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# Working Paper

**Title: Harmonic Development Index (H2DI): a novel approach to measure environmental, social, and economic development**

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**Keywords:** economic, sustainable, GDP, factor analysis

**Word count**

Abstract: 319

Text: 984

Tables: 4

Supplementary materials: 3

**Data availability:** Data are available upon reasonable request

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## Abstract

**Objectives:** Gross domestic product (GDP) is the most commonly used benchmark to measure a country's economic performance. The shortcomings of GDP in capturing overall well-being, economic development and sustainable growth are among the most debated issues in economic research. This study aimed to develop a measure that captures broader aspects of social and economic prosperity.

**Methods:** We compiled a panel dataset of yearly measurements of 32 social and economic indicators from 87 countries between 2005 and 2019 from publicly available sources. Linear interpolation, extrapolation, and random forest imputation methods were used for missing values. Logarithmic transformation of some selected variables, followed by the standardisation of all variables were applied to facilitate the usability and comparability of the variables. We used exploratory factor analysis with maximum likelihood estimation to construct six domain-specific subindices, or "domains" in short (variance explained by factors > 50%). Variances explained by the factors were used as weights to create the composite indicator.

**Results:** Interpolation, extrapolation, and imputation procedures were used to complete 32% of the data. Six domains were generated by factor analysis. Two domains had one dominant factor each (variance explained by the factor > 50%, $p < 0.05$). Three domains had two dominant factors each (cumulative variance explained by the factors > 50%; $p < 0.05$). One domain had one dominant factor that did not reach the variance explained cut-off value (36.8%), although the second factor was not significant ($p = 0.554$); therefore, the first factor was considered the only dominant factor. We found that domains including variables related to the real economy (25.8%), and social equality and sustainability (19.0%) had the highest weights in the composite indicator.

**Conclusion:** This study presents a novel measure to capture important aspects of social and economic prosperity in 87 countries. The Harmonic Development Index allows intercountry and intertemporal comparisons across six domains related to economic development, financial sustainability, environmental, work- and knowledge-based, social, and demographic areas.

## Introduction

A number of studies have argued that gross domestic product (GDP) is an imperfect measure of economic welfare and does not capture important aspects of our lives (1, 2). The areas not captured by GDP are grouped around three well-defined domains: well-being, economic welfare, and sustainability (3). The shortcomings of GDP are well known; thus, it is not surprising that several indices were developed to address the limitations of GDP in capturing important aspects of social and economic prosperity. One of the earliest attempts to better capture economic welfare was made by Nordhaus and Tobin with the development of the Measure of Economic Welfare (4). A study revealed that approximately 80% of the indices examined were developed between 1991 and 2005, and nearly half of all indices available in 2005 had been created between 2000 and 2005 (5). This is closely linked to the "beyond GDP" movement, which arguably reached its peak in 2007 when the European Commission held a conference on "beyond GDP", focusing on the most appropriate indices to measure progress (3). So far, several indices have been developed, including the Human Development Index (HDI), first published in 1990 by Anand and Sen (6), the Inclusive Development Index (IDI) by the World Economic Forum (7), and the Better Life Index (BLI) developed by the Organisation for Economic Co-operation and Development (8). For the HDI, limitations are often related to the choice of variables, weighting and aggregation methods, while criticism of IDI focus on data availability (9, 10). The BLI indicator is characterised by the unadopted weighting and aggregation approach (11).

In general, composite indicators (CI) are often used to evaluate and compare the performance of countries over time in different areas. CIs simplify large, multidimensional datasets while retaining the majority of the underlying information base (12). The development of CIs usually involves three steps: normalisation, weighting, and aggregation (13). Weighting methods are typically classified into three categories: equal weighting, data-based methods, and participatory based methods (13). Aggregation methods are commonly divided into two groups: compensatory and non-compensatory (14). Given that the methodology framework for the development of CIs is widely accepted, decisions often have to be made during the development process, while also allowing for the inclusion of so-called craftmanship (12, 13). The objective of the current study is to develop a composite indicator that captures important aspects of environmental, social, and economic prosperity and allows intercountry and intertemporal comparisons. We aim to develop a composite indicator that addresses the limitations of existing indices.

## Methods

We considered the following areas important for the development of the composite indicator: economic development, financial sustainability, environmental sustainability, work- and knowledge-based society, social sustainability, and demographic sustainability.

### Statistical analysis

We compiled a panel dataset containing annual measurements of 32 social and economic indicators across 87 countries between 2005 and 2019 from publicly available sources (Supplementary Tables). First, we applied linear interpolations and extrapolations to complete the missing values. Second, where missing values were still detected, we used random forest-based imputations. We used logarithmic transformation for the following variables due to their skewness and and/or monetary nature: real wage, median income, GDP per capita, CO2 emissions, air pollution, fertility rate, P90P10, R&D expenditure, unemployment ratio, labor productivity, and water stress (Supplementary Table 1). As in previous studies, in order to make the 32 variables comparable across countries, all variables were standardised by calculating the mean and standard deviation of each variable over the period examined (7, 15). We decided to use the data-based method for weighting and a compensatory technique for aggregation (13).

Six separate exploratory factor analyses with maximum likelihood estimation and varimax rotation were used to construct the six domains. Although various benchmark values are acceptable for the variance explained, we considered > 50% as cut-off value (16, 17). For financial sustainability, social sustainability, and work- and knowledge-based society domains, we multiplied the factors by minus one for better interpretation. Factor scores were generated for all factors in the six domains for 87 countries from 2005 to 2019. In domains where more than one dominant factor was found, we used the variances explained by the factors as weights to compute a single weighted average factor for each domain. In the aggregation phase, the variance explained by each factor as a proportion of the total variance was used as a weight. The composite indicator was calculated as the weighted sum of all domains. In the last step, both the composite indicator and the domains were rescaled between 0 and 100.

We used the R Statistical Software (v4.1.2 Vienna, Austria) to perform our analysis. We used the *tidyverse* package for interpolations and extrapolations, the *mice* package for imputation and the *stats* package for exploratory factor analysis (18-20).

## Results

Exploratory factor analysis pointed out that *economic development* and *demographic sustainability* domains each had one dominant factor (variance explained by the factor > 50%, $p < 0.05$). *Financial sustainability*, *work- and knowledge-based society*, and *social sustainability* domains each had two dominant factors (cumulative variance explained by the factors > 50%; $p < 0.05$). *Environmental sustainability* had one dominant factor that did not reach the variance explained cut-off value (36.8%), although the second factor was not significant ($p = 0.554$); therefore, the first factor was considered the only dominant factor (Table 1). Each variable was assigned to one of the domains (Supplementary Table 3).

**Table 1 Results of the exploratory factor analysis**

| Domain | Factor | p-value | Cumulative variance explained (%) |
|---|---|---|---|
| Economic development | 1 | < 0.001 | 84.6 |
| Economic development | 2 | < 0.05 | 89.3 |
| Financial sustainability | 1 | < 0.001 | 16.5 |
| Financial sustainability | 2 | < 0.001 | 29.9 |
| Environmental sustainability | 1 | < 0.001 | 36.8 |
| Environmental sustainability | 2 | 0.554 | 48.7 |
| Work- and knowledge-based society | 1 | < 0.001 | 30.5 |
| Work- and knowledge-based society | 2 | < 0.001 | 57.3 |
| Social sustainability | 1 | < 0.001 | 39.6 |
| Social sustainability | 2 | < 0.001 | 62.6 |
| Demographic sustainability | 1 | < 0.05 | 58.0 |

$p < 0.05$ was considered statistically significant

Considering that *economic development* and *demographic sustainability* domains each had one dominant factor and the second factor of *environmental sustainability* was not statistically significant, factor weights were only generated for the first factors. For *financial sustainability, work- and knowledge-based society,* and *social sustainability* domains, factor weights were generated for both the first and second factors (Table 2).

**Table 2 Factor weights of the domains**

| Domain | Factor | Factor weight |
|---|---|---|
| Economic development | 1 | 1.00 |
| Financial sustainability | 1 | 0.50 |
| Financial sustainability | 2 | 0.50 |
| Environmental sustainability | 1 | 1.00 |
| Work- and knowledge-based society | 1 | 0.51 |
| Work- and knowledge-based society | 2 | 0.49 |
| Social sustainability | 1 | 0.56 |
| Social sustainability | 2 | 0.44 |
| Demographic sustainability | 1 | 1.00 |

We calculated the variance explained by each of the six factors as a proportion of the total variance to generate the weights of the domains to the composite indicator (Table 3). The result of the aggregation is shown in Table 4.

**Table 3 Weights of the domains in the composite indicator**

| Name | Weight in the composite indicator (%) |
|---|---|
| Economic development | 25.8 |
| Social sustainability* | 19.0 |
| Demographic sustainability | 17.6 |
| Work- and knowledge-based society* | 17.5 |
| Environmental sustainability | 11.1 |
| Financial sustainability* | 9.1 |

Factors multiplied by minus one are marked with asterisks

Percentages may not total 100 due to rounding

## Country-specific results

**Table 4 Country rankings in 2019**

| Rank | Country | Harmonic Development Index | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|---|---|
| 1 | Iceland | 99 | 90 | 66 | 96 | 95 | 98 | 23 |
| 2 | Norway | 93 | 96 | 71 | 81 | 84 | 96 | 17 |
| 3 | Sweden | 89 | 90 | 77 | 83 | 76 | 92 | 17 |
| 4 | Switzerland | 87 | 97 | 77 | 59 | 91 | 88 | 9 |
| 5 | Denmark | 80 | 91 | 81 | 37 | 76 | 94 | 14 |
| 6 | Finland | 75 | 87 | 61 | 54 | 67 | 96 | 12 |
| 6 | Ireland | 75 | 94 | 62 | 19 | 79 | 87 | 25 |
| 6 | New Zealand | 75 | 82 | 63 | 43 | 84 | 83 | 23 |
| 9 | Netherlands | 73 | 89 | 78 | 9 | 78 | 95 | 13 |
| 10 | Austria | 72 | 88 | 69 | 41 | 72 | 90 | 8 |
| 11 | Canada | 70 | 87 | 53 | 41 | 76 | 85 | 12 |
| 11 | France | 70 | 85 | 56 | 59 | 57 | 87 | 19 |
| 11 | Luxembourg | 70 | 99 | 66 | 5 | 82 | 82 | 13 |
| 14 | Germany | 68 | 87 | 71 | 27 | 73 | 87 | 6 |

| Rank | Country | Harmonic Development Index | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|---|---|
| 14 | Israel | 68 | 80 | 69 | 3 | 73 | 76 | 47 |
| 16 | Australia | 67 | 89 | 55 | 11 | 81 | 83 | 21 |
| 16 | Belgium | 67 | 87 | 60 | 26 | 60 | 94 | 16 |
| 16 | Slovenia | 67 | 76 | 64 | 42 | 58 | 100 | 9 |
| 19 | United Kingdom | 64 | 86 | 47 | 25 | 76 | 81 | 17 |
| 20 | South Korea | 63 | 80 | 75 | 16 | 70 | 91 | 3 |
| 21 | Czechia | 61 | 73 | 59 | 26 | 61 | 96 | 10 |
| 21 | United States of America | 61 | 92 | 45 | 20 | 78 | 66 | 21 |
| 23 | Japan | 59 | 82 | 54 | 15 | 72 | 89 | 0 |
| 23 | Malta | 59 | 78 | 58 | 13 | 66 | 93 | 6 |
| 25 | Slovakia | 58 | 69 | 51 | 36 | 55 | 94 | 10 |
| 26 | Estonia | 57 | 73 | 70 | 9 | 64 | 87 | 13 |
| 27 | Spain | 55 | 79 | 55 | 32 | 51 | 84 | 6 |
| 28 | Cyprus | 54 | 78 | 50 | 5 | 65 | 87 | 12 |
| 29 | Portugal | 51 | 71 | 49 | 30 | 56 | 85 | 3 |

| Rank | Country | Harmonic Development Index | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|---|---|
| 29 | Hungary | 51 | 67 | 63 | 23 | 51 | 87 | 7 |
| 31 | Peru | 50 | 47 | 53 | 33 | 69 | 67 | 37 |
| 32 | China | 49 | 53 | 82 | 18 | 62 | 71 | 18 |
| 32 | Uruguay | 49 | 66 | 49 | 23 | 55 | 72 | 25 |
| 32 | Paraguay | 49 | 48 | 61 | 36 | 56 | 58 | 46 |
| 35 | Italy | 48 | 81 | 47 | 20 | 46 | 81 | 3 |
| 35 | Poland | 48 | 68 | 59 | 8 | 50 | 88 | 8 |
| 37 | Lithuania | 47 | 69 | 61 | 11 | 57 | 76 | 9 |
| 37 | Croatia | 47 | 65 | 58 | 26 | 39 | 88 | 6 |
| 39 | Latvia | 46 | 68 | 47 | 22 | 55 | 76 | 11 |
| 40 | Azerbaijan | 44 | 47 | 54 | 3 | 49 | 88 | 30 |
| 40 | Thailand | 44 | 50 | 68 | 7 | 57 | 81 | 15 |
| 42 | Chile | 43 | 64 | 45 | 28 | 50 | 65 | 22 |
| 42 | Dominican Republic | 43 | 52 | 54 | 13 | 51 | 63 | 42 |
| 42 | Ecuador | 43 | 47 | 47 | 37 | 50 | 59 | 43 |
| 42 | Malaysia | 43 | 62 | 40 | 7 | 59 | 65 | 33 |

| Rank | Country | Harmonic Development Index | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|---|---|
| 46 | Turkey | 42 | 62 | 53 | 22 | 34 | 65 | 34 |
| 47 | Argentina | 41 | 61 | 34 | 19 | 47 | 65 | 35 |
| 47 | Romania | 41 | 61 | 45 | 28 | 44 | 75 | 11 |
| 47 | Russia | 41 | 59 | 58 | 15 | 52 | 68 | 16 |
| 47 | Trinidad and Tobago | 41 | 63 | 52 | 0 | 55 | 68 | 23 |
| 51 | Costa Rica | 40 | 60 | 49 | 24 | 48 | 59 | 25 |
| 52 | Bolivia | 39 | 39 | 39 | 25 | 49 | 62 | 51 |
| 53 | Greece | 38 | 68 | 33 | 15 | 36 | 86 | 5 |
| 53 | Bulgaria | 38 | 57 | 62 | 35 | 41 | 65 | 6 |
| 53 | Mexico | 38 | 56 | 41 | 10 | 49 | 58 | 38 |
| 53 | Vietnam | 38 | 35 | 49 | 18 | 55 | 75 | 30 |
| 57 | Mongolia | 37 | 41 | 26 | 22 | 37 | 74 | 50 |
| 58 | Mauritius | 36 | 54 | 44 | 16 | 45 | 72 | 15 |
| 59 | Algeria | 35 | 40 | 47 | 0 | 7 | 92 | 51 |
| 59 | Indonesia | 35 | 37 | 50 | 7 | 48 | 67 | 38 |
| 61 | Brazil | 34 | 54 | 36 | 56 | 43 | 44 | 23 |

| Rank | Country | Harmonic Development Index | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|---|---|
| 62 | Iraq | 33 | 42 | 16 | 1 | 9 | 83 | 73 |
| 62 | Philippines | 33 | 36 | 56 | 13 | 36 | 59 | 50 |
| 62 | Salvador | 33 | 41 | 38 | 20 | 34 | 69 | 38 |
| 65 | Georgia | 32 | 42 | 46 | 18 | 35 | 74 | 22 |
| 65 | North Macedonia | 32 | 47 | 60 | 13 | 23 | 82 | 11 |
| 67 | Angola | 31 | 37 | 7 | 29 | 55 | 23 | 90 |
| 67 | Jordan | 31 | 41 | 31 | 8 | 1 | 82 | 60 |
| 69 | Albania | 30 | 42 | 28 | 23 | 31 | 84 | 16 |
| 69 | Columbia | 30 | 48 | 36 | 30 | 47 | 49 | 28 |
| 69 | Kyrgyzstan | 30 | 22 | 39 | 9 | 15 | 86 | 56 |
| 69 | Serbia | 30 | 49 | 39 | 22 | 30 | 77 | 9 |
| 73 | Ukraine | 29 | 38 | 35 | 30 | 20 | 91 | 10 |
| 73 | Venezuela | 29 | 41 | 36 | 31 | 30 | 57 | 38 |
| 75 | Egypt | 27 | 37 | 16 | 5 | 9 | 80 | 59 |
| 76 | Ghana | 26 | 27 | 30 | 5 | 40 | 51 | 69 |
| 76 | Morocco | 26 | 38 | 55 | 8 | 8 | 68 | 42 |

| Rank | Country | Harmonic Development Index | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|---|---|
| 76 | Myanmar | 26 | 20 | 59 | 4 | 25 | 78 | 37 |
| 79 | Armenia | 25 | 41 | 21 | 9 | 18 | 88 | 23 |
| 79 | Iran | 25 | 46 | 51 | 3 | 12 | 65 | 33 |
| 79 | Sri Lanka | 25 | 40 | 22 | 17 | 24 | 70 | 33 |
| 79 | Pakistan | 25 | 22 | 31 | 16 | 10 | 71 | 65 |
| 83 | Bangladesh | 23 | 20 | 57 | 1 | 20 | 75 | 38 |
| 84 | Uganda | 21 | 9 | 38 | 4 | 31 | 42 | 90 |
| 85 | Rwanda | 19 | 9 | 41 | 6 | 53 | 39 | 61 |
| 86 | India | 17 | 28 | 42 | 11 | 9 | 62 | 39 |
| 87 | South African Republic | 5 | 50 | 26 | 5 | 16 | 13 | 39 |

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# Supplementary materials

## Supplementary Table 1 List of 32 variables (in alphabetical order by short names)

| Short name of the variable | Full name of the variable | Source |
|---|---|---|
| Absolute poverty rate | Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population) | World Bank (21) |
| Account balance | Current account balance (% of GDP) | World Bank (21) |
| Air pollution* | Number of age-standardized disability-adjusted life-years lost per 100,000 persons (DALY rate) due to exposure to air pollution | Global Health Data Exchange (22) |
| CO2 emissions* | CO2 emissions (kg per PPP $ of GDP) | World Bank (21) |
| Domestic net migration | Net migration to population ratio | World Bank (21) |
| Economic dependency ratio | Employed to inactive + unemployed population ratio | World Bank (21) |
| Employment | Employment to population ratio, 15+, total (%) (modeled ILO estimate) | ILO (21) |
| Fertility rate* | Child poverty-adjusted fertility rate | UN, World Bank (21) |
| Fossil fuel | Per capita energy from fossil fuels, Relative | Our World in Data (23) |
| GDP per capita* | GDP per capita (constant 2015 US$) | World Bank (21) |
| GNI SD | SD of GNI per capita by region (NUTS 2) | Global Data Lab (24) |
| HALE | Healthy life expectancy (HALE) at birth (years) | WHO (25) |
| Income GINI | Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. | World Bank (21) |
| Interest payments | Interest payments (% of expense) | World Bank (21) |
| Internet usage | Individuals using the Internet (% of population) | World Bank (21) |
| ISCED 3 | Educational attainment, at least completed upper secondary, population 25+, total (%) (cumulative) | World Bank (21) |
| Labor productivity* | GDP per capita to employment ratio | ILO (21) |
| Labor tax | Labor tax and contributions (% of commercial profits) | World Bank (21) |
| LPI Score | LPI Score - LPI is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance | World Bank (21) |
| Median income* | Median daily per capita income or consumption expenditure (2011 PPP) | World Bank (21) |
| Net savings | Adjusted net savings, including particulate emission damage (% of GNI) | World Bank (21) |

| Short name of the variable | Full name of the variable | Source |
|---|---|---|
| Nuclear energy | Per capita energy from nuclear, Relative | Our World in Data (23) |
| Old dependency ratio | Age dependency ratio, old (% of working-age population) | World Bank (21) |
| P90P10* | The decile dispersion ratio presents the ratio of the average income of the richest 10 percent by that of the poorest 10 percent. | World Bank (21) |
| Public debt | Public debt as a share of GDP from the World Economic Database | IMF (26) |
| R&D expenditure* | Research and development expenditure (% of GDP) | World Bank (21) |
| Real wage* | Real GDP / Average annual hours worked by persons engaged | Penn World Table (27) |
| Renewables | Per capita energy from renewables, Relative | Our World in Data (23) |
| Unemployment ratio* | Unemployment, total (% of total labor force) (modeled ILO estimate) | ILO (21) |
| Water stress* | Level of water stress: freshwater withdrawal as a proportion of available freshwater resources | UN (FAO) (28) |
| Wealth GINI | Gini index measures the extent to which the distribution of wealth among individuals or households within an economy deviates from a perfectly equal distribution. | Credit Suisse (29) |
| Youth dependency ratio | Age dependency ratio, young (% of working-age population) | World Bank (21) |

Logarithmic transformed variables are marked with asterisks

**Supplementary Table 2 List of countries (in alphabetical order by country)**

| # | Country | Development level (based on IMF(30)) |
|---|---|---|
| 1. | Albania | Emerging and developing |
| 2. | Algeria | Emerging and developing |
| 3. | Angola | Emerging and developing |
| 4. | Argentina | Emerging and developing |
| 5. | Armenia | Emerging and developing |
| 6. | Australia | Advanced economies |
| 7. | Austria | Advanced economies |
| 8. | Azerbaijan | Emerging and developing |
| 9. | Bangladesh | Emerging and developing |
| 10. | Belgium | Advanced economies |
| 11. | Bolivia | Emerging and developing |
| 12. | Brazil | Emerging and developing |
| 13. | Bulgaria | Emerging and developing |
| 14. | Canada | Advanced economies |
| 15. | Chile | Emerging and developing |
| 16. | China | Emerging and developing |
| 17. | Columbia | Emerging and developing |
| 18. | Costa Rica | Emerging and developing |
| 19. | Croatia | Emerging and developing |
| 20. | Cyprus | Advanced economies |
| 21. | Czechia | Advanced economies |
| 22. | Denmark | Advanced economies |
| 23. | Dominican Republic | Emerging and developing |
| 24. | Ecuador | Emerging and developing |
| 25. | Egypt | Emerging and developing |
| 26. | Estonia | Advanced economies |
| 27. | Finland | Advanced economies |
| 28. | France | Advanced economies |
| 29. | Georgia | Emerging and developing |
| 30. | Germany | Advanced economies |
| 31. | Ghana | Emerging and developing |
| 32. | Greece | Advanced economies |
| 33. | Hungary | Emerging and developing |
| 34. | Iceland | Advanced economies |
| 35. | India | Emerging and developing |
| 36. | Indonesia | Emerging and developing |
| 37. | Iran | Emerging and developing |
| 38. | Iraq | Emerging and developing |
| 39. | Ireland | Advanced economies |
| 40. | Israel | Advanced economies |
| 41. | Italy | Advanced economies |
| 42. | Japan | Advanced economies |
| 43. | Jordan | Emerging and developing |
| 44. | Kyrgyzstan | Emerging and developing |
| 45. | Latvia | Advanced economies |
| 46. | Lithuania | Advanced economies |
| 47. | Luxembourg | Advanced economies |

| | | |
|---|---|---|
| 48. | Malaysia | Emerging and developing |
| 49. | Malta | Advanced economies |
| 50. | Mauritius | Emerging and developing |
| 51. | Mexico | Emerging and developing |
| 52. | Mongolia | Emerging and developing |
| 53. | Morocco | Emerging and developing |
| 54. | Myanmar | Emerging and developing |
| 55. | New Zealand | Advanced economies |
| 56. | North Macedonia | Emerging and developing |
| 57. | Norway | Advanced economies |
| 58. | Pakistan | Emerging and developing |
| 59. | Paraguay | Emerging and developing |
| 60. | Peru | Emerging and developing |
| 61. | Philippines | Emerging and developing |
| 62. | Poland | Emerging and developing |
| 63. | Portugal | Advanced economies |
| 64. | Romania | Emerging and developing |
| 65. | Russia | Emerging and developing |
| 66. | Rwanda | Emerging and developing |
| 67. | Salvador | Emerging and developing |
| 68. | Serbia | Advanced economies |
| 69. | Slovakia | Advanced economies |
| 70. | Slovenia | Emerging and developing |
| 71. | South African Republic | Emerging and developing |
| 72. | South Korea | Advanced economies |
| 73. | Spain | Advanced economies |
| 74. | Sri Lanka | Emerging and developing |
| 75. | Sweden | Advanced economies |
| 76. | Switzerland | Advanced economies |
| 77. | Thailand | Emerging and developing |
| 78. | Netherlands | Advanced economies |
| 79. | United States of America | Advanced economies |
| 80. | Trinidad and Tobago | Emerging and developing |
| 81. | Turkey | Emerging and developing |
| 82. | Uganda | Emerging and developing |
| 83. | Ukraine | Emerging and developing |
| 84. | United Kingdom | Advanced economies |
| 85. | Uruguay | Emerging and developing |
| 86. | Venezuela | Emerging and developing |
| 87. | Vietnam | Emerging and developing |

**Supplementary Table 3 Domain variables**

| Domains | Economic development | Financial sustainability | Environmental sustainability | Work- and knowledge-based society | Social sustainability | Demographic sustainability |
|---|---|---|---|---|---|---|
| Variables | GDP per capita | Net savings | Air pollution | Employment | HALE | Old dependency ratio |
| | LPI Score | Account balance | Fossil fuel | Labor productivity | Income GINI | Domestic net migration |
| | Internet usage | Economic dependency ratio | Nuclear energy | Labor tax | P90P10 | Youth dependency ratio |
| | Median income | Interest payments | Renewables | Unemployment ratio | Wealth GINI | Fertility rate |
| | Real wage | R&D expenditure | CO2 emissions | ISCED 3 | Absolute poverty rate | |
| | | Public debt | Water stress | | GNI SD | |