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Welfare Poverty and Human Development

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Keywords: Welfare poverty; multidimensional poverty; human development; social evaluation function.

JEL Classification: I32, O15.

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Abstract

This paper proposes an approach to poverty measurement based on the interpretation of poverty as a *welfare loss*. A multidimensional poverty index is derived here from a social evaluation function and a vector of poverty thresholds. A welfare poverty index is defined as the relative welfare loss due to the insufficient welfare of those agents whose achievements do not reach the minimum established. Under standard assumptions, this index can be expressed as the product of the incidence and the intensity of poverty. We include an application to the measurement of poverty among the countries that appear in the last Human Development Report, using the variables that conform the Human Development Index.

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1. Introduction

Poverty is a complex phenomenon that refers to the difficulty of having a decent standard of living and a satisfactory social and personal life. Intuitive as it is, this notion presents many difficulties when it comes to be measured. First, we must agree on the variables that describe life satisfaction and the standard of living, and decide on the levels of those variables that define insufficient achievement. Second, what poverty means might be different when considering societies with dissimilar levels of development. This is not only because their average standards of living and aspirations might be very diverse, but also because the different penetration of market institutions, the degree of substitutability between primary goods, and hence the relevance of monetary values to make computations. Third, poverty measurement may refer to the distribution of several variables, adopt a subjective or an objective approach, refer to some absolute or relative thresholds to define who are the poor, and consider quantitative and/or categorical variables.

Our analysis here refers to *objective poverty measurement for quantitative variables in a multidimensional context*. Focussing on quantitative variables leaves aside somehow the analysis of extreme poverty, which tends to be addressed nowadays in terms of qualitative variables (see Alkire & Santos, 2010, Alkire & Foster, 2012, and Alkire et al, 2015).[1] Yet poverty analysis regarding quantitative variables is also very relevant, especially after the substantial increase of inequality and poverty in most developing and developed countries due to the impact of the financial crisis and the Covid-19 pandemics. The multidimensional approach is important because poverty may involve several aspects that cannot always be represented by income or wealth alone. The reason is that those aspects may evolve differently within each society. See Dardadoni (1995), Tsui (2002), Atkinson (2003), Bourguignon & Chakravarty (2003), Duclos & Araar (2006), Wagle (2008), Chakravarty (2009), Haughton & Khandker (2009), or Aaberge & Brandolini (2015) for a comprehensive discussion.

Poverty measurement involves at least two different aspects: *incidence* and *intensity*. That is, how many poor people are in society, and how poor they are. It might also include inequality as a third aspect, that is, how unequal is the

[1] See also the flow of contributions emanating from the *Oxford Poverty and Human development Initiative* (http://www.ophi.org.uk).

distribution of the achievements among the poor. The most common approach to poverty measurement starts by defining a poverty line for each dimension, as the minimum level deemed acceptable, and then proceeds to construct an evaluation function that applies to those agents whose achievements are below some or all those thresholds. A poverty index is a mapping that associates real numbers to vectors of achievements, which incorporates some basic value judgements regarding our ethical appraisal of poverty (see Chakravarty, 2009, Ch. 2, Villar 2017, for a more detailed discussion).

We propose here the construction of a poverty index based on the interpretation of poverty as a *welfare loss*, following the Atkinson-Kolm-Sen approach to the normative theory of income inequality. Related ideas appear in the works of Blackorby & Donaldson (1980), Clark, Hemming & Ulph (1981), Vaughan (1987), Pyatt (1987), and Lewis & Ulph (1988) among others (see also the discussion in Kakwani (1997) and Chakravarty (2009, 2.3.3)).

In this paper we apply that welfare approach to a multidimensional context by identifying poverty with a welfare loss, in terms of a utilitarian social evaluation function defined on the space of multidimensional distributions. We use the term *welfare poverty index* to refer to this construct. Our approach follows what Duclos & Araar (2006, ch. 5) call "the poverty gap approach". Indeed, in the single-dimensional case a welfare poverty index corresponds to a standard relative poverty gap measure. Rather than looking for new poverty indices we shall provide here an easy venue to derive a familiar formula from a normative approach.

The reference model is presented in Section 2. Assuming that individual welfare can be evaluated with the same social evaluation function that applies for the whole society, we present a poverty measure that describes the welfare loss due to poverty. Using a utilitarian social evaluation function that satisfies factor decomposability, this poverty measure corresponds to an extension of the conventional relative poverty gap measure. This evaluation protocol is applied in Section 3 to analyse the world's welfare poverty in terms of human development. That is, using the same variables that define the human development index (health, education, and material wellbeing), we study those countries that are poor because they do not reach the minimum welfare admissible (set at the level determined by the 60% of the median of the distribution of those variables). Interestingly enough, all the countries that United Nations consider as "Low human development countries" are welfare-poor, according to our poverty measure. A few final

comments close the work.

2. The model

We consider here the evaluation of poverty in a society N consisting of n agents with respect to k different dimensions, all of which can be measured in terms of quantitative variables.

We denote by $\mathbf{Y}$ the $n \times k$ non-negative matrix that describes the achievements of the n agents in N, with respect to the k welfare dimensions. Assuming a relative poverty approach, we let $g: \mathbb{R}_+^{n\times k} \to \mathbb{R}_+^n - \{\mathbf{0}\}$ the function that defines the k poverty thresholds, that is, $g(\mathbf{Y}) = \boldsymbol{z}$. There is, therefore, one threshold for each dimension that defines the limit below which an agent will be regarded as poor in that dimension. All entries in $\mathbf{Y}$ and $\mathbf{z}$ are assumed to be non-negative (and not all equal to zero) and describe variables that are positively related to welfare. A poverty index is a function that applies the space of pairs $(\mathbf{Y}, \mathbf{z})$, for any (finite) dimension, into the real numbers. Following a normative approach to poverty measurement, we shall deduce our poverty indices from a social evaluation function, W, defined on the space of achievements. The poverty measure so obtained will be called a *welfare poverty index*.

Let $\Omega = \{\mathbf{Y} \in \mathbb{R}_+^{n\times k}, n, k \in \mathbb{N}\}$, that is, the family of all possible achievement matrices. We adopt the convention of describing each agent's vector of achievements as a row and the distribution across agents of the variable that captures each dimension, as a column. Agent i's achievements will be denoted by the (row) k-vector $\boldsymbol{y}_i$ whereas the distribution of dimension j across agents by the (column) n-vector $\boldsymbol{y}^{(j)}$. A poverty evaluation setting is thus summarized by the pair (Ω, g), whereas a poverty evaluation problem is given by a pair $(\mathbf{Y}, \boldsymbol{z})$, with $\boldsymbol{z} = g(\mathbf{Y})$. A **social evaluation function** is a mapping $W: \Omega \to \mathbb{R}_+$.

Given a matrix of achievements, $\mathbf{Y}$, we define for each agent $i \in N$, with achievements $\mathbf{y}_i \in \mathbb{R}_+^k$, his *personal welfare* in terms of our social evaluation function, when applied to a society consisting of this individual alone. That is, $W(\mathbf{y}_i)$ describes the social evaluation of individual i's welfare, rather than his subjective utility. This can be done as the social evaluation function is defined over the set Ω.

Note that the Cartesian product structure of the space of achievements, Ω, implies a separability property that allows applying the social evaluation function to single individuals. Moreover, this implies that agents' welfare is interpersonally comparable, so that it can be aggregated across agents.

Given a poverty evaluation problem, $(\mathbf{Y}, \boldsymbol{z})$, we can define an individual as poor when his personal welfare is below the minimum established by the poverty thresholds. That is, agent *i* is **welfare-poor** if and only if: $W(\mathbf{y}_i) < W(\mathbf{z})$.

We now define the poverty index as the relative welfare loss of the poor. To arrive at a precise formulation of that measure, let p stand for the number of the welfare-poor agents and $\mathbf{1}_p$ for the unit vector of dimension p. Then, the $p \times k$ matrix $\mathbf{Z}^p = \left(\mathbf{1}_p z_1, \mathbf{1}_p z_2, \dots, \mathbf{1}_p z_k\right)$ describes a situation in which all the poor are shifted to the limit outside the poverty lines. Therefore, $W(\mathbf{Z}^p)$ is the minimum welfare that society would like to ensure for the poor individuals. Yet the actual welfare of the poor is given by $W(\mathbf{Y}^p)$, where $\mathbf{Y}^p$is a $p \times k$ matrix that describes the achievements of the poor. The absolute welfare loss due to poverty is thus given by:

$$W(\mathbf{Z}^p) - W(\mathbf{Y}^p)$$

That is, how far away this society is from ensuring the minimum admissible welfare to all the poor.

Similarly, let $\mathbf{Z}^n = (\mathbf{1}_n z_1, \mathbf{1}_n z_2, \dots, \mathbf{1}_n z_k)$. Then, $W(\mathbf{Z}^n)$ is the minimum welfare admissible for the whole society. We define the multidimensional welfare poverty index, $P_W(\mathbf{Y}, \mathbf{z})$, as the relative welfare loss that results from the ratio between the absolute welfare loss and that minimum welfare value. Formally,

Definition 1: A ***welfare poverty index***, relative to a society N with n members, regarding k welfare dimensions, is a mapping $P_W: \mathbb{R}_+^{n \times k} \times \mathbb{R}_+^k \to \mathbb{R}_+$, given by:

$$P_W(\mathbf{Y}, \mathbf{z}) = \frac{W(\mathbf{Z}^p) - W(\mathbf{Y}^p)}{W(\mathbf{Z}^n)} \qquad [1]$$

Note that $P_W(\mathbf{Y}, \mathbf{z}) \in [0,1]$, with $P_W(\mathbf{Y}, \mathbf{z}) = 0$ if and only if there are no welfare-poor individuals.

From this it follows that we can define *individual welfare-poverty measures*, which are given by:

$$P_W(\boldsymbol{y}_i, \boldsymbol{z}) = max\left\{0, \quad \left(1 - \frac{W(\boldsymbol{y}_i)}{W(\boldsymbol{z})}\right)\right\} \qquad [2]$$

Therefore, an individual is welfare poor if and only if $P_W(\boldsymbol{y}_i, \boldsymbol{z})$ is positive.[2]

[2] It is interesting to point out that, within this framework, the determination of who are the poor is resolved in a simple and natural way. Let us recall here that counting the poor in a multidimensional context is not immediate because the poverty threshold is a vector with k >1 components and we may find that the achievements of some agents exceed the threshold levels in some dimensions and fall short in some others. There are two extreme positions in the poverty literature regarding this

Regarding the social evaluation function, we now introduce some properties that will lead to a closed formula. They are all familiar, transparent, and stringent. The first property says that the social evaluation function is homogeneous of degree one. Homogeneity is a cardinal property that ensures a consistent connection between welfare, inequality, and poverty measurement (Blackorby & Donaldson, 1978); it also implies a weak form of monotonicity as higher achievements are better.

P.1: Homogeneity. Let $\mathbf{Y} \in \mathbb{R}_+^{n\times k}, \lambda \in \mathbb{R}_+$, then, $W(\lambda\mathbf{Y}) = \lambda W(\mathbf{Y})$.

The second property, scale, serves the purpose of fixing the units in which social welfare is measured. It establishes that when an agent exhibits a constant vector of achievements, $y_{ij} = a, \forall\, j$, we can take a as the corresponding measure of personal welfare. Note that this property involves a form of anonymity.

P.2: Scale: Let $\boldsymbol{y}_i = (a, a, \dots, a)$. Then, $W(\boldsymbol{y}_i) = a$.

The last property, factor decomposability, is a restrictive assumption that is common in the analysis of multidimensional welfare, inequality and poverty, in order to simplify the discussion and get sensible formulae (e.g. Chakravarty, Mukherjee & Ranade, 1998). It implies constant rates of substitution between dimensions, given by the ratios of the coefficients that reflect their relative importance in the social evaluation function. Formally:

P.3: Factor decomposability. For all $\mathbf{Y} \in \mathbb{R}_+^{n\times k}$, we have

$$W(\mathbf{Y}) = \sum_{j=1}^{k} b_j W\left(\boldsymbol{y}^{(j)}\right)$$

Where $W\left(\boldsymbol{y}^{(j)}\right)$ is the social evaluation function relative to the *j*th dimension considered in isolation (i.e. the *j*th column of matrix $\mathbf{Y}$), with $b_j \geq 0$ and $\sum_{j=1}^{k} b_j = 1$.

problem: the *union approach*, that declares poor anyone who is below the reference value in some dimension, and the *intersection approach*, according to which one person is poor only if all her achievements are simultaneously below the reference values.

Those properties determine the form of the social evaluation function, as the following elementary result shows:

Proposition: *A differentiable social evaluation function* $W: \Omega \to \mathbb{R}_+$ *satisfies the properties of homogeneity, scale and factor decomposability, if and only if, for each* $\mathbf{Y} \in \mathbb{R}_+^{n \times k}$ *we have*:

$$W(\mathbf{Y}) = \sum_{i=1}^{n} \sum_{j=1}^{k} b_j y_{ij} \qquad [3]$$

Proof.-

It is immediate to check that this function satisfies all the properties. Let us prove the converse implication.

By homogeneity and differentiability, Euler's theorem permits one to write:

$$W(\mathbf{Y}) = \sum_{i=1}^{n} \sum_{j=1}^{k} \frac{\partial W}{\partial y_{ij}} y_{ij}$$

Now observe that, for $\boldsymbol{y}_i = \mathbf{1}_n a$, scale and factor decomposability imply that:

$$\frac{\partial W}{\partial a} a = b_j a$$

So that, $\frac{\partial W}{\partial y_{ij}} = b_j$ for all y_{ij} and we get:

$$W(\mathbf{Y}) = \sum_{i=1}^{n} \sum_{j=1}^{k} b_j y_{ij}$$

Q.e.d.

The social evaluation function turns out to be separable both across agents and across dimensions, so that we can write:

$$W(\mathbf{y}_i) = \sum_{j=1}^{k} b_j \, y_{ij}, \qquad W(\mathbf{z}) = \sum_{j=1}^{k} b_j \, z_j, \qquad W(\mathbf{Y}^p) = \sum_{i=1}^{p} \sum_{j=1}^{k} b_j y_{ij}$$

Applying the specification of the social evaluation function [3] to the welfare poverty measure, defined in equation [1], yields:

$$P_W(\mathbf{Y}, \mathbf{z}) = \frac{W(\mathbf{Z}^p) - W(\mathbf{Y}^p)}{W(\mathbf{Z}^n)} = \frac{p \sum_{j=1}^{k} b_j \, z_j - \sum_{i=1}^{p} \sum_{j=1}^{k} b_j y_{ij}}{n \sum_{j=1}^{k} b_j \, z_j}$$

And, letting $\mu_j(\mathbf{Y}^p) = \frac{1}{p} \sum_{i=1}^{p} y_{ij}$, i.e. the average achievement of the poor in the *j*th dimension, we obtain:

$$P_W(\mathbf{Y}, \mathbf{z}) = \frac{p}{n} \times \left(1 - \frac{\sum_{j=1}^{k} b_j \mu_j(\mathbf{Y}^p)}{\sum_{j=1}^{k} b_j z_j}\right) \quad [4]$$

That is, the welfare poverty measure consists of the product of the incidence of poverty (a head-count ratio) and the intensity of poverty (one minus the ratio between the weighted average of the achievements of the poor across dimensions and the weighted average of the thresholds). This turns out to be an n-dimensional extension of the familiar welfare poverty gap, with a clear content and an explicit derivation as a welfare loss in terms of a conventional social evaluation function.

3. Poverty and human development

We now apply this evaluation model to analyse welfare poverty among the 189 countries for which we have data to compute the Human Development Index, (HDI), according to the last Human Development Report (see UNDP 2020). We shall also compare those countries that are welfare-poor, according to our poverty measure, and those that conform the "Low human development countries", according to the HDI, to see how they are correlated. All data come from the United Nations Development Program, which thankfully are offered for free in a usable format.[3]

Let us recall that the *Human Development Index* is a multidimensional indicator that approaches human development in terms of three key dimensions, all regarded as equally worthy: health, knowledge, and material wellbeing. Introduced in 1990, and reformulated in 2010, soon became a successful and popular alternative to the GDP, with a large impact in the mass media because of its intuitive character and the large number of countries that entered the evaluation (see Seth & Villar 2018, for a discussion). The achievement in health is measured by the variable *life expectancy at birth* (the number of years that a new-born is expected to live). Knowledge, understood as educational achievements, is now measured by a composite indicator that consists of the (geometric) mean of the mean years of schooling and the expected years of schooling. Finally, material wellbeing is associated with the *logarithm of the per capita gross national income*. Each of those

[3] See http://hdr.undp.org/en/composite/HDI.

variables is normalized with respect to a maximum and a minimum, to avoid the impact of different units on the index. Since 2010 the HDI consists of the geometric mean of those three dimensions.

We now consider the countries as our agents and the world (more precisely the 189 countries included in the report) as our society. The social evaluation function involves three dimensions: (1) health, h_i, measured by life expectancy at birth (years); (2) Education, e_i, measured by an average of the mean years of schooling and the expected years of schooling, e_{i2}; and (3) Material wellbeing, measured by the logarithm of the per capita gross national income, y_i. That means that matrix **Y** would consist of 189 rows and 3 columns.

We normalize those variables following the same procedure that is applied to the HDI. More specifically, we let $x_{ij}^{max} = max_i\{x_{ij}\}$, $x_{ij}^{min} = min_i\{x_{ij}\}$, and substitute each variable x_{ij} by the difference between the actual value and the minimum, divided over the range. That is,

$$h_i^N = \frac{h_i - h_i^{min}}{h_i^{max} - h_i^{min}}, \quad e_i^N = \frac{e_i - e_i^{1min}}{e_i^{max} - e_i^{min}}, y_i^N = \frac{y_i - y_i^{min}}{y_i^{max} - y_i^{min}}$$

As for the coefficients b_j we adopt the United Nations convention of treating all three dimensions (counting the two educational measures as one dimension) as equally important, so that each country's welfare will be measured by the following expression:[4]

$$W(h_i^N, e_i^N, y_i^N) = \frac{1}{3}h_i^N + \frac{1}{3}e_i^N + \frac{1}{3}y_i^N$$

To determine the three corresponding thresholds, we adopt the usual convention of taking the 60% of the median for each normalized variable. Those values are $z_1 = 0.3946$, $z_2 = 0.3289$, and $z_3 = 0.3554$, and yield: $W(\boldsymbol{z}) = 0.3598$.

Hence, country *i* will be considered as welfare poor if and only if:

$$1 - \frac{(h_i^N + e_i^N + y_i^N)/3}{0.3598} > 0$$

From those values we obtain a total of 42 out of 189 countries that are deemed welfare poor, which gives an incidence of 22.22%. The mean values of the poor in the three dimensions are given by:

$$\mu_{Health}(\mathbf{Y}^p) = 0.2796\,, \mu_{Edu}(\mathbf{Y}^p) = 0.2185, \quad \mu_{Income}(\mathbf{Y}^p) = 0.2452$$

[4] We have used the GNI of Qatar rather than that of Liechtenstein, as the last one is much larger but corresponds to an extremely tiny country, assigning the maximum value of 1 to it.

The corresponding world's poverty index is: $P_W(\mathbf{Y}, \mathbf{z}) = 0.0299$, which being a single observation does not mean much.[5] More interesting is to know which are the countries that are welfare poor and how different they are regarding their individual poverty measures, according to [2].

Table 1 provides those values for the 42 countries that are welfare poor and their corresponding welfare poverty measures (both in absolute and relative terms). When comparing the set of countries that appear as welfare poor according to our index and those that the United Nations identifies as countries with "Low human development", we observe that: (1) All low human development countries are welfare poor; and (2) There are 5 other countries that are welfare poor but do not belong to the former category (Angola, Comoros, Congo, Zambia, and Zimbabwe).

We also include in Table 1 the information regarding the HDI value of the welfare-poor countries, both in absolute and relative terms. The first thing to note, when comparing human development and poverty values, is that there is a much smaller variability in the values of the HDI. The range of variation for welfare poverty is [100, 3.24], whereas the range of variation for the HDI is [100, 66.55] (with coefficients of variation of 0.65 and 0.104, respectively). The second noticeable feature is that poverty and human development are strongly (negatively) correlated, as one would expect, with a coefficient of correlation of -0.945. Figure 1 provides a visual summary of that relationship.

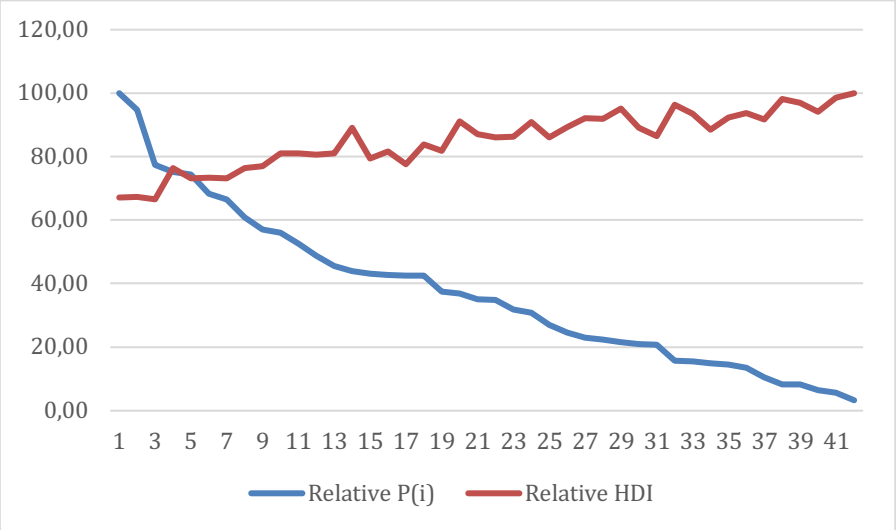
Table 1: Welfare poverty and human development among the welfare-poor countries

Rank	Country	$P_W(y_i, z)$	Relative P	HDI	Relative HDI
1	Central African Rep.	0,830	100,00	0,397	67,06
2	Chad	0,786	94,71	0,398	67,23
3	Niger	0,643	77,47	0,394	66,55
4	South Sudan	0,624	75,13	0,433	73,14
5	Sierra Leone	0,617	74,36	0,452	76,35
6	Mali	0,567	68,29	0,434	73,31
7	Burundi	0,551	66,43	0,433	73,14
8	Mozambique	0,505	60,87	0,456	77,03
8	Burkina Faso	0,473	56,99	0,452	76,35

[5] Let us recall that the overall poverty measure, contrary to individual poverty measures, involves the poverty rate, which makes its value much smaller than the average of the individual values.

10	Guinea-Bissau	0,465	56,08	0,48	81,08
11	Congo (Dem. Rep.)	0,436	52,54	0,48	81,08
12	Guinea	0,404	48,72	0,477	80,57
13	Liberia	0,378	45,52	0,48	81,08
14	Lesotho	0,364	43,91	0,527	89,02
15	Yemen	0,358	43,19	0,47	79,39
16	Malawi	0,355	42,72	0,483	81,59
17	Eritrea	0,353	42,58	0,459	77,53
18	Gambia	0,353	42,49	0,496	83,78
19	Nigeria	0,312	37,57	0,539	91,05
20	Togo	0,306	36,92	0,515	86,99
21	Ethiopia	0,292	35,14	0,485	81,93
22	Haiti	0,290	34,90	0,51	86,15
23	Côte d'Ivoire	0,264	31,84	0,538	90,88
24	Afghanistan	0,256	30,86	0,511	86,32
25	Sudan	0,225	27,08	0,51	86,15
26	Tanzania (Un. Rep.)	0,204	24,58	0,529	89,36
27	Benin	0,190	22,91	0,545	92,06
28	Uganda	0,185	22,29	0,544	91,89
29	Madagascar	0,179	21,54	0,528	89,19
30	Cameroon	0,174	21,02	0,563	95,10
31	Senegal	0,172	20,69	0,512	86,49
32	Zimbabwe	0,131	15,74	0,571	96,45
33	Comoros	0,129	15,54	0,554	93,58
34	Djibouti	0,123	14,79	0,524	88,51
35	Mauritania	0,121	14,52	0,546	92,23
36	Papua New Guinea	0,112	13,55	0,555	93,75
37	Rwanda	0,087	10,44	0,543	91,72
38	Angola	0,069	8,32	0,581	98,14
39	Congo	0,068	8,16	0,574	96,96
40	Pakistan	0,053	6,33	0,557	94,09
41	Zambia	0,046	5,57	0,584	98,65
42	Equatorial Guinea	0,027	3,24	0,592	100,00

Figure 1: Relative poverty and relative HDI when welfare-poor countries are arranged from higher to lower poverty values



Those data show that the evaluation of poverty we propose is well correlated, negatively, with the values of the human development index. So, they provide a similar ordinal information. Yet, the data also show that that the differences in poverty levels between welfare-poor countries are much higher than those that derive from the HDI. This entails that, from a quantitative viewpoint, our poverty measure exhibits higher discrimination power than the HDI, using the same data.

Note that, in this application, $P_W(\boldsymbol{y_i}, \boldsymbol{z})$ is an index that provides, for each country, a poverty measure relative to the rest of the world, rather than a conventional within country index.[6] It is a multidimensional indicator that uses the same variables that enter the HDI, so that it can be easily calculated without requiring further information. It should be clear, though, that this poverty measure cannot be interpreted as a substitute of the multidimensional poverty measures that are used for less developed countries (e.g. Alkire & Foster, 2012), because those indices have a different focus, use different variables, and provide a multidimensional deprivation measure, rather than the more conventional poverty gap measure defined over a set of quantitative variables and thresholds, as in our case.

[6] Indeed, for the case of a single country this index has no informative content, even though it can be calculated (as it happens with the world's welfare-poverty index for a single period, as mentioned above).

4. Final comments

We have presented in this paper a multidimensional poverty measure based on the interpretation of poverty as a social welfare loss. The key novelty is that of using the social evaluation function to describe agents' welfare, rather than individual subjective utility functions (see Decancq, Fleurbaey & Maniquet, 2019, and Maniquet, 2021, for a discussion on some implications of using utilities). Note that this construct is respectful with individual utilities, provided they are increasing in achievements. This theoretical twist permits one finding endogenously who are the poor in a multidimensional context and provides a natural extension of the poverty-gap methodology to this scenario. Adopting this approach solves the interpersonal comparability problem as all agents' welfare derives from the same social evaluation function applied to a reduced domain.[7] Let us underline that this formulation, that is summarized in equations [1] and [2], is compatible with different social evaluation functions, that would obtain from modifying the properties established (in particular, additivity and scale).

We have chosen an elementary social evaluation function of a utilitarian nature, that results in the intuitive formula in equation [3]. Simple as it is, the content of this social evaluation function can have several interpretations. For instance, if the variables are expressed in logs, it becomes a monotone transformation of a geometric mean and thus penalizes the asymmetries between the values of the different indicators. We can also introduce the inequality within the poor, in one or several dimensions, by recurring to the equally distributed equivalent values (e.g. Villar, 2017, Ch. 8).

The application to assess welfare poverty in the world, using the same variables as those in the human development index, is interesting because it permits identifying those countries that can be deemed poor, in terms of human development. Indeed, all countries that are considered as having low human development by the United Nations are welfare poor according to our evaluation (plus five additional ones). The value of the world's poverty index, on its own, does not provide any information, as there is a single observation in this application. Yet it will be interesting to analyse how this index evolves in the next years, to measure

[7] The structure of the domain, which consists of a Cartesian product of the reals for all possible dimensions, provides the required flexibility and keeps the vector space structure for any given subdomain.

the impact of the Covid-19 over the less favoured countries (see Alkire et al., 2021, for an application of this idea in terms of the MPI). From this point of view the data in this application may be regarded as the reference from which to evaluate such an impact).

Let us recall here that that the use of life expectancy at birth as the variable that measures the health component penalizes less developed countries, without a good reason. This is so because, due to the nature of this variable, a higher life expectancy means an older population, which need not be a plus from the future development viewpoint.[8] As discussed in Martínez, Herrero & Villar (2019), life potential seems a better alternative for this dimension.

Finally, let us stress that this approach to poverty might be of special interest in the context of subnational human development analysis (see Smits & Permanyer, 2019, Permanyer & Smits, 2020), where it can be applied to regions of different geographic areas with similar degrees of development (e.g. the European Union or within countries).

[8] Note that a society in which all agents are 85 years old would be the top country in this variable, as life expectancy at birth would be precisely 85 years. Yet there is little future for this society as no children are born. This is obviously an extreme case, but the differences in the countries' average age are quite large.

References

1. Aaberge, R. & Brandolini, A. (2015). Multidimensional poverty and inequality, in **Handbook of income distribution** (Vol. 2, pp. 141-216). Elsevier.
2. Alkire, S. & Foster, J. (2012), Counting and Multidimensional Poverty Measurement, **Journal of Public Economics**, 95 : 476-487.
3. Alkire, S., Foster, J., Seth, S., Santos, M.E., Roche, J.M., & Ballon, P. (2015), **Multidimensional Poverty: Measurement and Analysis**, Oxford University Press.
4. Alkire, S., Nogales, R., Naïri Quinnc, N. & Suppaa, N. (2021), Global multidimensional poverty and COVID-19: A decade of progress at risk?, **Social Science and Medicine**, 291, ref. 114457.
5. Alkire, S. & Santos, M.E. (2010), Acute Multidimensional Poverty: A New Index for Developing Countries, *Human Development Research Paper* 2010/11.
6. Atkinson, A.B. (2003), Multidimensional deprivation: contrasting social welfare and counting approaches, **Journal of Economic Inequality**, 1 : 51–65.
7. Blackorby, C. & Donalson, D. (1978), Measures of Relative Inequality and their Meaning in Terms of Social Welfare, **Journal of Economic Theory**, 18 : 59-80.
8. Blackorby, C. & Donalson, D. (1980), Ethical Indices for the Measurement of Poverty, **Econometrica**, 48, 1053-1060.
9. Bourguignon, F. and Chakravarty, S.R. (2003), The Measurement of Multidimensional Poverty, **Journal of Economic Inequality**, 1 : 25-49.
10. Chakravarty, S.R. (2009), **Inequality, Polarization and Poverty**, Springer, New York.
11. Chakravarty, S.R., Mukherjee, D. & Ranade, R. (1998), The family of subgroup and factor decomposable measures of multidimensional poverty, **Research on Economic Inequality**, 8 : 175-194.
12. Clark, S., Hemming, R. & Ulph, D. (1981), On Indices for the Measurement of Poverty, **The Economic Journal**, 91 : 515 - 526.
13. Dardadoni, V. (1995), On Multidimensional Poverty Measurement, **Research**

on Economic Inequality, 6 : 201-207.

14. Decancq, K., Fleurbaey, M., & Maniquet, F. (2019). Multidimensional poverty measurement with individual preferences, **The Journal of Economic Inequality**, 17(1), 29-49.
15. Duclos, J.-Y. & Araar, A. (2006), **Poverty and Equity: Measurement, Policy and Estimation with DAD**, New York, Springer.
16. Haughton, J. & Khandker, S.R. (2009), **Handbook of Poverty and Inequality**, The World Bank, Washington.
17. Herrero, C. R. Martínez, and A. Villar (2019), Population structure and the Human Development Index, **Social Indicators Research**, 141 : 731-763.
18. Kakwani, N. (1997), Inequality, Welfare and Poverty: Three Interrelated Phenomena, working paper 97/18, The University of New South Wales.
19. Lewis G.W. & Ulph, D.T. (1988), Poverty, Inequality and Welfare, **The Economic Journal**, 98, 117: 131.
20. Lugo, M.A. and Maasoumi, E. (2008), Multidimensional Poverty Measures from an Information Theory Perspective, Ecineq working paper 2008-85.
21. Maniquet, F. (2021), Multidimensional poverty measurement and preferences, LIDAM Discussion Paper CORE, 2021/21.
22. Permanyer, I. & Smits, J. (2020), Human Development across the Globe, **Population and Development Review**, 46 : 583-601.
23. Pyatt, G. (1987), Measuring Welfare, Poverty and Inequality, **The Economic Journal**, 97 : 459-467.
24. Seth, S. & Villar, A. (2018), Human Development and Poverty: Theoretical Approaches, in C. D'Ambrosio (Ed), **Handbook of Research on Economic and Social Well-being**, Edward Elgar, 2018, pp. 104-125.
25. Smits, J. & Permanyer, I. (2019). The subnational human development database, **Scientific data**, *6*(1), 1-15.
26. Tsui, K. (2002), Multidimensional Poverty Indices, **Social Choice and Welfare**, 19 : 69-93.
27. United Nations Development Program (2020), **Human Development Report 2020. The next frontier. Human development and the Anthropocene**, New York.
28. Vaughan, R. N. (1987), Welfare Approaches to the Measurement of Poverty, **The Economic Journal**, 97, 160 : 170.

29. Villar, A. (2017), **Lectures on Inequality, Poverty and Welfare**, Springer.
30. Wagle, U. (2008), **Multidimensional Poverty Measurement**, Springer, New York.

Appendix: Reference data

We present here the data that permit replicate the calculations presented in the paper. Countries are presented in alphabetical order. Coloured cells correspond to values of countries that are poor in some dimension (only the dimension in which they are poor is coloured). The name of the country is coloured only if it is welfare-poor, so that we find countries like Bangladesh that are poor in one dimension but not globally.

Table 2: Raw and normalised data for the construction of the corresponding welfare-poverty measures (UNDP, 2020)

Country	Life expectancy at birth		EYS	MYS	Mean	Material wellbeing			
	Years	Normalized	Years	Years	Mean years	Normal.	$ PPP	Log $	Norm.
Afghanistan	64,8	0,3649	10,2	3,9	7,05	0,2126	2.229	3,3482	0,2255
Albania	78,6	0,7997	14,7	10,1	12,42	0,6235	13.998	4,1461	0,6075
Algeria	76,9	0,7462	14,6	8,0	11,30	0,5374	11.174	4,0482	0,5607
Andorra	81,9	0,9054	13,3	10,5	11,90	0,5837	56.000	4,7482	0,8958
Angola	61,2	0,2484	11,8	5,2	8,48	0,3215	6.104	3,7856	0,4349
Antigua and Barbuda	77,0	0,7506	12,8	9,3	11,03	0,5173	20.895	4,3200	0,6908
Argentina	76,7	0,7396	17,7	10,9	14,30	0,7671	21.190	4,3261	0,6937
Armenia	75,1	0,6896	13,1	11,3	12,19	0,6055	13.894	4,1428	0,6060
Australia	83,4	0,9538	22,0	12,7	17,34	1,0000	48.085	4,6820	0,8641
Austria	81,5	0,8937	16,1	12,5	14,32	0,7688	56.197	4,7497	0,8966
Azerbaijan	73,0	0,6237	12,9	10,6	11,73	0,5710	13.784	4,1394	0,6043
Bahamas	73,9	0,6525	12,9	11,4	12,17	0,6042	33.747	4,5282	0,7905
Bahrain	77,3	0,7592	16,3	9,5	12,89	0,6592	42.522	4,6286	0,8386
Bangladesh	72,6	0,6104	11,6	6,2	8,91	0,3547	4.976	3,6969	0,3924
Barbados	79,2	0,8193	15,4	10,6	13,02	0,6692	14.936	4,1742	0,6210
Belarus	74,8	0,6801	15,4	12,3	13,86	0,7333	18.546	4,2683	0,6660
Belgium	81,6	0,8965	19,8	12,1	15,91	0,8908	52.085	4,7167	0,8807
Belize	74,6	0,6747	13,1	9,9	11,52	0,5544	6.382	3,8049	0,4442
Benin	61,8	0,2680	12,6	3,8	8,22	0,3020	3.254	3,5125	0,3041
Bhutan	71,8	0,5848	13,0	4,1	8,53	0,3255	10.746	4,0312	0,5525
Bolivia (Plur. State)	71,5	0,5763	14,2	9,0	11,61	0,5613	8.554	3,9322	0,5051
Bosnia and Herzegovina	77,4	0,7627	13,8	9,8	11,81	0,5767	14.872	4,1724	0,6201

Botswana	69,6	0,5155	12,8	9,6	11,20	0,5304	16.437	4,2158	0,6409
Brazil	75,9	0,7146	15,4	8,0	11,70	0,5681	14.263	4,1542	0,6114
Brunei Darussalam	75,9	0,7139	14,3	9,1	11,73	0,5704	63.965	4,8059	0,9235
Bulgaria	75,1	0,6883	14,4	11,4	12,89	0,6592	23.325	4,3678	0,7137
Burkina Faso	61,6	0,2620	9,3	1,6	5,46	0,0906	2.133	3,3290	0,2163
Burundi	61,6	0,2620	11,1	3,3	7,18	0,2222	754	2,8773	0,0000
Cabo Verde	73,0	0,6228	12,7	6,3	9,50	0,3996	7.019	3,8463	0,4640
Cambodia	69,8	0,5228	11,5	5,0	8,22	0,3017	4.246	3,6280	0,3594
Cameroon	59,3	0,1896	12,1	6,3	9,21	0,3775	3.581	3,5540	0,3240
Canada	82,4	0,9218	16,2	13,4	14,76	0,8027	48.527	4,6860	0,8660
Central African Republic	53,3	0,0000	7,6	4,3	5,93	0,1263	993	2,9970	0,0573
Chad	54,2	0,0297	7,3	2,5	4,94	0,0506	1.555	3,1918	0,1506
Chile	80,2	0,8506	16,4	10,6	13,52	0,7073	23.261	4,3666	0,7131
China	76,9	0,7472	14,0	8,1	11,02	0,5164	16.057	4,2057	0,6361
Colombia	77,3	0,7592	14,4	8,5	11,43	0,5479	14.257	4,1540	0,6113
Comoros	64,3	0,3487	11,2	5,1	8,16	0,2975	3.099	3,4913	0,2940
Congo	64,6	0,3566	11,7	6,5	9,12	0,3710	2.879	3,4593	0,2787
Congo (Dem. Rep.)	60,7	0,2335	9,7	6,8	8,24	0,3039	1.063	3,0263	0,0714
Costa Rica	80,3	0,8538	15,7	8,7	12,20	0,6063	18.486	4,2669	0,6653
Côte d'Ivoire	57,8	0,1418	10,0	5,3	7,62	0,2561	5.069	3,7049	0,3963
Croatia	78,5	0,7972	15,2	11,4	13,34	0,6937	28.070	4,4482	0,7522
Cuba	78,8	0,8070	14,3	11,8	13,04	0,6706	8.621	3,9355	0,5067
Cyprus	81,0	0,8759	15,2	12,2	13,67	0,7191	38.207	4,5821	0,8163
Czechia	79,4	0,8253	16,8	12,7	14,75	0,8021	38.109	4,5810	0,8158
Denmark	80,9	0,8734	18,9	12,6	15,75	0,8786	58.662	4,7684	0,9055
Djibouti	67,1	0,4370	6,8	4,1	5,45	0,0896	5.689	3,7551	0,4203
Dominica	78,2	0,7883	13,0	8,1	10,55	0,4806	11.884	4,0750	0,5735
Dominican Republic	74,1	0,6576	14,2	8,1	11,17	0,5280	17.591	4,2453	0,6550
Ecuador	77,0	0,7503	14,6	8,9	11,75	0,5725	11.044	4,0431	0,5582
Egypt	72,0	0,5915	13,3	7,4	10,38	0,4673	11.466	4,0594	0,5660
El Salvador	73,3	0,6335	11,7	6,9	9,30	0,3845	8.359	3,9222	0,5003
Equatorial Guinea	58,7	0,1722	9,7	5,9	7,82	0,2716	13.944	4,1444	0,6067
Eritrea	66,3	0,4120	5,0	3,9	4,45	0,0136	2.793	3,4461	0,2724
Estonia	78,8	0,8054	16,0	13,1	14,57	0,7877	36.019	4,5565	0,8041
Eswatini (Kingdom of)	60,2	0,2180	11,8	6,9	9,35	0,3884	7.919	3,8987	0,4891
Ethiopia	66,6	0,4209	8,8	2,9	5,85	0,1204	2.207	3,3437	0,2233
Fiji	67,4	0,4475	14,4	10,9	12,66	0,6422	13.009	4,1142	0,5923
Finland	81,9	0,9054	19,4	12,8	16,11	0,9059	48.511	4,6858	0,8660
France	82,7	0,9291	15,6	11,5	13,56	0,7108	47.173	4,6737	0,8601
Gabon	66,5	0,4168	13,0	8,7	10,84	0,5023	13.930	4,1439	0,6065

Gambia	62,1	0,2769	9,9	3,9	6,92	0,2022	2.168	3,3360	0,2196
Georgia	73,8	0,6478	15,3	13,1	14,20	0,7600	14.429	4,1592	0,6138
Germany	81,3	0,8870	17,0	14,2	15,56	0,8641	55.314	4,7428	0,8933
Ghana	64,1	0,3408	11,5	7,3	9,39	0,3919	5.269	3,7217	0,4043
Greece	82,2	0,9158	17,9	10,6	14,23	0,7620	30.155	4,4794	0,7671
Grenada	72,4	0,6044	16,9	9,0	12,95	0,6641	15.641	4,1943	0,6306
Guatemala	74,3	0,6646	10,8	6,6	8,69	0,3377	8.494	3,9291	0,5036
Guinea	61,6	0,2627	9,4	2,8	6,09	0,1390	2.405	3,3811	0,2412
Guinea-Bissau	58,3	0,1589	10,6	3,6	7,09	0,2157	1.996	3,3002	0,2025
Guyana	69,9	0,5256	11,4	8,5	9,96	0,4352	9.455	3,9757	0,5259
Haiti	64,0	0,3386	9,7	5,6	7,65	0,2580	1.709	3,2327	0,1702
Honduras	75,3	0,6953	10,1	6,6	8,32	0,3094	5.308	3,7250	0,4059
Hong Kong, China (SAR)	84,9	1,0000	16,9	12,3	14,60	0,7907	62.985	4,7992	0,9203
Hungary	76,9	0,7462	15,2	12,0	13,58	0,7125	31.329	4,4959	0,7750
Iceland	83,0	0,9396	19,1	12,8	15,93	0,8920	54.682	4,7378	0,8909
India	69,7	0,5177	12,2	6,5	9,33	0,3870	6.681	3,8249	0,4537
Indonesia	71,7	0,5829	13,6	8,2	10,89	0,5061	11.459	4,0592	0,5659
Iran (Islamic Republic of)	76,7	0,7399	14,8	10,3	12,58	0,6357	12.447	4,0951	0,5831
Iraq	70,6	0,5475	11,3	7,3	9,29	0,3841	10.801	4,0335	0,5536
Ireland	82,3	0,9180	18,7	12,7	15,69	0,8734	68.371	4,8349	0,9373
Israel	83,0	0,9389	16,2	13,0	14,60	0,7902	40.187	4,6041	0,8268
Italy	83,5	0,9560	16,1	10,4	13,23	0,6858	42.776	4,6312	0,8398
Jamaica	74,5	0,6703	13,1	9,7	11,44	0,5482	9.319	3,9694	0,5229
Japan	84,6	0,9915	15,2	12,9	14,04	0,7475	42.932	4,6328	0,8406
Jordan	74,5	0,6718	11,4	10,5	10,95	0,5108	9.858	3,9938	0,5346
Kazakhstan	73,6	0,6424	15,6	11,9	13,75	0,7255	22.857	4,3590	0,7095
Kenya	66,7	0,4241	11,3	6,6	8,95	0,3580	4.244	3,6277	0,3593
Kiribati	68,4	0,4769	11,8	8,0	9,89	0,4300	4.260	3,6294	0,3601
Korea (Republic of)	83,0	0,9408	16,5	12,2	14,35	0,7710	43.044	4,6339	0,8411
Kuwait	75,5	0,7022	14,2	7,3	10,76	0,4964	58.590	4,7678	0,9052
Kyrgyzstan	71,5	0,5744	13,0	11,1	12,04	0,5941	4.864	3,6870	0,3877
Lao People's Democratic Republic	67,9	0,4627	11,0	5,3	8,14	0,2956	7.413	3,8700	0,4753
Latvia	75,3	0,6959	16,2	13,0	14,60	0,7902	30.282	4,4812	0,7680
Lebanon	78,9	0,8111	11,3	8,7	10,00	0,4384	14.655	4,1660	0,6170
Lesotho	54,3	0,0326	11,3	6,5	8,93	0,3561	3.151	3,4984	0,2974
Liberia	64,1	0,3418	9,6	4,8	7,19	0,2233	1.258	3,0998	0,1065
Libya	72,9	0,6206	12,9	7,6	10,23	0,4556	15.688	4,1956	0,6312
Liechtenstein	80,7	0,8661	14,9	12,5	13,72	0,7230	131.032	5,1174	1,0000
Lithuania	75,9	0,7161	16,6	13,1	14,86	0,8100	35.799	4,5539	0,8028
Luxembourg	82,3	0,9161	14,3	12,3	13,28	0,6895	72.712	4,8616	0,9501

Madagascar	67,0	0,4348	10,2	6,1	8,14	0,2956	1.596	3,2031	0,1560
Malawi	64,3	0,3468	11,2	4,7	7,99	0,2840	1.035	3,0148	0,0658
Malaysia	76,2	0,7234	13,7	10,4	12,03	0,5933	27.534	4,4399	0,7482
Maldives	78,9	0,8108	12,2	7,0	9,61	0,4084	17.417	4,2410	0,6530
Mali	59,3	0,1902	7,5	2,4	4,91	0,0484	2.269	3,3558	0,2291
Malta	82,5	0,9250	16,1	11,3	13,72	0,7226	39.555	4,5972	0,8235
Marshall Islands	74,1	0,6585	12,4	10,9	11,64	0,5636	5.039	3,7023	0,3950
Mauritania	64,9	0,3680	8,6	4,7	6,66	0,1823	5.135	3,7105	0,3990
Mauritius	75,0	0,6864	15,1	9,5	12,30	0,6141	25.266	4,4025	0,7303
Mexico	75,1	0,6883	14,8	8,8	11,78	0,5746	19.160	4,2824	0,6728
Micronesia (Fed. States)	67,9	0,4614	11,5	7,8	9,68	0,4135	3.983	3,6002	0,3461
Moldova (Republic of)	71,9	0,5886	11,5	11,7	11,62	0,5623	13.664	4,1356	0,6025
Mongolia	69,9	0,5244	14,2	10,3	12,23	0,6088	10.839	4,0350	0,5543
Montenegro	76,9	0,7462	15,0	11,6	13,29	0,6904	21.399	4,3304	0,6958
Morocco	76,7	0,7399	13,7	5,6	9,68	0,4141	7.368	3,8674	0,4741
Mozambique	60,9	0,2389	10,0	3,5	6,76	0,1900	1.250	3,0971	0,1052
Myanmar	67,1	0,4377	10,7	5,0	7,85	0,2738	4.961	3,6955	0,3918
Namibia	63,7	0,3294	12,6	7,0	9,81	0,4238	9.357	3,9711	0,5237
Nepal	70,8	0,5532	12,8	5,0	8,89	0,3529	3.457	3,5387	0,3167
Netherlands	82,3	0,9171	18,5	12,4	15,45	0,8554	57.707	4,7612	0,9021
New Zealand	82,3	0,9174	18,8	12,8	15,81	0,8829	40.799	4,6106	0,8300
Nicaragua	74,5	0,6706	12,3	6,9	9,61	0,4087	5.284	3,7229	0,4049
Niger	62,4	0,2886	6,5	2,1	4,28	0,0000	1.201	3,0795	0,0968
Nigeria	54,7	0,0440	10,0	6,7	8,32	0,3092	4.910	3,6911	0,3897
North Macedonia	75,8	0,7120	13,6	9,8	11,70	0,5682	15.865	4,2004	0,6335
Norway	82,4	0,9209	18,1	12,9	15,48	0,8578	66.494	4,8228	0,9315
Oman	77,9	0,7772	14,2	9,7	11,96	0,5880	25.944	4,4140	0,7358
Pakistan	67,3	0,4421	8,3	5,2	6,72	0,1869	5.005	3,6994	0,3936
Palau	73,9	0,6528	15,8	12,5	14,14	0,7554	19.317	4,2859	0,6745
Palestine, State of	74,1	0,6566	13,4	9,2	11,29	0,5367	6.417	3,8074	0,4453
Panama	78,5	0,7978	12,9	10,2	11,57	0,5586	29.558	4,4707	0,7629
Papua New Guinea	64,5	0,3544	10,2	4,7	7,43	0,2415	4.301	3,6336	0,3621
Paraguay	74,3	0,6630	12,7	8,5	10,62	0,4859	12.224	4,0872	0,5793
Peru	76,7	0,7418	15,0	9,7	12,34	0,6176	12.252	4,0882	0,5798
Philippines	71,2	0,5674	13,1	9,4	11,27	0,5355	9.778	3,9902	0,5329
Poland	78,7	0,8047	16,3	12,5	14,39	0,7740	31.623	4,5000	0,7770
Portugal	82,1	0,9098	16,5	9,3	12,90	0,6602	33.967	4,5311	0,7919
Qatar	80,2	0,8522	12,0	9,7	10,88	0,5058	92.418	4,9658	1,0000
Romania	76,1	0,7199	14,3	11,1	12,67	0,6422	29.497	4,4698	0,7625
Russian Federation	72,6	0,6101	15,0	12,2	13,60	0,7138	26.157	4,4176	0,7375

Rwanda	69,0	0,4975	11,2	4,4	7,80	0,2699	2.155	3,3335	0,2184
Saint Kitts and Nevis	74,8	0,6791	13,8	8,7	11,25	0,5342	25.038	4,3986	0,7284
Saint Lucia	76,2	0,7247	14,0	8,5	11,25	0,5342	14.616	4,1648	0,6165
Saint Vincent and the Grenadines	72,5	0,6085	14,1	8,8	11,44	0,5484	12.378	4,0926	0,5819
Samoa	73,3	0,6335	12,7	10,8	11,75	0,5725	6.309	3,7999	0,4418
Sao Tome and Principe	70,4	0,5408	12,7	6,4	9,56	0,4047	3.952	3,5968	0,3445
Saudi Arabia	75,1	0,6908	16,1	10,2	13,18	0,6816	47.495	4,6767	0,8616
Senegal	67,9	0,4633	8,6	3,2	5,88	0,1231	3.309	3,5197	0,3076
Serbia	76,0	0,7184	14,7	11,2	12,97	0,6652	17.192	4,2353	0,6502
Seychelles	73,4	0,6361	14,1	10,0	12,07	0,5967	26.903	4,4298	0,7434
Sierra Leone	54,7	0,0443	10,2	3,7	6,94	0,2038	1.668	3,2222	0,1651
Singapore	83,6	0,9595	16,4	11,6	14,03	0,7469	88.155	4,9452	0,9902
Slovakia	77,5	0,7671	14,5	12,7	13,59	0,7130	32.113	4,5067	0,7802
Slovenia	81,3	0,8867	17,6	12,7	15,12	0,8298	38.080	4,5807	0,8156
Solomon Islands	73,0	0,6234	10,2	5,7	7,97	0,2825	2.253	3,3528	0,2277
South Africa	64,1	0,3427	13,8	10,2	12,02	0,5925	12.129	4,0838	0,5777
South Sudan	57,9	0,1440	5,3	4,8	5,05	0,0592	2.003	3,3018	0,2032
Spain	83,6	0,9579	17,6	10,3	13,93	0,7393	40.975	4,6125	0,8309
Sri Lanka	77,0	0,7494	14,1	10,6	12,37	0,6197	12.707	4,1041	0,5874
Sudan	65,3	0,3801	7,9	3,8	5,83	0,1188	3.829	3,5830	0,3379
Suriname	71,7	0,5816	13,2	9,3	11,22	0,5319	14.324	4,1561	0,6123
Sweden	82,8	0,9335	19,5	12,5	16,02	0,8986	54.508	4,7365	0,8902
Switzerland	83,8	0,9646	16,3	13,4	14,85	0,8098	69.394	4,8413	0,9404
Syrian Arab Republic	72,7	0,6139	8,9	5,1	6,98	0,2067	3.613	3,5579	0,3259
Tajikistan	71,1	0,5633	11,7	10,7	11,20	0,5299	3.954	3,5970	0,3446
Tanzania (Un. Republic)	65,5	0,3848	8,1	6,1	7,11	0,2170	2.600	3,4149	0,2574
Thailand	77,2	0,7547	15,0	7,9	11,48	0,5518	17.781	4,2500	0,6573
Timor-Leste	69,5	0,5127	12,6	4,8	8,71	0,3391	4.440	3,6474	0,3687
Togo	61,0	0,2449	12,7	4,9	8,81	0,3469	1.602	3,2048	0,1568
Tonga	70,9	0,5573	14,4	11,2	12,82	0,6543	6.365	3,8038	0,4436
Trinidad and Tobago	73,5	0,6396	13,0	11,0	12,00	0,5911	26.231	4,4188	0,7381
Tunisia	76,7	0,7405	15,1	7,2	11,17	0,5280	10.414	4,0176	0,5460
Turkey	77,7	0,7718	16,6	8,1	12,35	0,6184	27.701	4,4425	0,7494
Turkmenistan	68,2	0,4712	11,2	10,3	10,73	0,4942	14.909	4,1734	0,6206
Uganda	63,4	0,3187	11,4	6,2	8,79	0,3458	2.123	3,3270	0,2153
Ukraine	72,1	0,5940	15,1	11,4	13,24	0,6859	13.216	4,1211	0,5956
United Arab Emirates	78,0	0,7807	14,3	12,1	13,23	0,6853	67.462	4,8291	0,9345
United Kingdom	81,3	0,8867	17,5	13,2	15,37	0,8493	46.071	4,6634	0,8552
United States	78,9	0,8089	16,3	13,4	14,86	0,8104	63.826	4,8050	0,9230

Uruguay	77,9	0,7788	16,8	8,9	12,88	0,6587	20.064	4,3024	0,6824
Uzbekistan	71,7	0,5832	12,1	11,8	11,93	0,5862	7.142	3,8538	0,4676
Vanuatu	70,5	0,5434	11,7	7,1	9,40	0,3922	3.105	3,4920	0,2943
Venezuela (Bolivar. Rep.)	72,1	0,5937	12,8	10,3	11,56	0,5577	7.045	3,8479	0,4647
Viet Nam	75,4	0,6994	12,7	8,3	10,51	0,4769	7.433	3,8711	0,4759
Yemen	66,1	0,4060	8,8	3,2	5,98	0,1308	1.594	3,2024	0,1557
Zambia	63,9	0,3351	11,5	7,2	9,32	0,3858	3.326	3,5219	0,3086
Zimbabwe	61,5	0,2592	11,0	8,5	9,72	0,4166	2.666	3,4258	0,2626