Working Paper No. 352

A Note on Possible SDGs Index Rankings

Kazuyuki Nakamura

March 2023

UNIVERSITY OF TOYAMA 富山大学

SCHOOL OF ECONOMICS
UNIVERSITY OF TOYAMA

A Note on Possible SDGs Index Rankings[*]

Kazuyuki Nakamura[†]

Faculty of Social Sciences, University of Toyama
Gofuku 3190, Toyama 930-8555, JAPAN

2023.3.27

Abstract
The 17 goals stipulated in the UN's SDGs are essential to the sustainability of society. Governments and international organizations understandably take great interest in their achievement. This note proposes a new method for ranking countries based on their SDG status. To make the comparisons, current uses the arithmetic mean of normalized individual indicators to produce an aggregate SDG score. Our method relaxes the assumption of perfect substitutability between individual indicators that is inherent the current method. We identify the highest and lowest possible ranking using concave transformation functions.

key words: SDGs rankings, composite index, generalized Lorenz dominance.
JEL code: D63, O10, Q01

1 Introduction

The Sustainable Development Goals (SDGs) set forth by the United Nations 17 diverse goals that affect social welfare, including income, societal inequalities, poverty, and the global environment. Moreover, a unified index measures their achievement. For evaluate overall goal achievement, the Sustainable Development Solutions Network and the Bertelsmann Foundation annually release the SDGs index which aggregates the 17 individual indexes and provides the basis for ranking countries. Governments and citizens tend to be highly interested in assessing any changes in the indicators, making comparisons with other countries and analyzing their own current ranking. In both developed and developing countries, the news media commonly report changes in the rankings following the

[*] This work was supported by JSPS KAKENHI Grant Number 19K01694.
[†] Email: knakamur@eco.u-toyama.ac.jp

publication of the annual SDG report.[1]

However, caution should be exercised in aggregating the individual SDG indicators and using the aggregate value for ranking purpose, as there are many ways to aggregate. The most controversial issue is the issue of substitutability among the individual indicators. Since the current composite SDGs index is simply the arithmetic mean of 17 the sub-indicators, a one-point decline in one sub-indicator is entirely offset by a one-point increase in another. In other words, the integrated index does not consider the disparity among the various dimensions. Against this background, the United Nations, in 2010, changed the aggregation method for its Human Development Index (HDI), switching from the arithmetic mean to the geometric mean. However, aggregation using the geometric mean has its own disadvantage in that the value of the overall composite index is zero if the value of any one of the individual indicators is zero.

There have been a number of studies dealing with the aggregation method used to create for so-called composite indicators such as the SDGs index (Zhou et al., 2010; Greco et al., 2019; Salvatia and Carluccib, 2014; Permanyer, 2011). Based on the philosophy behind the SDGs, a desirable index is one that will evaluate positively the case in which the difference between the indicators in one country is not sizeable will be desirable. The procedure proposed by Cherchye et al. (2008) applies the generalized Lorenz (GL) dominance criterion is quite robust: If an index in one country dominates another in terms of the GL, any index that is increasing concave in the attributes preserves the order. In Cherehye et al. (2008), for each country, the number of GL-dominating countries and the number of GL-dominated countries give lower and upper bounds for the ranking of the SDGs, respectively.

In this study, we refine the upper and lower bounds obtained by GL pair-wise comparisons. We present a simple procedure for assessing the lower and upper bounds of the SDGs ranking by extending the GL dominance criteria which exhibits a partial ordering in pairwise comparisons but cannot give a ranking when there are more than three agents to compare. We identify the highest (lowest) possible ranking in the sense that any composite index constructed as the sum of increasing concave functions for each indicator does not show a higher (lower) ranking than the one provided. As is clear from our methodology, the highest possible ranking is lower than that obtained by the number of GL-dominated countries, while the lowest possible ranking is greater than the number of GL-dominated countries. A standard mixed-integer linear programming problem gives the procedure for finding these rankings.

Our results show that even if the different goals are evaluated with equal weights, there is a substantial variation in the possible rankings. We also show that the ranking based on an index using the average value is not the average value, or the median value of the range obtained from the various evaluation functions. In this sense, we need to use an aggregate or integrated SDGs index with caution.

In the next section, we describe our analytical framework. In Section 3, we show the results of

[1] For example, see Australia's United Nations sustainability ranking drops (The Weekly Times, October 13, 2020) <https://www.weeklytimesnow.com.au>, and Pakistan ranking in SDGs drops from 115 in 2016 to 134 in 2020 (The Nation, January 25, 2021) <https://nation.com.pk/25-Jan-2021>.

our analysis. Section 4 describes some of the implications and limitations of our note.

2 Analytical Framework

First, we can best explain our motivation by using the simple example summarized in Table 1. Consider an index consisting of three attributes, and assume that there are three countries, denoted by A, B, and C. Suppose that composite index CI^i represents the social welfare of country i calculated as the sum of three individual indicators such that $CI^i = \sum_{k=1}^{3} I(x_k^i)$ for $i \in \{A, B, C\}$, where x_k^i is the k-th indicator of country i and $I(x)$ is a transformation function. We assume that each attribute is normalized in the appropriate manner and is aggregated using a transformation function $I(x)$ that is non-decreasing concave. From Table 1, we can easily confirm that no country dominates the other countries in terms of GL dominance: i.e., the three countries are not rankable.

However, we can verify that the ranking of country B cannot be the worst for all non-decreasing concave transformation function. This is because $CI^A > CI^B$ implies that $I(15) - I(10) < I(30) - I(25) + I(50) - I(40)$, while $CI^C > CI^B$ requires that $I(40) - I(30) + I(25) - I(20) < I(20) - I(15)$. Considering the concavity and increasingness of $I(x)$, we obtain $I(40) - I(30) + I(25) - I(20) \geq I(50) - I(40) + I(30) - I(25)$ and $I(15) - I(10) \geq I(20) - I(15)$. Thus, country B cannot become the worst country: the lowest possible ranking of country B is 2.

Table 1 An Explanatory Example

	Countries		
	A	B	C
Attribute 1	10	40	20
Attribute 2	30	25	30
Attribute 3	50	15	20

On the other hand, we can confirm that the highest possible rank of country B is 1. Indeed, when the transformation function takes the form

$$I(x) = \begin{cases} 2x, & if\ 0 \leq x < 20, \\ 20 + x, & if\ 20 \leq x < 40, \\ 60, & if\ 40 \leq x < \infty. \end{cases}$$

we obtain $CI^B = 135 > 130 = CI^A = CI^C$.

We can now turn to the formal framework. Consider $N(> 1)$ countries (regions or cities) for comparison. We rank each country's achievement with a composite indicator consisting of $K(> 1)$ dimensional attributes. Let $\mathcal{N} = \{1, \ldots, N\}$ and $\mathcal{K} = \{1, \ldots, K\}$ be the set of countries and the set of attributes, respectively. Each attribute is normalized in an appropriate manner in finite interval $\mathcal{D} =$

$[0, \bar{x}]$. Let $x_k^i \in \mathcal{D}$ be the k-th indicator of country $i \in \mathcal{N}$. Thus, the vector consisting of the individual indicator of country $i \in \mathcal{N}$ is $\mathbf{x}^i = (x_1^i, \dots, x_K^i)$. Here, we consider an additively separable composite index. That is, the composite index $CI(\mathbf{x}^i)$ takes the form

$$CI(\mathbf{x}^i) = \sum_{k=1}^{K} I(x_k^i) \tag{1}$$

where $I: \mathbb{R} \to \mathbb{R}$ is a transformation function that is i) continuous, ii) monotone increasing, and iii) concave. Hereafter, we denote by $\mathcal{I}$ the set of functions satisfying these conditions. From these properties of the transformation function, we can say that $CI(\mathbf{x}^i) \geq CI(\mathbf{x}^j)$ holds for every $I \in \mathcal{I}$, if and only if $\mathbf{x}^i$ dominates $\mathbf{x}^j$ in the sense of GL dominance (e.g., Shorrocks, 1983).

For a given transformation function $I \in \mathcal{I}$, we obtain its piecewise linear approximation by introducing M sampling coordinates $\mathbf{t} = (t_1, \dots, t_M)$ as follows:

$$\hat{I}(x; \mathbf{t}) = \alpha_0 - \sum_{m=1}^{M} \alpha_m (t_m - x)^+, \tag{2}$$

where $(a)^+ = \max\{0, a\}$, $\alpha_0 \in \mathbb{R}$ and $\alpha_m \in \mathbb{R}_+$. Particularly, by setting $M = KN$ and $\mathbf{t} = [\mathbf{x}^1, \dots, \mathbf{x}^N]$, we can choose α_0 and α_m such that the value of $\hat{I}(x; \mathbf{t})$ completely replicates the composite index:

$$CI(\mathbf{x}^i) = \sum_{k=1}^{K} \hat{I}(x_k^i; \mathbf{t}). \tag{3}$$

For example, let $0 < x_{(1)} <, \dots, < x_{(M)}$ be the coordinates of indicators in increasing order.[2] For a given $I^* \in \mathcal{I}$ and $[\mathbf{x}^1, \dots, \mathbf{x}^N]$, we obtain its piecewise linear approximation by applying the following procedures, recursively: $\alpha_0 = I^*(x_{(M)})$, $\alpha_M = [I^*(x_{(M)}) - I^*(x_{(M-1)})]/(x_{(M)} - x_{(M-1)})$, $\alpha_m = [I^*(x_{(m)}) - I^*(x_{(m-1)})]/(x_{(m)} - x_{(m-1)}) - \sum_{j=m+1}^{M} \alpha_j$, and $x_{(0)} = 0$ for $m = 1, \dots, M$.

Now, we can compare two countries' scores as $\mathbf{x}^i$ and $\mathbf{x}^j$. The difference in the value of the composite indices $\Delta CI^{ij} = CI(\mathbf{x}^i) - CI(\mathbf{x}^j)$ becomes

$$\Delta CI^{ij} = \sum_{m=1}^{M} \alpha_m \Delta v_m^{ij}, \tag{4}$$

[2] For explanatory purposes, we assume that the scores take different values.

where $\Delta v_m^{ij} = -\sum_{k=1}^{K}\left[\left(t_m - x_k^i\right)^+ - \left(t_m - x_k^j\right)^+\right]$.

In (4), country *i* dominates country *j* in the sense of GL dominance if and only if there is no α_m for $m = 1, \dots, M$ such that $\sum_{m=1}^{M} \alpha_m \Delta v_m^{ij} < 0$ holds. However, the GL criterion provides the dominance relationship for only two countries.

We can now consider the possible ranking among more than two countries. We will focus here on two types of ranking method. One is the standard competition '1224' ranking. For a given transformation function $I \in \mathcal{I}$, let f_S^i be the ranking of country $i \in \mathcal{N}$ from the top defined as follows:

$$f_S^i = N - \#\left\{ j \in \mathcal{N} \setminus \{i\}: CI(\mathbf{x}^i) \geq CI(\mathbf{x}^j), CI = \sum_{k=1}^{K} I(x_k), I \in \mathcal{I} \right\}. \tag{5}$$

where $\#$ is the cardinality of the set A.

The other ranking method is the modified competition '1334' ranking, which is defined as

$$f_M^i = 1 + \#\left\{ j \in \mathcal{N} \setminus \{i\}: CI(\mathbf{x}^i) \leq CI(\mathbf{x}^j), CI = \sum_{k=1}^{K} I(x_k), I \in \mathcal{I} \right\}. \tag{6}$$

In the discussion below, we employ the 1224 method to obtain the lowest possible ranking (LPR) and the 1334 method for the highest possible ranking (HPR).

Thus, we define the LPR for country i as follows:

Definition 1a. (The lowest possible ranking of country *i*)

$$f_L^i = \max_{I \in \mathcal{I}} f_S^i. \tag{7}$$

Similarly, the HPR for country i is as follows:

Definition 1b. (The highest possible ranking of country i)

$$f_H^i = \min_{I \in \mathcal{I}} f_M^i. \tag{8}$$

The reasons for using different ranking methods for HPR and LPR are obvious. We are trying to clarify the ranking under all functions belonging to $\mathcal{I}$. If we use the 1224 method for the HPR, the HPR for all countries will be 1. On the other hand, if we use the 1334 method for the LPR, the LPR for all countries will be N. For example, let $CI(\mathbf{x}^i) = \sum_{k=1}^{K}[\alpha_0 - \alpha(t - x_k^i)^+]$ be a composite index where $\alpha_0 - \alpha(t - x)^+ \in \mathcal{J}$ with $\alpha > 0$. In this case, if we set $t = \min_{i \in \mathcal{N}} \min_{k \in \mathcal{K}} x_k^i$, the HPR for all countries is 1 under the 1224 method, and the LPR of all countries is N under the 1334 method.

Conversely, by using the 1224 method to obtain the LPR of country i, we can know the maximum number of countries that are strictly higher than the value of the composite index for country i. In addition, by using the 1334 method for the HPR, we can clarify the maximum number of countries with strictly lower composite index values than that of country i.[3]

Next, consider the procedure for finding the LPR and HPR. Noting that for a given data set $\mathbf{x}$, every function in $\mathcal{J}$ is replicated as (3), we can obtain the LPR and HPR by solving the following mixed-integer linear programming problems (MILP):

MILP 1 (MILP for the lowest possible ranking for country *i*)

$$\min_{s_j, \alpha_k} \sum_{j \in \mathcal{N} \setminus \{i\}} s_j, \tag{9}$$

$$\sum_{m=1}^{M} \alpha_m \Delta v_m^{ij} - z s_j \leq -b, \qquad j \in \mathcal{N} \setminus \{i\}, \tag{10}$$

$$\alpha_m \geq 0, \qquad m = 1, \ldots, M, \tag{11}$$

$$s_j \in \{0,1\}, \qquad j \in \mathcal{N} \setminus \{i\}, \tag{12}$$

where z and b are positive constants and $M = KN$.

Once MILP 1 is solved, we can easily obtain the lowest possible ranking. Let S_L^{*i} be the optimal value for MILP 1. The lowest possible ranking for country i is $f_L^i = N - S_L^{*i}$. Note that this ranking follows the 1224 method. That is, we can construct a composite index such that at most $f_L^i - 1$ countries have strictly higher values than country *i*.

Similarly, the MILP to obtain the HPR is as follows:

MILP 2 (MILP for the highest possible ranking for country *i*)

$$\min_{s_j, \alpha_k} \sum_{j \in \mathcal{N} \setminus \{i\}} s_j \tag{13}$$

[3] One complication of using this combination of ranking rules is that the HPR does not always rank higher than the LPR. For example, suppose that the original indicators of some countries are identical in the sense that $\mathbf{x}^i = \mathbf{\Pi}^{ij}\mathbf{x}^j$ holds for a permutation matrix $\mathbf{\Pi}^{ij}$. In such cases, the LPR based on the 1224 rule may rank higher than the HPR based on the 1334 rule because there are always multiple countries that have the same score for any given transformation function. However, if we consider continuous indicators, such a case will rarely arise. Indeed, in the present analysis, the HPR is ranked higher than the LPR for all countries.

$$-\sum_{m=1}^{M} \alpha_m \Delta v_m^{ij} - z s_j \leq -b, \qquad j \in \mathcal{N} \setminus \{i\}, \tag{14}$$

$$\alpha_m \geq 0, \qquad k = 1, \dots, M, \tag{15}$$

$$s_j \in \{0,1\}, \qquad j \in \mathcal{N} \setminus \{i\}. \tag{16}$$

Let S_H^{*i} be the optimal value for MILP2. The highest possible ranking for country i is $f_H^i = 1 + S_H^{*i}$. This ranking follows the 1334 method. Thus, f_H^i implies that there is a composite index such that the scores of $N - f_H^i$ countries are strictly lower than that of country i.

3 Results

We employed the normalized SDG scores for the 17 goals published by the Bertelsmann Foundation as *Sustainable Development Report 2020*. Our comparison focuses on 108 countries that had scores for all goals. Table 2 shows the summary statistics. Variations are particularly large in areas such as poverty, inequality, infrastructure, and energy.

Table 2 Summary statistics for 108 states having complete data

	Mean	Median	Max	Min	Std
SDG 1: No poverty	78.13	92.73	99.99	0.00	28.59
SDG 2: Zero hunger	55.75	56.55	80.24	20.76	10.06
SDG 3: Good health and well-being	71.13	77.13	97.08	24.84	18.96
SDG 4: Quality education	80.26	87.51	99.91	16.86	20.42
SDG 5: Gender equality	61.69	62.95	91.23	28.84	16.20
SDG 6: Clean water and sanitation	70.36	71.87	94.95	32.71	14.13
SDG 7: Affordable and clean energy	74.19	87.94	99.35	6.81	25.00
SDG 8: Decent work and economic growth	73.60	74.40	88.12	45.04	9.55
SDG 9: Industry, innovation and infrastructure	45.84	40.08	98.76	5.17	26.98
SDG 10: Reduced inequalities	56.39	56.37	100.00	0.00	23.05
SDG 11: Sustainable cities and communities	73.27	77.46	95.59	29.63	15.27
SDG 12: Responsible consumption and production	77.50	81.97	96.13	27.68	15.94
SDG 13: Climate action	85.04	89.87	99.56	15.09	15.92
SDG 14: Life below water	61.30	61.11	83.07	33.21	10.16
SDG 15: Life on land	65.86	64.99	97.84	25.25	15.05
SDG 16: Peace, justice and strong institutions	67.16	67.90	94.65	29.90	13.55
SDG 17: Partnerships for the goals	61.47	60.92	100.00	35.39	14.06
overall	68.17	70.25	84.72	47.12	9.52

Source: Bertelsmann Stiftung (2020). *Sustainable Development Report 2020.*

Table 3 shows the LPR and HPR results for the 108 countries.[4] HGLR and LGLR are the rankings based on the GL dominance criterion. In particular, let g_H^i be the number of countries that dominate country i in the GL sense: $g_H^i = \#\{j \in \mathcal{N} \setminus \{i\}: GL(\mathbf{x}^i) \leq GL(\mathbf{x}^j)\}$.[5] Similarly, let g_L^i be

[4] To solve the mixed integer programming problem, we used the 'intlinprog' command of MATLAB.

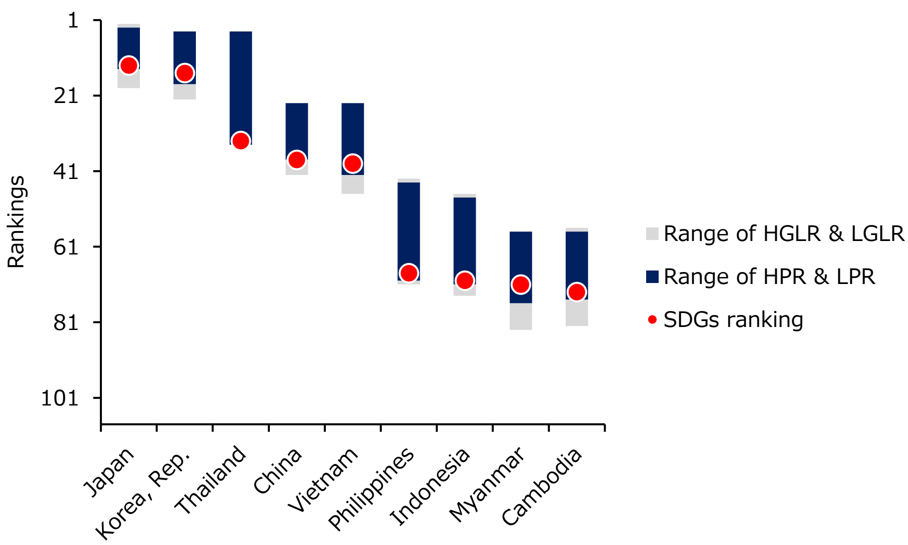
[5] $GL(\mathbf{x}^i) \leq GL(\mathbf{x}^j)$ means that $\sum_{k=1}^{s} x_{(k)}^i \leq \sum_{k=1}^{s} x_{(k)}^j$ holds for all $s = 1, \dots, K$, where $x_{(k)}^i$ denotes the elements of the vector $\mathbf{x}^i$ rearranged according to increasing order: $x_{(1)}^i \leq x_{(2)}^i, \dots, \leq x_{(K)}^i$.

the number of countries that are dominated by country i in the GL sense: $g_L^i = \#\{j \in \mathcal{N} \setminus \{i\}: GL(\mathbf{x}^i) \geq GL(\mathbf{x}^j)\}$. As shown in Cherchye (2008), we can consider the possible ranking based on the number of dominating and dominated countries in the GL sense. That is, the highest possible ranking based on the GL (HGLR) is $1 + g_H^i$, and the lowest possible ranking based on the GL (LGLR) is $N - g_L^i$.

As mentioned earlier, the rankings by GL do not coincide with the rankings by the HPR or LPR. For example, Sweden dominates 97 countries in the GL sense, which implies that Sweden ranks 11th or higher. Solving MILP2, however, we see that Sweden's ranking will be no lower than 8th for any transformation function belonging to $\mathcal{J}$.

By the definition, the range between the HPR and LPR is narrower than the range of rankings determined by GL: $HGLR^i \leq HPR^i$ and $LGLR^i \geq LPR^i$ hold. Nevertheless, some countries still have a broad range of HPR and LPR. For example, Norway ranks 6th in the SDGs ranking based on the individual indicators but 81st according to the LPR. This is due to Norway's low score for Goal 13. Thus, under a transformation function with strong concavity, the country's rating would be lower. In general, if the index for a particular goal is significantly lower, the LPR will be much lower than the SDG ranking. Conversely, if there is no significant difference between the indexes for the individual goals, the HPR will be much higher than the SDG ranking. This is a consequence of assuming concavity in the transformation function.

Figure 1 Rankings of East Asian countries



Source: Author's calculation based on the SDGs index 2020.

Figure 1 shows the ranking results for several East Asian countries. In all countries, the ranking values for the LPR and SDGs are close, indicating that there is not much variation in the indicators among the targets. Furthermore, there is not much difference between the LPR and HPR for Japan and Korea. This is also the case for the pairs China and Vietnam, the Philippines and Indonesia, and Myanmar and Cambodia. Thus, caution should be exercised in evaluating a country's sustainability based on a simple SDG ranking alone. On the other hand, the LPRs of Japan and Korea are higher than the HPRs of China and Vietnam, suggesting that there is a difference in ranking among these countries. This difference is robust in the sense that it holds for all transformation functions $I \in \mathcal{I}$. We can observe a similar situation between the groups of China and Vietnam and those of the Philippines, Indonesia, Myanmar, and Cambodia.

4 Remark

The 17 goals set forth in the UN's SDGs are essential to the sustainability of society. Therefore, it is important to construct an index that comprehensively assesses the achievement of the SDGs. In this note, we propose a new method to identify the highest and lowest possible rankings of the SDGs index. The calculation of the rankings proposed here does not specify the evaluation function, but rather the range of rankings under a general evaluation function. This analysis suggests that countries should not focus on small changes in ranking, but rather raise their lowest-achieving indexes. On the other hand, if the highest possible ranking of one country is lower than the lowest possible ranking of another, there is a robust difference in SDG achievement between the two countries. Such differences provide important information regarding how we think about international aid and strategies for achieving the SDGs globally.

A fundamental assumption in our analysis is that the 17 indicators are properly normalized. This note does not address the method of normalization. Nor does it discuss the relationship between the 17 SDG goals and the indicators of their achievement. These considerations, along with the evaluation methodology proposed in this note, are important to the broad and substantial achievement of the SDGs. We leave these as issues for future study.

Table 3 Results

r	Country	HGLR	HPR	LPR	LGLR	r	Country	HGLR	HPR	LPR	LGLR
1	Sweden	1	1	8	11	55	Montenegro	45	46	61	69
2	Denmark	1	1	32	32	56	Dominican Republic	47	47	70	74
3	Finland	1	1	7	9	57	Fiji	48	49	72	76
4	France	1	1	4	5	58	El Salvador	50	53	83	85
5	Germany	3	3	15	16	59	Panama	48	49	70	76
6	Norway	6	6	81	82	60	Egypt, Arab Rep.	37	38	64	67
7	Netherlands	5	5	26	30	61	Jamaica	40	40	72	74
8	Estonia	5	5	30	32	62	Nicaragua	51	53	92	92
9	Belgium	5	5	22	25	63	Jordan	30	30	64	64
10	Slovenia	6	7	23	28	64	Maldives	64	64	97	99
11	United Kingdom	4	5	16	21	65	Cabo Verde	52	52	77	80
12	Ireland	10	10	41	43	66	Sri Lanka	50	51	73	78
13	Japan	2	3	14	19	67	Lebanon	38	38	67	70
14	Croatia	1	1	14	14	68	Philippines	43	44	70	71
15	Korea, Rep.	4	4	18	22	69	Ghana	36	36	70	70
16	Canada	8	9	22	24	70	Indonesia	47	48	71	74
17	Spain	6	6	18	22	71	Myanmar	57	57	76	83
18	Poland	4	4	18	22	72	Honduras	67	67	89	93
19	Latvia	16	18	48	50	73	Cambodia	56	57	75	82
20	Portugal	3	3	20	24	74	Mauritius	62	62	85	87
21	Iceland	20	20	65	67	75	Bangladesh	58	60	78	82
22	Chile	14	15	56	58	76	South Africa	70	70	105	105
23	Italy	6	7	23	27	77	Gabon	47	47	77	77
24	United States	14	15	29	33	78	Iraq	57	57	79	81
25	Malta	19	19	42	48	79	Sao Tome and Principe	72	72	84	89
26	Cyprus	19	22	45	50	80	India	56	56	84	85
27	Costa Rica	21	22	49	56	81	Venezuela, RB	71	71	94	95
28	Lithuania	16	18	33	37	82	Namibia	79	79	106	106
29	Australia	29	29	91	92	83	Guatemala	75	75	93	95
30	Romania	14	14	31	34	84	Vanuatu	69	69	84	89
31	Bulgaria	3	3	31	32	85	Kenya	57	57	85	85
32	Israel	16	17	42	45	86	Senegal	71	72	87	91
33	Thailand	4	4	34	34	87	Cote d'Ivoire	66	66	88	88
34	Greece	12	12	35	35	88	Gambia, The	85	85	97	100
35	Uruguay	23	23	38	43	89	Mauritania	76	77	94	95
36	Ecuador	25	27	51	58	90	Tanzania	75	75	93	95
37	Ukraine	26	29	52	58	91	Cameroon	78	78	93	94
38	China	23	23	38	42	92	Pakistan	72	72	92	94
39	Vietnam	23	23	42	47	93	Congo, Rep.	91	91	106	106
40	Bosnia and Herzegovina	29	32	57	61	94	Djibouti	67	67	95	96
41	Argentina	22	22	42	47	95	Mozambique	92	92	103	103
42	Brazil	31	34	71	73	96	Benin	90	90	103	103
43	Algeria	30	32	50	52	97	Comoros	81	81	97	100
44	Russian Federation	16	16	49	50	98	Togo	91	91	102	103
45	Georgia	32	32	49	55	99	Angola	85	87	101	102
46	Iran, Islamic Rep.	21	21	46	47	100	Guinea	97	97	106	106
47	Malaysia	29	29	50	51	101	Sierra Leone	97	97	106	106
48	Peru	33	35	55	60	102	Haiti	89	89	103	105
49	Tunisia	28	29	51	52	103	Papua New Guinea	94	95	104	105
50	Morocco	34	34	51	57	104	Congo, Dem. Rep.	102	103	107	107
51	Colombia	45	46	78	83	105	Sudan	88	88	105	106
52	Albania	45	47	63	69	106	Nigeria	86	86	107	107
53	Mexico	49	50	80	84	107	Madagascar	106	106	108	108
54	Turkey	37	37	57	62	108	Liberia	103	103	108	108

Notes.
r: SDGs ranking among 108 countries.
HPR: Highest possible ranking
LPR: Lowest possible ranking
HGLR: Highest ranking according to the GL criterion
LGLR: Lowest ranking according to the GL criterion.
Source: Author’s calculation based on the SDGs index 2020.

References

Chatterjee, S. K. (2005). Measurement of Human Development: an alternative approach. *Journal of Human Development*, 6(1), 31-44.

Cherchye, L., Ooghe, E., & Van Puyenbroeck, T. (2008). Robust human development rankings. *Journal of Economic Inequality*, 6(4), 287-321.

Greco, S., Ishizaka, A., Tasiou, M., & Torrisi, G. (2019). On the methodological framework of composite indices: A review of the issues of weighting, aggregation, and robustness. *Social Indicators Research*, 141(1), 61-94.

Joint Research Centre-European Commission. (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD publishing.

Panigrahi, R., & Sivramkrishna, S. (2002). An adjusted human development index: robust country rankings with respect to the choice of fixed maximum and minimum indicator values. *Journal of Human Development*, 3(2), 301-311.

Permanyer, I. (2011). Assessing the robustness of composite indices rankings. *Review of Income and Wealth*, 57(2), 306-326.

Salvati, L., & Carlucci, M. (2014). A composite index of sustainable development at the local scale: Italy as a case study. *Ecological Indicators*, 43, 162-171.

Shorrocks, A. F. (1983). Ranking income distributions. *Economica*, 50(197), 3-17.

Zhou, P., Ang, B. W., & Zhou, D. Q. (2010). Weighting and aggregation in composite indicator construction: A multiplicative optimization approach. *Social indicators research*, 96(1), 169-181.