# REVIEW AND IMPROVEMENTS ON OECD BETTER LIFE INDEX [1]

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**ABSTRACT**

*The Organization for Economic Cooperation and Development (OECD) has developed the Better Life Index (BLI) as part of the OECD Better Life initiative to facilitate the better understanding of what drives well-being of people and guide the policy-making. The BLI is a three-level hierarchical composite indicator which covers several socio-economic aspects. In this paper, we depart from the traditional approaches of building composite indices by introducing a hierarchical evaluation methodology for the assessment of BLI. We establish a common basis for fair and democratic evaluation as the aggregation schemes for both first and second level of BLI are determined jointly by the assessed countries through optimization process. We also incorporate into the assessment the public opinion that is captured from the worldwide responses in the web platform of OECD BLI. In addition, we enrich our methodology by incorporating the data from previous years into the normalization process of the indicators, thus smoothing the deviations of indicators' values among the years. We apply our approach to the data of 38 countries for the year 2017. The robust results obtained from our approach provide insights about the key role that public opinion plays in the evaluation of BLI.*

***Keywords****: OECD Better Life Index; Composite Index; Hierarchical Evaluation; Public Opinion*

## INTRODUCTION

The evolution of societies is accompanied with tremendous changes that occur in main aspects such as economy, politics, education and environment. As it is observed, economic growth is not always followed by other societal aspects, nor is it equally shared and beneficial to all parts of societies. However, the quality of life is more important than income. Hence, to obtain a better picture of society, it is important to go beyond the ordinary income-based measures that are inadequate to capture the societal progress. Instead, for measuring the well-being, more comprehensive measures are needed that incorporate multifaceted human-centric criteria, such as material conditions, quality of life and sustainability.

On this basis, the Organization for Economic Cooperation and Development (OECD) launched the OECD Better Life initiative (OECD, 2011) with the aim to develop better well-being metrics and facilitate the

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understanding of what drives well-being of people. The initiative provides regular monitoring and benchmarking through the biennial "How's Life?" report (OECD 2011, 2013, 2015 and 2017) and the interactive web platform[1] that promotes the OECD Better Life Index (BLI). The OECD BLI covers several socio-economic aspects by incorporating eleven key topics that the OECD has identified as essential to well-being in terms of material living conditions and quality of life. Each topic is composed by one to four indicators. The BLI has a hierarchical structure with three levels (Figure 1). In a bottom-up representation, the first (bottom) level comprises of the indicators that form the eleven topics of the second level, which subsequently form the BLI at the 3rd level. The complete description of each topic and indicator included in BLI, can be found in the "How's Life?" report OECD (2011).

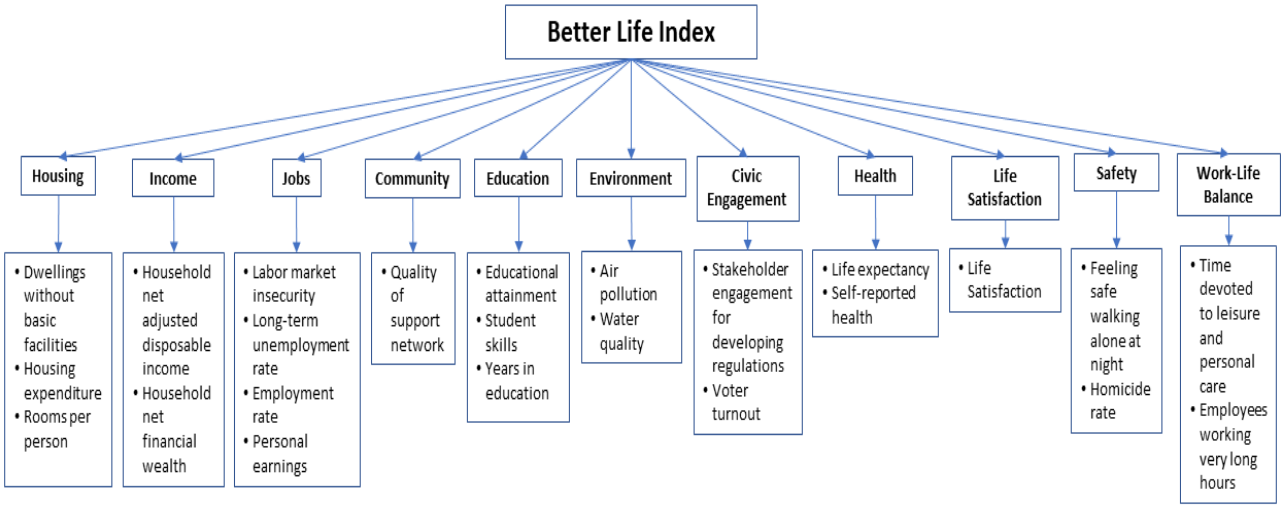


**Figure. 1**: Hierarchical Structure of OECD Better Life Index

The multidimensional nature of well-being renders its measurement a rough task, which requires computational methods adequate to capture the several aspects involved. On the other hand, it is challenging to synthesize the multifaceted components of BLI to obtain a single measure of well-being. The OECD Handbook for the construction of composite indices (OECD, 2008) provides directives and methodological tools, however there is still a great debate about the aggregation techniques that should be adopted. For instance, it is arbitrary to consider that the eleven topics of BLI are of equal importance, i.e. that people believe that each topic has the same impact in their life. An alternative to the equal or fixed weighting procedure, based on Data Envelopment Analysis (DEA) (Cooper et al, 2011), is the *Benefit of the Doubt* (BoD) approach. The BoD approach (Cherchye et al, 2007), is a popular approach for constructing composite indices where the weights derive endogenously from the optimization process.

The OECD has not adopted, so far, an aggregation approach for the case of BLI. It is left to the citizens though, as declared in the corresponding website "*Your Better Life Index is designed to let you, the user, investigate how each of the 11 topics can contribute to well-being*", to create the BLI based on their views. However, this deliberate omission has stimulated the research about the construction of BLI. Mizobuchi

[1] The OECD Better Life Index is promoted through the web platform http://www.oecdbetterlifeindex.org.

(2014) applied the BoD approach to construct the BLI for 34 countries (32 OECD members, Brazil and Russia) for the data of year 2011. The BoD was applied for the aggregation of the eleven topics (level 2), whose scores were estimated by the original averaging formula proposed by the OECD BLI initiative[1]. The obtained BLI scores were used to further investigate the link between the countries' well-being and the economic development, as reflected by per capita GDP. However, the approach of Mizobuchi (2014) generates country-specific weights that maximize the performance (composite indicator) of each country, failing in this way to provide a common basis for comparisons among the countries. Mizobuchi (2017) introduced another topic to BLI, apart from the 11 initial topics, to account for the sustainability of well-being. Such an addition has been also proposed by OECD as a future complement in the BLI. In contrast to Mizobuchi (2014), in Mizobuchi (2017) the corrected convex non-parametric least squares (C2NLS) method was applied for constructing the BLI. Barrington-Leigh and Escande (2018) conducted a comparative study of indicators that measure progress and countries' well-being, reviewing the BLI and highlighting its advantages. In the same context, Lorenz et al (2017) developed BoD based models to estimate the weighting schemes that allow each country to attain the highest possible rank according to its BLI performance. Finally, Peiro-Palomino and Picazo-Tadeo (2017) calculated the BLI based only on ten topics. They used instead the "*Life Satisfaction*" topic for comparison purposes with the calculated BLI. They employed the goal-programming model proposed by Despotis (2002) for the assessment and they also performed hierarchical cluster analysis to group the assessed countries in terms of well-being.

In this paper we differentiate from the other studies on BLI by introducing a hierarchical (bottom-up) procedure to aggregate the components of each level of BLI. Our methodology is based on linear programming to perform the assessment. First, we estimate a common set of weights for the indicators of the first level to derive the aggregate measures (topics) of the second level. Then, we estimate alternative common sets of weights, under different concepts, for these measures (topics of level 2) to derive the BLI (level 3). Our approach is neutral and more democratic than the existing ones since the weighting schemes are jointly decided by the assessed countries and the varying opinions of their citizens. We incorporate into the assessment the reported views of people as recorded in the web platform of OECD BLI. These views are translated into weight restrictions and incorporated into the proposed models. In addition, we take into account the discrepancy on the metrics of the indicators (level 1) over time, by incorporating the data of previous years into a preliminary data normalization process.

**METHODS**

As the multilateral indicators are expressed in different units (dollars, years, etc.), the composition of BLI requires data normalization, prior to the aggregation of the raw data. In the OECD BLI web platform the OECD normalization procedure[2] involves, only for the year under assessment, the minimum and maximum observed values of the indicators from the participating countries. However, these values may have been changed significantly among the years. As a result, the dispersion of the indicators' (level 1) values among

[1] The method proposed by OECD for the aggregation of the indicators of level 1 assumes equal weights, it can be found in http://www.oecdbetterlifeindex.org/about/better-life-initiative/#question15.
[2] The normalization procedure used by OECD for the data of the indicators of level 1 can be found in http://www.oecdbetterlifeindex.org/about/better-life-initiative/#question16.

the years is not considered during the necessary normalization process. Unlike the existing studies on BLI, we smooth the deviations of indicators' values and we establish cross-year compatibility by incorporating in the normalization process their minimum and maximum observed values across the years (i.e. of the available data of 2013-2017).

*Incorporation of Public Opinion*

The OECD has not still published a complete methodology for the construction of the BLI, but at this point it aims to prompt people to participate in the public debate about what shapes well-being and to capture their views over the eleven topics that compose the BLI. The users of the web-based application are prompted to rate the eleven topics of level 2 to build their own BLI. The preferences expressed by people are stored in a publicly accessible database that enables the cross-country comparisons and aid the OECD to better understand what is most important for the well-being. In the context of our approach, we transfer the benefits obtained from the public deliberation by incorporating the public opinion in the assessment of BLI. Although people's authentic responses are subjective judgements, they reveal the true needs and beliefs. Hence, public opinion is the best driver for assessing the countries concerning the well-being and enables us to take into account equally all the different views in a democratic form of assessment. To date, more than 132,566 users from 218 countries have shared their views on the OECD web platform. The complete list of the responses of people worldwide is publicly available at the web platform. In this study, we have chosen to include only the 117,434 responses that derive from the citizens of the 38 countries under evaluation. Table 1 depicts the normalized weights retrieved for the 38 countries as well as the representative (total) weights of the worldwide responses as provided by OECD.

**Table 1**: Normalized weights retrieved from OECD

| Country | HO | IW | JE | SC | ES | EQ | CG | HS | SW | PS | WL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Australia** | 0.090 | 0.087 | 0.084 | 0.074 | 0.098 | 0.083 | 0.063 | 0.103 | 0.099 | 0.092 | 0.127 |
| **Austria** | 0.091 | 0.083 | 0.086 | 0.080 | 0.098 | 0.095 | 0.068 | 0.107 | 0.103 | 0.097 | 0.091 |
| **Belgium** | 0.094 | 0.087 | 0.087 | 0.079 | 0.100 | 0.092 | 0.065 | 0.107 | 0.103 | 0.092 | 0.094 |
| **Canada** | 0.090 | 0.088 | 0.089 | 0.080 | 0.099 | 0.091 | 0.064 | 0.107 | 0.104 | 0.096 | 0.093 |
| **Chile** | 0.090 | 0.089 | 0.092 | 0.076 | 0.106 | 0.092 | 0.073 | 0.104 | 0.096 | 0.090 | 0.093 |
| **Czech Republic** | 0.085 | 0.092 | 0.092 | 0.076 | 0.098 | 0.094 | 0.068 | 0.104 | 0.103 | 0.098 | 0.090 |
| **Denmark** | 0.083 | 0.081 | 0.087 | 0.081 | 0.103 | 0.094 | 0.073 | 0.102 | 0.112 | 0.091 | 0.094 |
| **Estonia** | 0.096 | 0.090 | 0.090 | 0.078 | 0.099 | 0.097 | 0.067 | 0.103 | 0.100 | 0.099 | 0.083 |
| **Finland** | 0.087 | 0.083 | 0.085 | 0.079 | 0.099 | 0.098 | 0.069 | 0.105 | 0.107 | 0.097 | 0.091 |
| **France** | 0.094 | 0.087 | 0.091 | 0.088 | 0.099 | 0.092 | 0.062 | 0.108 | 0.099 | 0.088 | 0.093 |
| **Germany** | 0.090 | 0.084 | 0.086 | 0.083 | 0.099 | 0.092 | 0.068 | 0.105 | 0.109 | 0.090 | 0.094 |
| **Greece** | 0.086 | 0.090 | 0.092 | 0.077 | 0.102 | 0.092 | 0.066 | 0.110 | 0.100 | 0.094 | 0.090 |
| **Hungary** | 0.092 | 0.090 | 0.085 | 0.084 | 0.096 | 0.093 | 0.062 | 0.101 | 0.105 | 0.099 | 0.095 |
| **Iceland** | 0.097 | 0.089 | 0.090 | 0.081 | 0.101 | 0.085 | 0.064 | 0.108 | 0.094 | 0.104 | 0.087 |
| **Ireland** | 0.088 | 0.089 | 0.089 | 0.083 | 0.099 | 0.087 | 0.068 | 0.101 | 0.111 | 0.085 | 0.100 |
| **Israel** | 0.094 | 0.103 | 0.088 | 0.077 | 0.103 | 0.082 | 0.064 | 0.107 | 0.101 | 0.088 | 0.093 |
| **Italy** | 0.086 | 0.082 | 0.093 | 0.083 | 0.098 | 0.095 | 0.072 | 0.104 | 0.103 | 0.088 | 0.095 |
| **Japan** | 0.090 | 0.088 | 0.087 | 0.081 | 0.098 | 0.087 | 0.063 | 0.103 | 0.102 | 0.111 | 0.090 |
| **Korea** | 0.093 | 0.089 | 0.088 | 0.080 | 0.096 | 0.086 | 0.069 | 0.097 | 0.107 | 0.101 | 0.094 |
| **Latvia** | 0.087 | 0.094 | 0.087 | 0.080 | 0.094 | 0.097 | 0.069 | 0.093 | 0.103 | 0.097 | 0.097 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Luxembourg** | 0.089 | 0.098 | 0.094 | 0.078 | 0.092 | 0.093 | 0.062 | 0.106 | 0.101 | 0.093 | 0.092 |
| **Mexico** | 0.091 | 0.091 | 0.092 | 0.076 | 0.104 | 0.088 | 0.074 | 0.100 | 0.097 | 0.093 | 0.092 |
| **Netherlands** | 0.093 | 0.085 | 0.084 | 0.079 | 0.099 | 0.092 | 0.067 | 0.105 | 0.111 | 0.092 | 0.095 |
| **New Zealand** | 0.088 | 0.085 | 0.086 | 0.081 | 0.099 | 0.096 | 0.067 | 0.102 | 0.108 | 0.091 | 0.097 |
| **Norway** | 0.093 | 0.088 | 0.090 | 0.079 | 0.095 | 0.092 | 0.065 | 0.107 | 0.105 | 0.093 | 0.095 |
| **Poland** | 0.090 | 0.094 | 0.091 | 0.078 | 0.101 | 0.086 | 0.061 | 0.098 | 0.109 | 0.098 | 0.095 |
| **Portugal** | 0.088 | 0.084 | 0.093 | 0.078 | 0.096 | 0.090 | 0.069 | 0.104 | 0.104 | 0.099 | 0.096 |
| **Slovak Republic** | 0.085 | 0.088 | 0.092 | 0.081 | 0.096 | 0.093 | 0.068 | 0.104 | 0.104 | 0.097 | 0.091 |
| **Slovenia** | 0.089 | 0.084 | 0.087 | 0.083 | 0.099 | 0.102 | 0.065 | 0.101 | 0.099 | 0.100 | 0.092 |
| **Spain** | 0.086 | 0.084 | 0.091 | 0.078 | 0.102 | 0.087 | 0.075 | 0.109 | 0.097 | 0.094 | 0.097 |
| **Sweden** | 0.088 | 0.084 | 0.089 | 0.079 | 0.097 | 0.096 | 0.070 | 0.105 | 0.107 | 0.090 | 0.095 |
| **Switzerland** | 0.090 | 0.089 | 0.089 | 0.083 | 0.097 | 0.092 | 0.064 | 0.103 | 0.106 | 0.092 | 0.093 |
| **Turkey** | 0.091 | 0.093 | 0.088 | 0.083 | 0.099 | 0.090 | 0.073 | 0.100 | 0.095 | 0.094 | 0.094 |
| **United Kingdom** | 0.091 | 0.089 | 0.090 | 0.079 | 0.098 | 0.091 | 0.062 | 0.105 | 0.111 | 0.086 | 0.097 |
| **United States** | 0.086 | 0.087 | 0.087 | 0.081 | 0.099 | 0.092 | 0.063 | 0.104 | 0.112 | 0.091 | 0.098 |
| **Brazil** | 0.090 | 0.087 | 0.089 | 0.074 | 0.107 | 0.087 | 0.065 | 0.104 | 0.102 | 0.103 | 0.092 |
| **Russia** | 0.096 | 0.095 | 0.090 | 0.080 | 0.094 | 0.088 | 0.074 | 0.100 | 0.095 | 0.096 | 0.092 |
| **South Africa** | 0.095 | 0.093 | 0.091 | 0.074 | 0.096 | 0.088 | 0.061 | 0.100 | 0.106 | 0.097 | 0.100 |
| **Total** | 0.090 | 0.088 | 0.089 | 0.080 | 0.099 | 0.090 | 0.066 | 0.104 | 0.104 | 0.092 | 0.097 |

*HO: Housing, IW: Income, JE: Jobs, SC: Community, ES: Education, EQ: Environment, CG: Civic engagement, HS: Health, SW: Life Satisfaction, PS: Safety, WL: Work-Life Balance.*

The public opinion can be incorporated into the evaluation models by translating it into direct weight restrictions (Allen et al, 1997). We translate the opinions of Table 1 to absolute limits that the weights of the eleven topics (level 2) can receive. In Table 2 we present the lower and upper bounds that the weight $u$ ($Lower \leq u \leq Upper$) of each topic (level 2) can receive. These bounds derive from the minimum and maximum values of each column of Table 1. We denote the whole set of the weight restrictions with $\Omega$.

**Table 2:** Lower and Upper Bounds of weights of the eleven topics (level 2)

| | **HO** | **IW** | **JE** | **SC** | **ES** | **EQ** | **CG** | **HS** | **SW** | **PS** | **WL** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lower Bound** | 0.083 | 0.081 | 0.084 | 0.074 | 0.092 | 0.082 | 0.061 | 0.093 | 0.094 | 0.085 | 0.083 |
| **Upper Bound** | 0.097 | 0.103 | 0.094 | 0.088 | 0.107 | 0.102 | 0.075 | 0.110 | 0.112 | 0.111 | 0.127 |

*HO: Housing, IW: Income, JE: Jobs, SC: Community, ES: Education, EQ: Environment, CG: Civic engagement, HS: Health, SW: Life Satisfaction, PS: Safety, WL: Work-Life Balance.*

*Evaluation Models*

As noticed, the BLI is a composite index with a hierarchical structure, which derives from the aggregation of the components that lie on three different levels. The indicators of level 1 are aggregated with equal weights to derive the values of each topic of level 2. This method[2] besides being employed by OECD for the BLI, it also prevails in the literature. The BLI is not provided directly as an index, but the aggregation scheme of the eleven topics for its construction is left to the people. The users of the web-based application are prompted to rate the eleven topics of level 2 to build their own BLI. Also, the reported approaches in the literature are mainly devoted to this task. On the contrary, in our methodology we obtain the values of each topic (level 2) from optimization process, instead of commonly aggregating with equal weights the

indicators that they comprise. In addition, we derive the BLI (level 3) through linear programming (LP) models that incorporate the reported views of people over the eleven topics of level 2.

The conventional form of BoD, model (1) below, can be characterized as an index maximizing LP model that it is solved for one country at a time (Despotis, 2005). The composite index $h_j$ for the specific country $j$ ($j=1,..n$) derives as the weighted sum $uY_j$, where $Y_j = (Y_{j1}, Y_{j2}, \dots, Y_{jm})$ denotes the vector of the $m$ components' values and $u = (u_1, u_2, .., u_m)$ denotes the vector of the variables used as weights.

$$\begin{aligned} & h_{j_0} = max\, uY_{j_0} \\ & s.t. \\ & uY_j \le 1, \;\; j = 1, \dots, n \\ & \qquad\qquad u \ge \varepsilon \end{aligned} \tag{1}$$

Model (1) is solved for all the countries, thus the optimal multiplier vectors $u^*$ are generally different for the various countries $j$ under evaluation. The different weighting schemes derived for each country $j$ under evaluation, allow each one of them to reach the highest possible score. This is attributed to the flexibility of the model to assign large values to the weights of the components that each country performs well relative to the other countries and low values to the ones that performs poorly. However, this approach lacks a common basis for cross-country comparisons and ranking. A common basis for fair evaluation can be established by finding a common set of multipliers $u$ that will be used to obtain the composite index for each country. Also, this vector of multipliers should be derived under the rational assumption that yields ratings as near as possible to the ideal ones for each country, i.e. $h_j=1, j=1, \dots, n$. For this purpose, we propose model (2) as a variant of model (1) under a goal programming setting, with common weights for all the assessed countries as follows:

$$\begin{aligned} & min \sum_{j=1}^{n} d_j \\ & s.t. \\ & uY_j + d_j = 1, \;\; j = 1, \dots, n \\ & d_j \ge 0, \;\; u \ge \varepsilon \end{aligned} \tag{2}$$

In model (2), the objective function minimizes the sum of the deviations ($L_1$ norm) of all countries between the performance that they can achieve, using the common multipliers, and the ideal rating ($d_j = 1 - uY_j$). Model (2) is solved only once for all countries collectively and provides higher discrimination regarding the performance of the evaluated countries as well as it allows for ranking.

If the analysis is oriented to the disadvantaged countries with poor performance, then the min-max goal-programming model (3) could be applied. In model (3) the largest deviation $\delta$ from the ideal performance ($L_\infty$ norm) dominates, i.e. the optimal solution (set of common weights) is solely determined by the country with the lowest performance. Model (3) minimizes the distance between the ideal objective vector and the feasible objective region by employing the augmented Tchebycheff norm (Steuer and Choo, 1983).

$$
\begin{aligned}
& min\ \delta + \rho \sum_{j=1}^{n} (1 - uY_j) \\
& s.t. \\
& uY_j + \delta \geq 1, \quad j = 1, \dots, n \\
& uY_j \qquad \leq 1, \quad j = 1, \dots, n \\
& \delta \geq 0, \ u \geq \varepsilon
\end{aligned}
\tag{3}
$$

In the objective function of model (3) the aggregate of the deviations from the ideal performance ($L_1$-*term*) is called correction or augmentation term that guarantees the Pareto optimality of the solution. The augmentation term is multiplied by a sufficiently small positive scalar $\rho$.

**RESULTS AND DISCUSSIONS**

We evaluate the OECD BLI by applying our novel methodology to the data of 35 OECD countries and three key partners, namely Brazil, Russia and South Africa, for the year 2017. Initially, we employ the proposed normalization procedure for the raw data of indicators (level 1). The complete raw data of the indicators can be found in the online database of OECD. Next, we derive the values of the eleven topics (level 2) using the normalized data of the indicators (level 1). Contrary to the common aggregation method employed by OECD with the equal weighting scheme for the indicators, we apply model (2) exclusively to the normalized data of the indicators that each topic comprises. Notice that models (1), (2) and (3) can be used not only for the construction of BLI but also for the construction of the topics (level 2). However, we employ the model (2) for the desired characteristics that it possesses. The model (2) provides a fair evaluation by estimating a common set of multipliers for all the countries and for each topic separately. These weighting schemes derive collectively by all countries under evaluation and they are used for the calculation of each topic. Table 3 exhibits the resulting values for each of the eleven topics.

**Table 3**: Data of eleven topics (level 2) derived from optimization process - model (2)

| Country | HO | IW | JE | SC | ES | EQ | CG | HS | SW | PS | WL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Australia** | 0.970 | 0.699 | 0.942 | 0.839 | 0.916 | 0.960 | 1 | 0.985 | 0.839 | 0.971 | 0.718 |
| **Austria** | 0.973 | 0.674 | 0.965 | 0.774 | 0.880 | 0.740 | 0.412 | 0.930 | 0.742 | 0.993 | 0.857 |
| **Belgium** | 0.938 | 0.602 | 0.883 | 0.774 | 0.767 | 0.760 | 0.824 | 0.926 | 0.710 | 0.971 | 0.917 |
| **Canada** | 0.995 | 0.598 | 0.959 | 0.806 | 0.963 | 0.920 | 0.887 | 0.951 | 0.839 | 0.956 | 0.921 |
| **Chile** | 0.746 | 0.223 | 0.840 | 0.516 | 0.586 | 0.740 | 0.240 | 0.840 | 0.645 | 0.843 | 0.789 |
| **Czech Republic** | 0.984 | 0.351 | 0.980 | 0.677 | 1 | 0.660 | 0.679 | 0.828 | 0.613 | 0.978 | 0.881 |
| **Denmark** | 0.984 | 0.573 | 0.986 | 0.871 | 0.892 | 0.880 | 0.765 | 0.913 | 0.903 | 0.982 | 0.962 |
| **Estonia** | 0.814 | 0.282 | 0.924 | 0.710 | 0.911 | 0.900 | 0.787 | 0.784 | 0.290 | 0.894 | 0.946 |
| **Finland** | 0.986 | 0.585 | 0.955 | 0.871 | 1 | 0.940 | 0.674 | 0.941 | 0.903 | 0.956 | 0.922 |
| **France** | 0.986 | 0.635 | 0.870 | 0.645 | 0.765 | 0.800 | 0.665 | 0.969 | 0.548 | 0.985 | 0.847 |
| **Germany** | 0.997 | 0.706 | 0.984 | 0.774 | 0.929 | 0.780 | 0.638 | 0.904 | 0.742 | 0.993 | 0.909 |
| **Greece** | 0.986 | 0.235 | 0.368 | 0.452 | 0.680 | 0.700 | 0.502 | 0.926 | 0.161 | 0.971 | 0.846 |
| **Hungary** | 0.884 | 0.229 | 0.901 | 0.516 | 0.834 | 0.680 | 0.262 | 0.714 | 0.194 | 0.963 | 0.939 |
| **Iceland** | 1 | 0.615 | 1 | 0.968 | 0.833 | 1 | 0.543 | 0.979 | 0.903 | 0.974 | 0.678 |
| **Ireland** | 0.997 | 0.473 | 0.929 | 0.903 | 0.853 | 0.920 | 0.163 | 0.946 | 0.742 | 0.985 | 0.906 |
| **Israel** | 0.881 | 0.434 | 0.988 | 0.613 | 0.870 | 0.640 | 0.258 | 0.970 | 0.806 | 0.945 | 0.677 |
| **Italy** | 0.984 | 0.491 | 0.755 | 0.742 | 0.500 | 0.700 | 0.475 | 0.975 | 0.387 | 0.978 | 0.920 |
| **Japan** | 0.827 | 0.564 | 1 | 0.710 | 1 | 0.780 | 0.213 | 1 | 0.387 | 0.996 | 0.538 |
| **Korea** | 0.886 | 0.368 | 1 | 0.258 | 0.923 | 0.500 | 0.778 | 0.932 | 0.387 | 0.967 | 0.558 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| **Latvia** | 0.651 | 0.186 | 0.835 | 0.581 | 0.957 | 0.840 | 0.615 | 0.666 | 0.387 | 0.766 | 0.952 |
| **Luxembourg** | 1 | 0.923 | 0.960 | 0.774 | 0.740 | 0.820 | 0.620 | 0.971 | 0.710 | 0.985 | 0.925 |
| **Mexico** | 0.886 | 0.147 | 0.945 | 0.387 | 0.112 | 0.740 | 1 | 0.696 | 0.613 | 0.354 | 0.361 |
| **Netherlands** | 1 | 0.568 | 0.968 | 0.710 | 0.810 | 0.780 | 0.475 | 0.946 | 0.871 | 0.985 | 1 |
| **New Zealand** | 0.992 | 0.443 | 0.936 | 0.871 | 0.786 | 0.960 | 0.810 | 0.958 | 0.839 | 0.960 | 0.683 |
| **Norway** | 1 | 0.765 | 0.991 | 0.839 | 0.865 | 0.960 | 0.629 | 0.976 | 0.903 | 0.985 | 0.940 |
| **Poland** | 0.927 | 0.288 | 0.919 | 0.677 | 0.985 | 0.620 | 0.643 | 0.785 | 0.419 | 0.978 | 0.858 |
| **Portugal** | 0.973 | 0.334 | 0.798 | 0.613 | 0.334 | 0.860 | 0.208 | 0.909 | 0.161 | 0.971 | 0.828 |
| **Slovak Republic** | 0.962 | 0.327 | 0.806 | 0.742 | 0.943 | 0.640 | 0.783 | 0.758 | 0.452 | 0.978 | 0.897 |
| **Slovenia** | 0.992 | 0.334 | 0.890 | 0.742 | 0.938 | 0.740 | 0.679 | 0.912 | 0.355 | 0.985 | 0.907 |
| **Spain** | 0.997 | 0.408 | 0.509 | 0.871 | 0.512 | 0.840 | 0.462 | 0.994 | 0.548 | 0.985 | 0.913 |
| **Sweden** | 1 | 0.618 | 0.912 | 0.774 | 0.906 | 0.940 | 0.733 | 0.974 | 0.839 | 0.971 | 0.981 |
| **Switzerland** | 1 | 0.783 | 0.988 | 0.839 | 0.922 | 0.760 | 0.588 | 1 | 0.903 | 0.989 | 0.857 |
| **Turkey** | 0.824 | 0.236 | 0.728 | 0.581 | 0.223 | 0.660 | 0.756 | 0.806 | 0.258 | 0.945 | 0.269 |
| **United Kingdom** | 0.989 | 0.557 | 0.976 | 0.806 | 0.816 | 0.840 | 0.864 | 0.919 | 0.645 | 1 | 0.733 |
| **United States** | 0.997 | 1 | 0.969 | 0.710 | 0.951 | 0.860 | 0.950 | 0.851 | 0.710 | 0.828 | 0.756 |
| **Brazil**[1] | 0.819 | 0.099 | 0.879 | 0.710 | 0.308 | 0.860 | 0.733 | 0.688 | 0.613 | 0.000 | 0.848 |
| **Russia** | 0.627 | 0.225 | 0.941 | 0.710 | 0.998 | 0.760 | 0.163 | 0.543 | 0.419 | 0.595 | 1 |
| **South Africa**[2] | 0 | 0.061 | 0.191 | 0.645 | 0.205 | 0.620 | 0.489 | 0.049 | 0.032 | 0.642 | 0.604 |

*HO: Housing, IW: Income, JE: Jobs, SC: Community, ES: Education, EQ: Environment, CG: Civic engagement, HS: Health, SW: Life Satisfaction, PS: Safety, WL: Work-Life Balance.*

Then, we incorporate in models (1), (2) and (3) the weight restrictions $\Omega$ described in Table 2 and we apply them to the data of Table 3 to derive the BLI for each country. The results obtained from each model as well as the corresponding ranking of each country are presented in Table 4 (columns 6-11). The columns 2-3 of Table 4 exhibit the BLI scores and the ranking that derive by directly employing the normalized weights of Table 1 for each country respectively. Similarly, the columns 4-5 present the BLI scores and the ranking as calculated by utilizing the worldwide (Total) weights.

**Table 4**: BLI Scores

| Country | Country Specific Weights | Ranking | OECD Total Weights | Ranking | Model (1) with Ω | Ranking | Model (2) with Ω | Ranking | Model (3) with Ω | Ranking |
|---|---|---|---|---|---|---|---|---|---|---|
| **Australia** | 0.887 | 5 | 0.893 | 2 | 0.987 | 4 | 0.984 | 5 | 0.983 | 4 |
| **Austria** | 0.825 | 16 | 0.825 | 16 | 0.915 | 16 | 0.912 | 16 | 0.911 | 16 |
| **Belgium** | 0.826 | 15 | 0.826 | 15 | 0.917 | 15 | 0.917 | 15 | 0.915 | 14 |
| **Canada** | 0.893 | 3 | 0.893 | 2 | 0.990 | 2 | 0.990 | 2 | 0.987 | 2 |
| **Chile** | 0.649 | 31 | 0.652 | 31 | 0.729 | 31 | 0.729 | 31 | 0.721 | 31 |
| **Czech Republic** | 0.788 | 19 | 0.790 | 19 | 0.880 | 19 | 0.880 | 19 | 0.872 | 19 |
| **Denmark** | 0.888 | 4 | 0.888 | 5 | 0.986 | 5 | 0.986 | 4 | 0.982 | 5 |
| **Estonia** | 0.748 | 24 | 0.747 | 23 | 0.837 | 22 | 0.837 | 22 | 0.830 | 22 |
| **Finland** | 0.894 | 2 | 0.893 | 2 | 0.990 | 2 | 0.990 | 2 | 0.986 | 3 |
| **France** | 0.798 | 18 | 0.797 | 18 | 0.887 | 18 | 0.883 | 18 | 0.881 | 18 |
| **Germany** | 0.856 | 11 | 0.857 | 11 | 0.951 | 11 | 0.949 | 11 | 0.948 | 11 |
| **Greece** | 0.627 | 34 | 0.627 | 34 | 0.707 | 34 | 0.705 | 34 | 0.696 | 34 |
| **Hungary** | 0.657 | 30 | 0.657 | 30 | 0.740 | 30 | 0.738 | 30 | 0.730 | 30 |
| **Iceland** | 0.875 | 8 | 0.871 | 8 | 0.961 | 8 | 0.960 | 8 | 0.957 | 9 |

[1] The performance of Brazil in topic *Safety* is very low, in fact it attains 0.0000002. This is attributed to the lowest observed values for its indicators (level 1) that compose the topic *Safety* (level 2).

[2] The performance of South Africa in topic *Housing* is very low, in fact it attains 0.00001. This is attributed to the lowest observed values for its indicators (level 1) that compose the topic *Housing* (level 2).

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ireland** | 0.815 | 17 | 0.819 | 17 | 0.913 | 17 | 0.910 | 17 | 0.904 | 17 |
| **Israel** | 0.752 | 21 | 0.753 | 21 | 0.834 | 23 | 0.832 | 23 | 0.827 | 23 |
| **Italy** | 0.722 | 27 | 0.724 | 27 | 0.811 | 27 | 0.807 | 27 | 0.803 | 27 |
| **Japan** | 0.749 | 23 | 0.742 | 24 | 0.822 | 26 | 0.816 | 26 | 0.816 | 26 |
| **Korea** | 0.692 | 28 | 0.691 | 28 | 0.766 | 28 | 0.764 | 28 | 0.758 | 28 |
| **Latvia** | 0.677 | 29 | 0.680 | 29 | 0.764 | 29 | 0.764 | 28 | 0.757 | 29 |
| **Luxembourg** | 0.866 | 9 | 0.862 | 10 | 0.959 | 10 | 0.952 | 9 | 0.956 | 10 |
| **Mexico** | 0.558 | 37 | 0.556 | 37 | 0.614 | 37 | 0.613 | 37 | 0.602 | 37 |
| **Netherlands** | 0.843 | 12 | 0.842 | 12 | 0.935 | 12 | 0.935 | 12 | 0.931 | 12 |
| **New Zealand** | 0.842 | 13 | 0.841 | 13 | 0.931 | 13 | 0.931 | 13 | 0.925 | 13 |
| **Norway** | 0.906 | 1 | 0.904 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Poland** | 0.738 | 25 | 0.740 | 25 | 0.826 | 24 | 0.826 | 24 | 0.818 | 24 |
| **Portugal** | 0.646 | 32 | 0.643 | 33 | 0.724 | 33 | 0.720 | 33 | 0.713 | 33 |
| **Slovak Republic** | 0.751 | 22 | 0.753 | 21 | 0.841 | 21 | 0.841 | 21 | 0.833 | 21 |
| **Slovenia** | 0.777 | 20 | 0.773 | 20 | 0.863 | 20 | 0.863 | 20 | 0.855 | 20 |
| **Spain** | 0.737 | 26 | 0.738 | 26 | 0.825 | 25 | 0.825 | 25 | 0.818 | 24 |
| **Sweden** | 0.884 | 7 | 0.884 | 7 | 0.981 | 6 | 0.981 | 6 | 0.978 | 6 |
| **Switzerland** | 0.885 | 6 | 0.885 | 6 | 0.980 | 7 | 0.976 | 7 | 0.977 | 7 |
| **Turkey** | 0.565 | 36 | 0.562 | 36 | 0.623 | 36 | 0.623 | 36 | 0.615 | 36 |
| **United Kingdom** | 0.827 | 14 | 0.830 | 14 | 0.918 | 14 | 0.918 | 14 | 0.915 | 14 |
| **United States** | 0.865 | 10 | 0.868 | 9 | 0.961 | 8 | 0.952 | 9 | 0.958 | 8 |
| **Brazil** | 0.581 | 35 | 0.592 | 35 | 0.662 | 35 | 0.660 | 35 | 0.648 | 35 |
| **Russia** | 0.639 | 33 | 0.647 | 32 | 0.726 | 32 | 0.725 | 32 | 0.720 | 32 |
| **South Africa** | 0.306 | 38 | 0.309 | 38 | 0.359 | 38 | 0.358 | 38 | 0.359 | 38 |

We observe from the second column of Table 4 that none country is deemed efficient by utilizing the specific weights that derived by the responses of its own citizens. Also, this is the case when the BLI scores (column 4) are calculated by applying directly the weights derived from the overall worldwide responses. However, it is noteworthy that the weights (people's responses) represent an objective reality since for each country the BLI scores obtained by the two different weighting schemes are close and we also spot slight differences on their rankings. For instance, the ranking of the top five countries with the highest BLI performance for the former is Norway, Finland, Canada, Denmark and Australia while for the latter is Norway, Finland, Canada, Australia and Denmark.

On the contrary, the weighting schemes derived by models (1), (2) and (3) with the incorporation of the weight restrictions Ω, render one country as efficient, namely Norway. As expected the BLI scores obtained by the BoD model (1) are higher or equal than the ones obtained from models (2) and (3). This is justified, as noticed, by the country-specific weighting schemes that derived by model (1), which allow each country to achieve the highest possible BLI score. Comparing the scores obtained from models (2) and (3) we notice that they do not follow a specific rule as in the case of model (1). Though, we observe that the scores obtained by model (3) are slightly decreased for the most countries while they are slightly increased for Luxembourg, United States and South Africa. The discrepancies on the BLI scores derived by models (2) and (3) are clearly justified by the different optimality criterion of each model. Although each model yields a common optimal solution for all the countries, these solutions are generally different. The optimal solution of model (2) is absolutely determined by all countries, since all the constraints, except the ones imposed by the weight restrictions Ω, should structurally be binding at optimality. On the other hand, the optimal

solution of the min-max model (3) is determined by the country whose performance has the largest deviation from the ideal one, i.e. the binding constraint corresponds to South Africa. Indeed, South Africa has the lowest performance among all countries, no matter the weighting scheme that is used.

A general observation is that the BLI scores obtained from all models as well as the rankings do not differentiate considerably. Thus, we conclude that the incorporation of the public opinion in the form of the weight restrictions Ω play a crucial role to the assessment of BLI. The weight restrictions restrain the flexibility of the models and drive them to yield robust BLI scores with low dispersion. The analysis reveals that there is a clear divide between the Nordic countries as well as Australia and Canada which achieve high BLI scores and the rest countries that generally achieve relatively low BLI scores. Notice that the Southern and Eastern European countries are absent from the Top 10 as well as the countries from Asia, South America and Africa.

## CONCLUSIONS

In this paper we proposed a hierarchical evaluation approach for the aggregation of the components of BLI that lie on different levels. Also, we explored alternative concepts of policy making that provide different weighting schemes for the construction of the BLI. Our methodology absorbs possible extreme variations of indicators' values between the years, as it incorporates data from previous years into the normalization process. It is also neutral and democratic since the weighting schemes are jointly determined by the assessed countries and the public opinion that is captured from the global responses in the web platform of OECD BLI. In addition, our approach grants the citizens-countries to be heard equally and be considered in the well-being exercises despite their varying necessities and cultures. We demonstrated how the public opinion can be incorporated potentially in a democratic decision-making process. We applied our approach to the data of 38 countries for the year 2017. Our findings illustrate that the public opinion in the form of weight restrictions can effectively drive the optimization process and depict the collective preferences to the BLI scores. Also, the results verify the real living conditions of the assessed countries.

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