Adjustments to the Global Innovation Index Framework and Year-on-Year Comparability of Results

The Global Innovation Index (GII) is a cross-country performance assessment, compiled on an annual basis, which continuously seeks to update and improve the way innovation is measured. The GII report pays special attention to making accessible the statistics used in the Country/Economy Profiles and Data Tables, providing data sources and definitions, and detailing the computation methodology (Appendices I, II, III, and IV, respectively). This annex summarizes the changes made this year and provides an assessment of the impact of these changes on the comparability of rankings.

Adjustments to the Global Innovation Index framework

The GII model is revised every year in a transparent exercise. This year, no change was made at the pillar level. At the sub-pillar level, the name of sub-pillar 4.3 was changed from 'Trade and competition' to 'Trade, competition, and market scale' following the addition of one new indicator (see Table 1).

Beyond the use of World Intellectual Property Organization (WIPO) data, we collaborate with both public international bodies such as the International Energy Agency; the United Nations Educational, Scientific and Cultural Organization (UNESCO); the United Nations Industrial Development Organization (UNIDO); the International Telecommunication Union (ITU); and the Joint Research Centre of the European Commission (JRC) as well as with private organizations such as the International Organization for Standardization (ISO); IHS Global Insight; QS Quacquarelli Symonds Ltd; Bureau van Dijk (BvD); ZookNIC Inc; and Google to obtain the best available data on innovation measurement globally.

Although the rationale for the adjustments made to the GII framework is explained in detail in Annex 1, Table 1 provides a summary of these changes for quick reference.

Table 1: Changes to the Global Innovation Index framework

GII 2015		Adjustment	GII 2016	
2.3.3	QS university ranking average score top 3 universities	Number changed	2.3.4	QS university ranking average score top 3 universities
		New indicator	2.3.3	Global R&D companies, average top 3 spenders
4.2.1	Ease of protecting investors	Name change	4.2.1	Ease of protecting minority investors
4.3	**Trade & competition**	**Sub-pillar name change**	**4.3**	**Trade, competition, and market scale**
		New indicator	4.3.3	Domestic market scale
5.2.5	Patent families filed in at least three offices	Methodology changed	5.2.5	Patent families filed in at least two offices
5.3.1	Royalties and license fees payments	Name and methodology change	5.3.1	Intellectual property payments
5.3.3	Communications, computer and information services imports	Name and methodology change	5.3.3	ICT services imports
		New indicator	5.3.5	Research talent in business enterprise
6.1.1	National office patent applications	Name change	6.1.1	Patent applications by origin
6.1.3	National office resident utility model applications	Name change	6.1.3	Utility model applications by origin
6.3.1	Royalties and license fees receipts	Name and methodology change	6.3.1	Intellectual property receipts
6.3.3	Communications, computer and information services exports	Name and methodology change	6.3.3	ICT services exports
7.1.1	National office resident trademark applications	Name change	7.1.1	Trademark application class count by origin
7.1.2	Madrid System trademark applications by country of origin	Replaced	7.1.2	Industrial designs by origin

Note: Orange text refers to name change at the sub-pillar level. Refer to Annex 1 and Appendix III for detailed explanation of terminologies and acronyms. Indicators whose name did not change but methodology at the source did are not part of this list. Refer to Appendix III for detailed explanation on methodological changes at the source.

A total of one sub-pillar and fourteen indicators were modified this year: sub-pillar 4.3 as well as four indicators underwent name changes, eight indicators underwent methodological changes (new computation methodology at the source), three indicators were added, one indicator was replaced, and one indicator changed its number as a result of the framework adjustments. Indicators that retained the same name as last year but are derived from a source that changed its methodology are not identified in Table 1.

The statistical audit performed by the JRC (see Annex 3) provides a confidence interval for each ranking following a robustness and uncertainty analysis of the modelling assumptions.

Sources of changes in the rankings

The GII compares the performance of national innovation systems across economies, and it also presents changes in economy rankings over time.

Importantly, scores and rankings from one year to the next are not directly comparable (see Annex 2 of the GII 2013 for a full explanation). Making inferences about absolute or relative performance on the basis of year-on-year differences in rankings can be misleading. Each ranking reflects the relative positioning of that particular country/economy on the basis of the conceptual framework, the data coverage, and the sample of economies—elements that change from one year to another.

A few particular factors influence the year-on-year ranking of a country/economy:

- the actual performance of the economy in question;
- adjustments made to the GII framework;
- data updates, the treatment of outliers, and missing values; and
- the inclusion or exclusion of countries/economies in the sample.

Additionally, the following characteristics complicate the time-series analysis based on simple GII scores or rankings:

- **Missing values.** The GII produces relative index scores, which means that a missing value for one economy affects the index score of other economies. Because the number of missing values decreases every year, this problem is reduced over time.
- **Reference year.** The data underlying the GII do not refer to a single year but to several years, depending on the latest available year for any given variable. In addition, the reference years for different variables are not the same for each economy. The motivation for this approach is that it widens the set of data points for cross-economy comparability.
- **Normalization factor.** Most GII variables are normalized using either GDP or population. This approach is also intended to enable cross-economy comparability. Yet, again, year-on-year changes in individual variables may be driven either by the variable's numerator or by its denominator.
- **Consistent data collection.** Finally, measuring year-on-year performance changes relies on the consistent collection of data over time. Changes in the definition of variables or in the data collection process could create movements in the rankings that are unrelated to true performance.

A detailed economy study based on the GII database and the country/economy profile over time, coupled with analytical work on grounds that include innovation actors and decision makers, yields the best results in terms of grasping an economy's innovation performance over time as well as possible avenues for improvement.

Methodology and data

The revision of the computation methodology for certain individual indicators has caused significant shifts in the results for several countries. The methodologies underpinning indicators 5.2.5 (computed by World Intellectual Property Organization) and 5.3.1, 5.3.3, 6.3.1, 6.3.3, and 7.2.1 (computed by World Trade Organization) have been revised. In addition, indicators 4.2.2 and 4.3.3 (computed by the World Bank) changed methodology because of the need for a different source of data.[1]

Missing values

Since its inception, the GII has had a positive influence on data availability, increasing awareness of the importance of submitting timely data. The number of data points submitted by economies to international data agencies has substantially increased in recent years.

When it comes to country coverage, the objective is to include as many economies as possible. However, it is also important to maintain a good level of data coverage within each

of these economies. Because the GII results are linked to data availability (see the JRC Statistical Audit presented in Annex 3 for more details), which affects the overall GII ranks, this year the minimum data coverage threshold rule was adjusted—on the recommendation of the JRC—to maintain the significance of both the GII results and the country sample. This year, to be included in the GII, an economy must have a minimum symmetric data coverage of 33 indicators in the Innovation Input Sub-Index (60%) and 16 indicators in the Innovation Output Sub-Index (60%), and it must have scores for at least two sub-pillars per pillar. Missing values are indicated with 'n/a' and are not considered in the sub-pillar score.

This adjustment derives from a sensitivity that is the result of the data availability, which is less satisfactory in the case of the Output Sub-Index: 13 countries that were part of the GII 2015 have data coverage below the 60% threshold in the 27 variables in the Output Sub-Index. In contrast, data coverage is satisfactory in all of these cases in the Input Sub-Index (all of these economies have indicator coverage of more than 60% over the 55 input variables). As a result, the following countries included in the GII 2015 dropped out this year: Angola, Barbados, Cabo Verde, Fiji, Gambia, Guyana, Lesotho, Myanmar, Seychelles, Sudan, Swaziland, Uzbekistan, and Zimbabwe.[2]

Despite this rule change, for several economies the number of missing data points remains very high. Table 2 lists the countries that have the highest number of missing data points (20 or more), ranking them according to how many data points are missing.

Conversely, Table 3 lists those economies with the best data coverage, ranking them according to the least number of missed data points. These economies are missing at most only five data points; some are missing none at all.

Table 2: GII economies with the most missing values

Economy	Number of missing values
Yemen	29
Nicaragua	27
Burundi	27
Niger	27
Bhutan	26
Togo	26
Benin	24
Guinea	24
Malawi	23
Côte d'Ivoire	23
Burkina Faso	23
Rwanda	22
Tajikistan	22
Jamaica	22
Honduras	21
Nepal	21
Mozambique	20
Cambodia	20

Table 3: GII economies with the fewest missing values

Economy	Number of missing values
Hungary	0
Mexico	0
Colombia	0
Malaysia	1
Poland	1
Russian Federation	1
Japan	2
France	2
Austria	2
Czech Republic	2
Italy	2
Portugal	2
Turkey	2
Thailand	2
South Africa	2
Ukraine	2
Germany	3
Korea, Rep.	3
Australia	3
Belgium	3
Slovakia	3
Bulgaria	3
Chile	3
Romania	3
Indonesia	3
Switzerland	4
Sweden	4
United Kingdom	4
Finland	4
New Zealand	4
Israel	4
Norway	4
Estonia	4
Slovenia	4
Lithuania	4
Brazil	4
Philippines	4
Kazakhstan	4
Argentina	4
United States of America	5
Ireland	5
Denmark	5
Latvia	5
Greece	5
India	5
Egypt	5

Notes

1 The update by the World Intellectual Property Organization for patent families filed in two instead of three offices is meant to capture a wider range of patent families. The update for indicators derived from the World Trade Organization data is twofold: it reflects changes to the codes and also a different classification methodology for the variables used to calculate these indicators, which now follows the *Balance of Payments Manual 6*. The changes in the World Bank indicators are based on the fact that Standard & Poor's discontinued its *Global Stock Markets Factbook,* which was the main source of data for these indicators. The current source of the data used is the World Federation of Exchanges (WFE), which uses a different methodology. The WFE provides data according to its membership list. See Appendix III for further details.

2 Although Trinidad and Tobago has sufficient coverage in both the Input and Output Sub-Indices, it also drops out of the GII this year because it does not have scores for at least two sub-pillars in pillar 2: Human capital and research. Conversely, Benin—which was not included in the GII 2015—enters the GII this year with the required coverage in both sub-indices and sufficient data availability per pillar.