratio (5)	732.00	301.00	0.045
11. Incidence of tuberculosis (6)	301.83	207.67	0.056
12. Tuberculosis death rate (6)	55.08	31.31	0.077
13. Improved sanitation facilities (7)	27.47	62.23	0.076
14. Improved water source (7)	59.06	79.53	0.065
15. Net ODA received (8)	6.20	8.53	0.042
16. Internet users (8)	0.10	26.26	0.068

Notes. <sup>a</sup>Normalised correction factors obtained with the P2 Distance method for the 48 least developed countries in 2015.

For the rest of the indicators in which the MDG targets are not established quantitatively, we have taken into account the complete empirical distribution in the 48 LDCs and considered the mean value of the 12 countries that reported the best performance in each indicator in 2015 (the best quartile).

Table 7 displays the results for the 48 LDCs in 2015 in the composite indices built with the P2 Distance method ( $CPI_{2015}$ ) and the multi-criterion approach with a double reference point (WI, SI and MI). Except in the case of SI, the country ranking of all the indices is practically the same. Spearman's rank correlation coefficient is 0.9622 ( $p < .001$ ,  $n = 48$ ) between the  $CPI_{2015}$  and WI, 0.9652 ( $p < .001$ ,  $n = 48$ ) between  $CPI_{2015}$  and MI, and 0.4987 ( $p < .001$ ,  $n = 48$ ) between the  $CPI_{2015}$  and the SI. Note that SI is the strictest index that reflects the minimum of all values, as it does not permit substitution between the indicators. In our study, all the LDCs register negative values, thus indicating that none of the 48 countries reached the ambition values in all the indicators. More specifically, Mauritania shows the highest value (SI = -0.003) and ranks first because it reaches the ambition threshold in all the indicators except in *Improved water source*, with only a small difference between the registered value (57.9) and the ambition level (59.06). However, given that the SI provides the information of only one indicator, in which each country registers the worst result, it should not be considered representative of the countries' performance in terms of MDGs.



Table 7. Comparisons of composite indices for the least developed countries in terms of Millennium Development Goals, 2015 (n = 48)

Country	Ranking CPI	CPI	Ranking WI	WI	Ranking SI	SI	Rankin MI	MI
Afghanistan	41	29.91	39	0.20	41	-0.058	40	0.07
Angola	40	30.39	43	0.15	34	-0.050	43	0.05
Bangladesh	9	39.68	10	0.76	22	-0.034	10	0.37
Benin	28	34.94	25	0.53	14	-0.028	25	0.25
Bhutan	1	44.48	1	1.17	2	-0.010	1	0.58
Burkina Faso	30	34.56	19	0.58	15	-0.028	21	0.28
Burundi	16	37.48	16	0.71	21	-0.032	16	0.34
Cambodia	10	39.58	12	0.74	6	-0.015	11	0.36
Central African Republic	46	26.73	46	0.04	20	-0.032	45	0.00
Chad	47	25.94	47	0.01	38	-0.056	47	-0.02
Comoros	17	37.35	17	0.70	31	-0.047	17	0.33
Congo, Dem. Rep.	43	29.27	44	0.08	24	-0.035	44	0.02
Djibouti	25	35.13	20	0.58	4	-0.012	20	0.28
Equatorial Guinea	22	35.58	22	0.56	32	-0.047	23	0.26
Eritrea	33	32.15	34	0.35	33	-0.048	34	0.15
Ethiopia	27	35.01	29	0.46	13	-0.028	26	0.21
Gambia, The	15	38.41	11	0.75	11	-0.023	12	0.36
Guinea	35	31.60	35	0.31	12	-0.028	35	0.14
Guinea-Bissau	38	30.82	37	0.25	28	-0.042	36	0.10
Haiti	31	34.38	24	0.54	26	-0.038	24	0.25
Kiribati	14	38.96	9	0.82	17	-0.029	9	0.40
Lao PDR	12	39.33	15	0.72	9	-0.019	13	0.35
Lesotho	32	34.19	31	0.42	37	-0.056	30	0.18
Liberia	36	31.24	40	0.18	27	-0.039	39	0.07
Madagascar	37	31.18	36	0.25	39	-0.057	37	0.10
Malawi	18	37.29	18	0.66	19	-0.032	18	0.31
Mali	39	30.64	33	0.38	30	-0.045	33	0.17
Mauritania	21	35.77	21	0.58	1	-0.003	19	0.29
Mozambique	34	31.70	38	0.22	23	-0.035	38	0.09
Myanmar	11	39.56	13	0.73	16	-0.028	14	0.35
Nepal	6	41.37	6	0.92	8	-0.018	6	0.45
Niger	44	28.28	41	0.17	42	-0.065	41	0.05
Rwanda	2	44.44	2	1.16	10	-0.021	2	0.57
Sao Tome and Principe	5	41.99	5	0.97	5	-0.014	5	0.48
Senegal	7	40.71	8	0.88	3	-0.011	7	0.44
Sierra Leone	42	29.32	42	0.16	35	-0.052	42	0.05
Solomon Islands	8	40.02	7	0.91	36	-0.053	8	0.43
Somalia	48	24.63	48	-0.06	45	-0.071	48	-0.06
South Sudan	45	27.31	45	0.08	47	-0.076	46	0.00
Sudan	23	35.18	28	0.46	25	-0.035	28	0.21
Tanzania	20	36.26	30	0.44	48	-0.077	31	0.18
Timor-Leste	24	35.18	26	0.50	46	-0.074	27	0.21
Togo	13	39.32	14	0.73	40	-0.058	15	0.34

Tuvalu	3	43.54	3	1.09	18	-0.031	3	0.53
Uganda	29	34.89	32	0.40	29	-0.043	32	0.18
Vanuatu	4	42.06	4	1.04	43	-0.067	4	0.48
Yemen, Rep.	26	35.05	27	0.46	44	-0.067	29	0.20
Zambia	19	37.19	23	0.55	7	-0.016	22	0.27

Notes. CPI: Country Performance Index. WI: Weak Index. SI: Strong Index. MI: Mixed Index.

#### 5.4. Conclusions

The main findings of the study are summarised in what follows.

First, in line with the United Nations (2015a) and other studies (see, for instance, Besada et al., 2017; D'Alessandro & Zulu, 2017; Sessa, 2016), our work concludes that all the countries analysed have made significant progress in achieving the MDGs over the period 2000–2015. Taking into account the changes in the ranking from 2000 to 2015, Cambodia registered the best performance and South Sudan the worse. However, much work remains to be done since the LDCs are far from reaching the levels that mark the world averages in the targets studied and because all the countries reached undesirable values (worse values than the reservation thresholds) in at least one indicator in 2015.

Second, the disparities between countries have been reduced globally in terms of the Millennium goals. Nevertheless, there is an enormous dispersion in some key variables related to macroeconomic variables, such as the *Real PPP GNI per capita* and the *Net ODA received*, and in others related to health such as *Incidence of tuberculosis* and *Tuberculosis death rate*. On the other hand, there seems to have been more widespread progress and less dispersion in such important objectives as education and gender equality (*School enrolment*, *gender parity* and *Primary completion rate*).

Third, the results of the double reference point indices (WI, SI and MI) provide robustness to the results obtained with the CPI<sub>2000</sub> and CPI<sub>2015</sub> indices built with the P2 Distance method, since the country rankings regarding fulfilment of the MDGs are very similar. In our study, the double reference point indices should be considered complementary to the CPI<sub>2000</sub> and CPI<sub>2015</sub> indices, since the latter allow us to perform an analysis spanning the full period of validity of the MDGs (2000–2015) and examine territorial disparities, as opposed to the former, which only considers a single year (2015). Furthermore, including the world average in the CPI indices has allowed us to compare the evolution of the LDCs with respect to the world average in terms of the MDGs.

#### 6. Discussion and Policy Implications

In this section we discuss the principal policy implications of our study for the 2030 Agenda for Sustainable Development with special reference to international cooperation as a key factor.

Firstly, several targets of the MDG Agenda are poorly specified, thus they cannot be monitored reliably. A prominent case is goal 1, which focuses on the reduction of poverty. For the LDCs there is no information for the income distribution and the poverty indicators are not available for all the countries analysed over the period 2000–2015. Moreover, as we discussed in section 2.2, the study of poverty must take into account the society in which people live. Despite this, the growth narrative continues to be predominant in international organisations; an approach which has been applied to the MDGs through the poverty lines (Vandemoortele, 2011). One of the main criticisms of the poverty lines is whether income can be understood as a reliable measure of human development. In the LDCs, relative poverty lines divert attention away from the basic needs of the poorest households since

they attempt to establish a minimum income requirement relative to the prevailing income levels in the whole population of the country (Duclos et al., 2006). In addition, for the specific case of poorer countries, absolute poverty lines tend to equate poverty with hunger. Thus, many poverty reduction policies are based on the idea that the poor need food. Except in very specific cases (for example, in natural disasters), people remain poor even if they eat enough (Banerjee & Duflo, 2015). Food cannot continue to play a leading role in explaining poverty, the deprivation of other capacities must be taken into account (Clark, 2003; Davis, 2017; Robeyns, 2005). Lastly, the aggregation exercise done through simple head counting does not pay attention to the fact that people could be a little below the line, or a lot, nor does it take into account the distribution of income among the poor (Sen, 1992).

Secondly, in relation to the previous point, the MDG Agenda has been criticised in the context of the LDCs because the MDG approach focuses on long-term determinants of growth and development instead of the short-term alleviation of poverty, which is a priority in LDCs (Basnett et al., 2014). Given their extreme vulnerability and the magnitude of their poverty, it would have been necessary to implement a comprehensive set of strategic components to ensure fuller delivery of the MDGs (Bhattacharya & Khan, 2014). To overcome these shortcomings, in 2011 the UN adopted the Istanbul Programme of Action (IPoA) to be implemented by the LDCs in order to improve their economic and social conditions. The IPoA foresees favourable measures for the LDCs in economic, social and governance areas that foster the structural transformation, diversification and productive capacities they demand.

Thirdly, although the MDGs have encouraged the collection of statistical information in the LDCs, the availability of data remains a major constraint to better assess the achievements, improve accountability and analyse the true nature of the problems affecting these countries (Vandemoortele, 2011). A lack of scientifically valid data on some MDGs does not allow the improvement achieved to be measured adequately or to be compared with a baseline. The LDCs and the UN need to work together to make more quality data available in real time (LDC IV Monitor, 2014), especially in order to account for the fulfilment of the 2030 Agenda goals.

Fourth, in reference to aid, ODA continues to be the largest source of external financing for development and for combating poverty in the LDCs. In quantitative terms, under the framework of the MDGs (goal 8), the UN target states that donor countries should have provided between 0.15–0.20% of their GNI as ODA to LDCs, which, in average terms, would represent 8.52% of the GNI of the group of LDCs for 2015. Over the period 2002–2008, the LDCs received 8.53% of their GNI annually. However, as a consequence of the economic crisis, from 2008 to 2014 the ODA received as a percentage of the GNI has been successively reduced to 4.55%, almost half of the 2015 MDG target. This aid was primarily intended to finance social infrastructure and services (UNCTAD, 2016a).

Despite the fact that development aid has broadened to include human and social capital, there is a lack of a general agreement as to its benefits and some major shortcomings have been identified. The dominance of economic approaches and the imposition of conditionalities act as barriers to development in aid-recipient countries (Jakupec, 2018). Another central point is how the aid is distributed within countries. For the specific case of 17 low-income African countries, Briggs (2017) concluded that political and economic factors within aid recipients are skewing aid towards richer regions. That is, while multilateral donors are able to target aid to poorer countries, the distribution of their aid within countries is fostering inequalities.

The reduction of aid by the donor countries and the way it is being distributed has undermined progress towards poverty reduction and the MDG targets. In the future both governments and donors must provide more resources to achieve the 2030 Agenda goals. International aid should be sustainable over time and be combined with innovative mechanisms. Accountability and close monitoring of corruption regarding the use of resources must be an essential part of the framework. Likewise, the participation of civil society and its accountability is key for a strong new policy development and implementation process (Hook, 2015; Lomazzi et al., 2014).

Finally, with regard to trade as another key aspect of international cooperation, the fact is that economic vulnerability has not diminished significantly in the LDCs. Many of them are dependent on commodity exports and, due to insufficient export diversification, are struggling significantly with commodity prices (UN-OHRLLS, 2017; United Nations, 2015a). The LDCs also remain heavily exposed to severe economic and natural shocks, including threats related to climate change, and are far less equipped to deal with such challenges (Bhattacharya & Khan, 2014). The Enhanced Integrated Framework (EIF), the only multi-donor programme that exclusively helps LDCs to use trade as a vehicle for poverty reduction and growth, offers the LDCs the chance to receive technical assistance. These countries require results in terms of building productive capacity, transforming the structure of economies, and lifting binding constraints to trade development (Osakwe, 2015). However, policies which best support poverty reduction should not be based on a trade strategy alone, but also connected with the nation's development objectives. In practice, this means that trade objectives and trade policy priorities need to be 'mainstreamed' into a country's national development strategy (Santos-Paulino & Urrego-Sandoval, 2015).

To sum up, the 2030 Agenda for the LDCs should be informed by the results and experience of the MDG Agenda. Country-specific strategies and international support are required for dealing with the multiple challenges facing these countries (LDC IV Monitor, 2014). Likewise, inequalities must be taken into account for monitoring the social progress under the 2030 Agenda. Our findings indicate that the disparities between countries in terms of the MDGs have been reduced. However, as several studies have pointed out, within-country disparities in income, health, gender, and social aspects have grown in the poorest countries to the point of slowing down global progress, thus making it difficult for them to achieve the MDGs or the Sustainable Development Goals (Bussolo & De Hoyos, 2009; Clemens et al., 2007; Fukuda-Par, 2010; Fukuda-Par et al., 2013; Reidpath et al., 2009). Synergies and complementarities between the IPoA and the 2016–2030 Sustainable Development Goals (United Nations, 2015b) need to be taken into account, and the monitoring of these various agendas at national, regional and global levels needs to be aligned (UN-OHRLLS, 2017). These results encourage us to undertake more specific studies on the LDCs in the 2030 Agenda context.

## References

- Akobeng, E. (2016). Growth and Institutions: A Potential Medicine for the Poor in Sub-Saharan Africa. *African Development Review*, 28(1), 1–17.
- Andrews, F. M., and Withey, S. B. (1976). *Social indicators of well-being*. New York: Plenum Press.
- Banerjee, A.V. and Duflo, E. (2015). *Poor Economics. A Radical Rethinking of the Way to Fight Global Poverty*. New York: Public Affairs.

- Basnett, Y., Keane, J., and Velde, D.W. (2014). The Istanbul Programme of Action for LDCs: A Monitoring and Benchmarking Exercise (chapter 2). In LDC IV Monitor (2014). *Istanbul Programme of Action for the LDCs (2011-2020) Monitoring Deliverables, Tracking Progress – Analytical Perspectives* (pp. 38-70). London: Commonwealth Secretariat.
- Besada, H., Xu, J., Mathers, A., and Carey, R. (2017). Advancing African agency in the new 2030 transformative development agenda. *African Geographical Review*, 36(1), 19-44. DOI: 10.1080/19376812.2016.1138232
- Bhattacharya, D. and Khan, T.I. (2014). The Challenges of Structural Transformation and progress towards the MDGs in LDCs (chapter 1). In LDC IV Monitor. *Istanbul Programme of Action for the LDCs (2011-2020) Monitoring Deliverables, Tracking Progress – Analytical Perspectives* (pp. 1-37). London: Commonwealth Secretariat.
- Booyesen, F. (2002). An overview and evaluation of composite indices of development. *Social Indicators Research*, 59(2), 115–51.
- Briant Carant, J.B. (2017). Unheard voices: a critical discourse analysis of the Millennium Development Goals' evolution into the Sustainable Development Goals. *Third World Quarterly*, 38(1), 16-41.
- Briggs, R. (2017). Does Foreign Aid Target the Poorest?. *International Organization*, 71 (1), 187-206. DOI 10.1017/S20818316000345.
- Bussolo, M., and De Hoyos, R. 2009. The Gender Effects of Trade Liberalization in Developing Countries: A Review of the Literature. In M. Bussolo and R. E. De Hoyos (Eds.), *Gender Aspects of the Trade and Poverty Nexus - A Macro-micro Approach*. Washington, D.C.: World Bank.
- Clark, D. A. (2003). Sen's Capability Approach and the Many Spaces of Human Well Being. *Journal of Development Studies*, 41(8), 1139-1168.
- Clemens, M.A., Kenny, C.J., and Moss, T.J. (2007). The Trouble with the MDGs: Confronting Expectations of Aid and Development Success. *World Development*, 35(5), 735-751. DOI:10.1016/j.worlddev.2006.08.003
- Cuenca, E., Rodríguez, J. A., and Navarro, M. (2010). The features of development in the pacific countries of the African, Caribbean and Pacific group. *Social Indicators Research*, 99, 469–485.
- D'Alessandro, C. and Zulu, L.C. (2017). From the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs): Africa in the post-2015 development Agenda. A geographical perspective. *African Geographical Review*, 36(1), 1–18. DOI: 10.1080/19376812.2016.1253490
- Davis, T.J. (2017). Good governance as a foundation for sustainable human development in sub-Saharan Africa. *Third World Quarterly*, 38(3), 636–654.
- Davis T.W.D. (2011). The MDGs and the incomplete relationship between development and foreign aid. *Journal of the Asia Pacific Economy*, 16, 562–578. DOI:10.1080/13547860.2011.610888.
- Duclos, J., Sahn, D., and Younger, S. (2006). Robust Multidimensional Poverty Comparisons. *The Economic Journal*, 116, 943–968.
- Fosu, A. K. (2010). Inequality, Income, and Poverty: Comparative Global Evidence. *Social Science Quarterly*, 91(5), 1432-1446.
- Fritz, V. and Menocal, A.R. (2007). Developmental States in the New Millennium: Concepts and Challenges for a New Aid Agenda. *Development Policy Review*, 25(5), 531-552.

- Fukuda-Parr, S. (2010). Reducing inequality–The missing MDG: A content review of PRSPs and bilateral donor policy statements. *IDS Bulletin*, 41(1), 26-35.
- Fukuda-Parr, S. and Shiva Kumar, A.K. (2003). *Readings in Human Development*. Delhi: Oxford University Press.
- Fukuda-Parr S., Greenstein J., and Stewart D. (2013). How should MDG success and failure be judged: Faster progress or achieving the targets?. *World Development*, 41,19–30. DOI:10.1016/j.worlddev.2012.06.014.
- Gough, I., McGregor, A. J., and Camfield, L. (2007). Theorising wellbeing in international development. In I. Gough, and A. J. McGregor (Eds.). *Wellbeing in Developing Countries: From Theory to Research* (pp. 3-44). Cambridge: Cambridge University Press.
- Hook, S. W. (2015). Foreign aid in comparative perspective: Regime dynamics and donor interests. In R. Groelsema, T.F. Buss, and L.A. Picard (Eds.). *Foreign aid and foreign policy: Lessons for the next half-century* (pp. 86-105). New York: Routledge.
- Jakupec V. (2018) A Critique of the Development Aid Discourse. In: *Development Aid—Populism and the End of the Neoliberal Agenda*. Chapter 3. SpringerBriefs in Philosophy. Springer, Cham. Pp. 37-52. DOI: 10.1007/978-3-319-72748-6\_3
- Kaiser, H. F. (1970). A second generation Little Jiffy. *Psychometrika*, 35, 401-415.
- Kuklys, W. (2005). *Amartya Sen's Capability approach: Theoretical insights and empirical applications*. Berlin: Springer Verlag.
- LDC IV Monitor (2014). *Istanbul Programme of Action for the LDCs (2011-2020) Monitoring Deliverables, Tracking Progress – Analytical Perspectives*. London: Commonwealth Secretariat.
- Leftwich, A. (1995). Bringing Politics Back in: Towards a Model of the Development State. *The Journal of Development Studies*, 31(3), 400-427.
- Lomazzi, M., Borisch, B., and Laaser, U. (2014). The Millennium Development Goals: experiences, achievements and what's next. *Global Health Action*, 7(1), 10.3402/gha.v7.23695. DOI: 10.3402/gha.v7.23695
- Luque, M., Pérez-Moreno, S., Robles, J.A., and Rodríguez, B. (2017). Measuring Child and Maternal Health in Developing Countries: A Proposal of New Hybrid MDG Composite Indices. *Applied Research in Quality of Life*, 12(3): 737-758.
- Michalos, A. C., Smale, B., Labonté, R., Muharjarine, N., Scott, K., Moore, K., et al. (2011). *The Canadian Index of Wellbeing. Technical Report 1.0*. Waterloo, ON: Canadian Index of Wellbeing and University of Waterloo.
- Neumayer, E. (2003). Beyond income: Convergence in living standards, big time. *Structural Change and Economic Dynamics*, 14, 275–96.
- Nussbaum, M. C. (2011). *Creating Capabilities. The Human Development Approach*. Cambridge, MA: The Belknap Press of Harvard University Press.
- OECD, European Commission, Joint Research Centre (2008). *Handbook on Constructing Composite Indicators. Methodology and User Guide*. OECD publishing. DOI:10.1787/9789264043466-en
- OECD (2013). *How's Life? 2013. Measuring Well-being*. OECD publishing.
- Osakwe, P.N. (2015). Mainstreaming Trade in Africa: Lessons from Asia and the Way Forward. *UNCTAD Trade and Poverty Paper Series No. 4*. United Nations Conference on Trade and Development, Geneva.

- Pena Trapero, J.B. (1977). *Problemas de la medición del bienestar y conceptos afines (Una aplicación al caso español)*. Madrid, Spain: INE.
- Permanyer, I. (2011). Assessing the robustness of composite indices rankings. *Review of Income and Wealth*, 57(2), 306–26.
- Pogge T. (2004). The first United Nations millennium development goal: A cause for celebration?. *Journal of Human Development*, 5, 377–397.
- Reidpath, D., Morel, C., Mecaskey, J. and Allotey, P. (2009). The Millennium Development Goals Fail Poor Children: The Case for Equity-Adjusted Measures. *PLOS Medicine*, 6(4). DOI:10.1371/journal.pmd.1000062.
- Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development*, 6(1), 93–114.
- Robeyns, I. (2006). The capability approach in practice. *The Journal of Political Philosophy*, 14(3), 351–376.
- Rosenthal, J.A. (1996). Qualitative descriptors of strength of association and effect size. *Journal of Social Service Research*, 21(4), 37-59.
- Sánchez, A., Chica-Olmo, J., and Jiménez-Aguilera, J.D. (2018). A Space–Time Study for Mapping Quality of Life in Andalusia During the Crisis. *Social Indicators Research*, 135(2), 699-728. DOI: 10.1007/s11205-016-1497-9
- Santos-Paulino, A.U., and Urrego-Sandoval, C. (2015). Integrating into National Development Strategies and Plans: The Experience of African LDCs. *UNCTAD Trade and Poverty Paper Series No. 3*. United Nations Conference on Trade and Development, Geneva.
- Sen, A. (1980). Equality of what? In S. McMurrin (Ed.), *Tanner lectures on human values* (Vol. 1). Cambridge: Cambridge University Press.
- Sen, A. (1987). *Standard of living*. New York: Cambridge University Press.
- Sen, A. (1992). *Inequality re-examined*. New York: Oxford University Press.
- Sessa, M. (2016). Measuring and Monitoring the Achievements of the Millennium Development Goals Through Dynamic Composite Indices. *Social Indicators Research*, 127, 469–503.
- Stiglitz, J., Sen, A., and Fitoussi, J. (2011). *Mismeasuring Our Lives: Why GDP doesn't Add Up*. New York: The New Press.
- UN-OHRLLS (2017). *State of the Least Developed Countries 2017. Follow-up of the Implementation of the Istanbul Programme of Action*. New York.  
[http://unohrlls.org/custom-content/uploads/2017/07/State-of-the-LDCs\\_2017.pdf](http://unohrlls.org/custom-content/uploads/2017/07/State-of-the-LDCs_2017.pdf)
- UNCTAD (2016a). *Statistical Tables on the Least Developed Countries 2016*. Geneva: United Nations.
- UNCTAD (2016b). *The Least Developed Countries Report 2016*. Geneva: United Nations.
- United Nations (2000). *United Nations Millennium Declaration*. Resolution 55/2 adopted by the General Assembly at its fifty-fifth session. New York: United Nations.
- United Nations (2015a). *The Millennium Development Goals Report 2015*. New York: United Nations.  
[http://www.un.org/millenniumgoals/2015\\_MDG\\_Report/pdf/MDG%202015%20rev%20\(July%2015\).pdf](http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%2015).pdf)

United Nations (2015b). *Transforming our world: the 2030 Agenda for Sustainable Development*. Resolution 70/1 adopted by the General Assembly on 25 September 2015. [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/70/1&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E)

Unwin, T. (2007). No End to Poverty. *Journal of Development Studies*, 43(5), 929-953.

Van den Bergh, J. (2009). The GDP Paradox. *Journal of Economic Psychology*, 30(2), 117–135.

Vandemoortele, J. (2011). The MDG story: intention denied. *Development and Change*, 42(1), 1-21.

Zarzosa Espina, P., and Somarriba Arechavala, N. (2013). An Assessment of Social Welfare in Spain: Territorial Analysis Using a Synthetic Welfare Indicator. *Social Indicators Research*, 111(1), 1-23.

### **Appendix 1. The least developed countries by United Nations regions**

1. East Asia and Pacific (eight countries)

Cambodia, Kiribati, Lao People’s Democratic Republic, Myanmar, Solomon Islands, Timor-Leste, Tuvalu and Vanuatu.

2. Latin America and Caribbean (one country)

Haiti.

3. Middle East and North Africa (two countries)

Djibouti and Yemen.

4. South Asia (four countries)

Afghanistan, Bangladesh, Bhutan and Nepal.

5. Sub-Saharan Africa (33 countries)

Angola, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Democratic Republic, Congo, Equatorial Guinea, Eritrea, Ethiopia, Guinea, Guinea-Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda and Zambia.

### **Appendix 2. Definitions and sources of the indicators**

Indicator	Definition
1	Percentage of children under age 5 whose weight for age is more than two standard deviations below the median for the international reference population ages 0-59 months.
2	PPP GNI is gross national income (GNI) converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States.
3	Number of new entrants (enrolments minus repeaters) in the last grade of primary education, regardless of age, divided by the population at the entrance age for the last grade of primary education. Data limitations preclude adjusting for students who drop out during the final year of primary education.
4	Number of pupils of the school-age group for primary education, enrolled either in primary or secondary education, expressed as a percentage of the total population in that age group.
5	Percentage of parliamentary seats in a single or lower chamber held by women.
6	Ratio of girls to boys enrolled at primary level in public and private schools.



7	Percentage of children ages 12-23 months who received vaccinations before 12 months or at any time before the survey. A child is considered adequately immunized against measles after receiving one dose of vaccine.
8	Probability per 1,000 that a newborn baby will die before reaching age five.
9	Number of births per 1,000 women ages 15-19.
10	Number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births.
11	Estimated number of new and relapse tuberculosis cases arising in a given year, expressed as the rate per 100,000 population. All forms of TB are included, including cases in people living with HIV.
12	Estimated number of deaths from tuberculosis among HIV-negative people, expressed as the rate per 100,000 population.
13	Percentage of the population using improved sanitation facilities. Improved sanitation facilities are likely to ensure hygienic separation of human excreta from human contact. They include flush/pour flush (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet.
14	Percentage of the population using an improved drinking water source. The improved drinking water source includes piped water on premises (piped household water connection located inside the user's dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection).
15	Consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients. It includes loans with a grant element of at least 25% (calculated at a rate of discount of 10%).
16	Individuals who have used the Internet (from any location) in the last 12 months. Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV, etc.

Note. Adapted from the World Bank, Millennium Development Goals.

<sup>1</sup> UN Resolution 2768 (XXVI) of 18 November 1971.

<sup>2</sup> Based on a three-year average estimate there is a threshold of \$1,035 for possible cases of inclusion in the list and a threshold of \$1,242 for cases of graduation from LDC status.

<sup>3</sup> The Human Assets Index is a composite index of human capital based on five indicators of health and education that takes values from 0 to 100. Low levels of human assets indicate major structural impediments to sustainable development. The inclusion threshold has been set at 60 and the graduation threshold at 66.

<sup>4</sup> The Economic Vulnerability Index (EVI) is a measure of structural vulnerability to economic and environmental shocks based on eight indicators. A higher EVI represents higher economic vulnerability. The inclusion threshold has been set at 36 and the graduation threshold at 32.

<sup>5</sup> There exist two kinds of poverty lines: an absolute one, in which a group of experts establishes the minimum cost or income necessary to consume a given basket of goods; and a relative one, in which the threshold or minimum income is set to some fraction of average or median income of the territory under analysis.

<sup>6</sup> The concept of substitutability refers to the possibility of compensating a worse value of an indicator by improving the value of another one, keeping the index constant.

<sup>7</sup> From the calculation formula facilitated by Luque et al. (2017, p. 746) it is easy to check that in the event that all the countries register a negative value in at least one of the normalised indicators ( $z_{ij}$ ), the  $C_i$  term will be equal to 0.