

U21

# Ranking of National Higher Education Systems 2020





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A project sponsored by

**UNIVERSITAS 21**

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# Executive Summary

This report presents the results for the ninth annual ranking of national systems of higher education undertaken under the auspices of the *Universitas 21* (U21) group of universities. Fifty national systems of higher education, from all continents, are evaluated across 24 indicators. The measures are standardised for population size. Countries are ranked overall and on each of four modules: Resources, Environment, Connectivity and Output. Within each measure the highest achieving country is given a score of 100 and scores for other countries are expressed as a percentage of this highest score.

Resources and the Environment are input variables. Resources, whether private or public, are a necessary condition for a quality system of higher education but they must be complemented by a policy environment which facilitates their efficient use. The five measures in the Environment module include diversity of institutions, autonomy of institutions and the extent of external monitoring of institutional performance. The highest ranked countries for Resources, based on five expenditure measures, are, in rank order, Norway, Singapore, Switzerland, Denmark, Sweden, Canada, Austria and Saudi Arabia. The countries with the most favourable Environment are judged to be the United States, Australia, New Zealand, Hong Kong SAR, Finland, the United Kingdom, Singapore and the Netherlands.

Connectivity and Output are measures of outcomes. The worth of a national higher education system is enhanced if it is well connected domestically with other sectors of the economy and is linked internationally in education and research. The five Connectivity measures are: joint publications with international authors and with authors from industry, international student numbers, web connectivity and the views of business on the extent of knowledge transfer. The nine Output measures encompass research output and its impact, student throughput, the national stock of graduates and researchers, the quality of a nation's best universities, and the employability of graduates.

The top six nations for Connectivity are Switzerland, Austria, Singapore, the United Kingdom, the Netherlands and Denmark. The best performer in the Output module is clearly the United States, followed by the United Kingdom, Australia, Denmark, Switzerland, Sweden, Canada and the Netherlands.

An overall ranking is derived using a weight of 40 per cent for Output and 20 per cent for each of the other three modules. The top ten countries, in rank order, are the United States, Switzerland, Denmark, Singapore, Sweden, the United Kingdom, Canada, Finland, Australia and the Netherlands. A subsidiary ranking compares how nations perform relative to countries at similar levels of GDP per capita. The top ranked countries after this adjustment are Finland, South Africa, the United Kingdom and Denmark.

In a separate study we examine two characteristics of graduates: perceptions of business and generic skills. Business values the qualities of graduates most highly in Switzerland, Singapore, Finland and the Netherlands. Numeracy levels are highest in Austria, Finland, Belgium and the Netherlands; the degree of literacy is highest in Finland, the Netherlands, Sweden and Japan; problem solving skills are highest in Sweden, New Zealand, the Czech Republic and Japan.

Finally, we look at research funding. The share of higher education in national R&D expenditure is highest in Hong Kong SAR, Portugal, Chile and Canada. The share of higher education expenditure on R&D that is financed by business enterprises is highest in China, Russia, Bulgaria, Germany and Korea.

Below:

## Overall U21 2020 Ranking

Rank (2020)	Rank (2019)	Country	Score (2020)	Score (2019)
1	1	United States	100.0	100.0
2	2	Switzerland	90.1	88.6
3	5	Denmark	85.7	82.5
4	7	Singapore	84.5	81.3
5	4	Sweden	84.3	82.9
6	3	United Kingdom	83.6	84.5
7	6	Canada	83.2	81.9
8	9	Finland	82.8	80.4
9	8	Australia	82.2	80.9
10	10	Netherlands	81.6	80.2
11	11	Norway	80.5	77.8
12	12	Austria	79.3	77.2
13	13	Belgium	75.6	73.6
#14	14	New Zealand	72.7	71.5
#14	15	Hong Kong SAR	72.7	70.2
16	16	Germany	70.5	69.6
17	17	France	68.6	67.6
18	18	Israel	67.4	67.3
19	19	Ireland	66.0	64.7
20	20	Japan	61.9	61.7
21	21	Taiwan-China	60.5	60.5
22	22	Saudi Arabia	59.3	59.3
23	24	Spain	58.6	57.3
24	23	Korea	58.0	57.4
25	25	Portugal	57.6	56.8

Rank (2020)	Rank (2019)	Country	Score (2020)	Score (2019)
26	27	China	56.8	54.7
27	28	Malaysia	56.1	54.5
28	29	Slovenia	55.4	53.6
29	26	Czech Republic	54.8	55.2
30	30	Italy	54.5	53.4
31	32	Chile	54.3	51.3
32	31	Poland	52.6	52.2
33	#35	Hungary	51.3	48.5
34	34	South Africa	49.7	48.7
35	#35	Russia	49.1	48.5
36	#38	Ukraine	47.8	45.1
37	37	Greece	47.4	47.0
38	33	Slovakia	47.2	49.6
39	42	Turkey	46.3	43.3
40	#38	Argentina	46.0	45.1
41	40	Brazil	45.6	44.1
42	41	Serbia	44.2	43.4
43	43	Croatia	43.6	42.1
44	45	Romania	43.0	41.7
45	44	Bulgaria	42.7	41.8
46	46	Thailand	42.3	41.2
47	48	Iran	42.2	39.2
48	47	Mexico	41.7	41.1
49	49	India	39.6	38.8
50	50	Indonesia	35.0	33.5

# denotes equal rank

# 1. Introduction

This report presents the results for the ninth annual ranking of national systems of higher education undertaken under the auspices of the *Universitas 21* (U21) group of universities. The national ranking of systems complements the many international rankings of universities.

The indicators used in the ranking of national systems must reflect the aims of higher education. These include the education and training of a nation's people, contributing to innovation through research, and facilitating interconnections between tertiary institutions and external stakeholders, both domestic and foreign. A good system of higher education will encompass a range of institutions to meet individual personal desires and perceived national needs. Diversity can also be an effective way to improve enrolment rates and at a reduced per student cost.

We use 24 measures of performance grouped into four modules: Resources, Environment, Connectivity and Output. The first two are input measures and the second pair measure outcomes. For each variable, the best performing country is given a score of 100 and scores for all other countries are expressed as a percentage of this highest score. Separate rankings are provided for each of the modules. A description of each variable is given in the next section. This year there are no major changes in the variables used, although we note a continued increase in the quality, availability and timeliness of data.

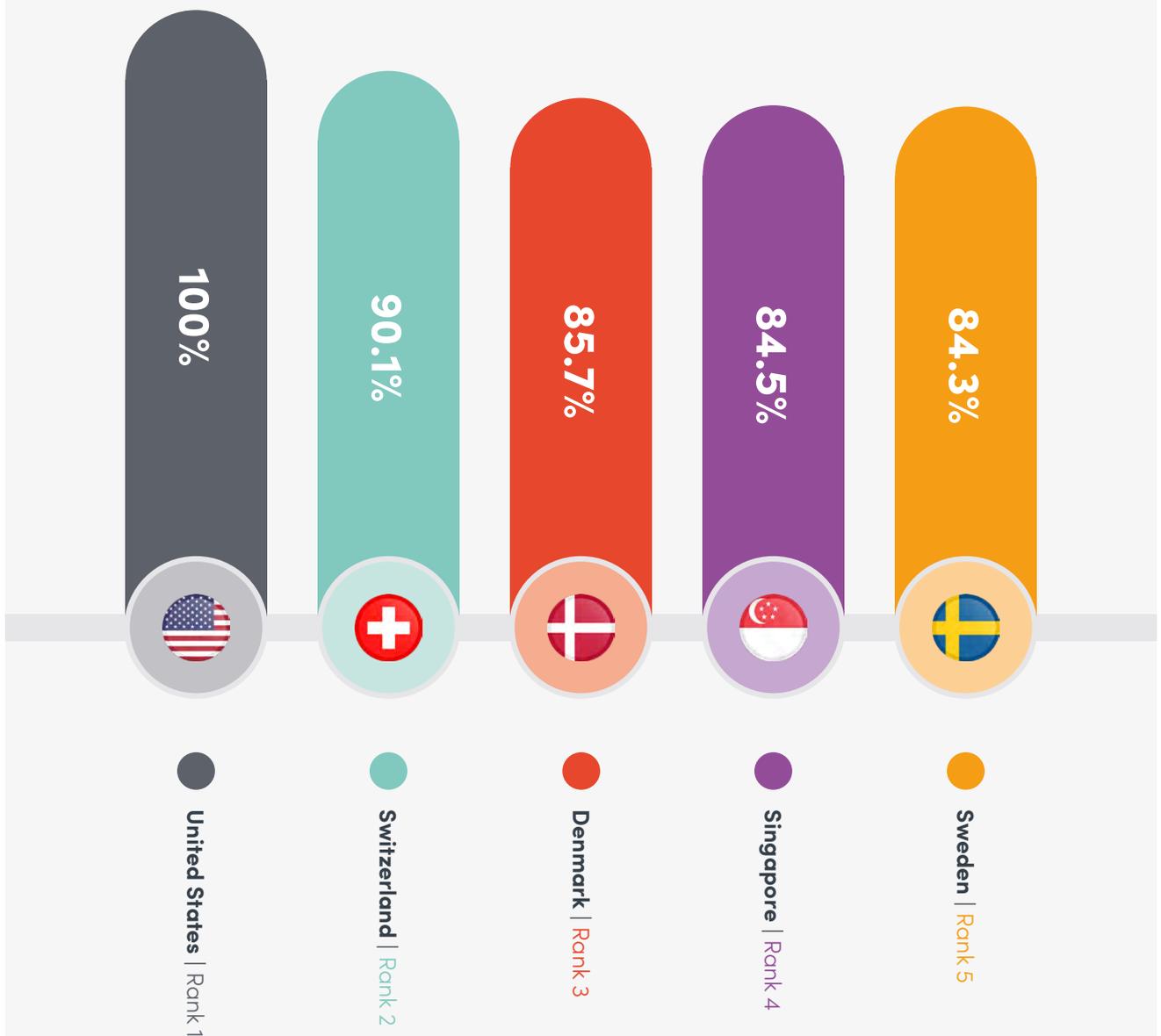
Resources, whether public or private, are a necessary condition for a well-functioning system of higher education, but they are not sufficient. A well-designed policy environment is needed to ensure that resources are used well. The Environment module includes measures of institutional autonomy, external monitoring of performance and the degree of diversity.

Turning to outcomes, our Output variables encompass attributes such as participation rates, research performance, the existence of some world class universities, and employability of graduates. There is a world-wide trend for governments to encourage institutions of higher education to strengthen relationships with each other and with business, both domestically and internationally. The Connectivity module includes variables which span this wider concept.

Our work extends well beyond ranking. Using our data, countries can benchmark performance over a range of attributes. We also provide estimates of a country's performance relative to its level of GDP per capita. This year we also present some indicators of the qualities of graduates. The first indicator is a ranking of how graduates are perceived by business; the second is a ranking of countries by the generic skills of graduates. Finally, in a section on research funding, we examine the relative contribution of higher education to national expenditure on R&D and the extent to which expenditure by the higher education sector is financed by business enterprises.

Below:

## Top 5 Overall U21 Ranking 2020



## 2. Measures and Results

### 2.1 Resources (weight of 20%)

A necessary condition for a well-performing higher education system is that it is adequately resourced, whether by government or the private sector. One measure is expenditure by tertiary institutions as a share of GDP. But for low-income countries, especially those with a large student-age population, a high share of GDP may not translate into high expenditure per student, so we also include the latter. To measure the contribution of tertiary education to a nation's research effort we include measures of expenditure on research and development in tertiary institutions. In summary, our five measures of resources and their weights are:

**R1:** (5%) Government expenditure on tertiary education institutions as a percentage of GDP, 2016.

**R2:** (5%) Total expenditure on tertiary education institutions as a percentage of GDP, 2016.

**R3:** (5%) Annual expenditure per student (full-time equivalent) by tertiary education institutions in USD purchasing power parity, 2016.

**R4:** (2.5%) Expenditure in tertiary education institutions for R&D as a percentage of GDP, 2017.

**R5:** (2.5%) Expenditure in tertiary education institutions for R&D per head of population at USD purchasing power parity, 2017.

In a reversal of recent trends government expenditure as a share of GDP has risen: the median share is 0.96 compared with 0.94 per cent in last year's rankings. However, this fall has been more than offset by a fall in private expenditure: as a share of GDP total expenditure is estimated to have fallen from 1.46 to 1.40 per cent.

The seven highest ranked countries for Resources are Norway, Singapore, Switzerland, Denmark, Sweden, Canada and Austria in that order. Norway has jumped five places from last year's ranking owing to a marked increase in government expenditure as a share of GDP. Other large improvers include Chile (now 20th) and Turkey (17th). Both countries have improved five places following improvements in both public and private expenditure as a share of GDP. The United Kingdom has fallen six places to 19th.

Turning to the rankings of the five components, government expenditure on higher education is highest in Saudi Arabia, Norway, Austria, Finland and Denmark, in that order. The six lowest ranked countries, where government expenditure on tertiary education is under 0.6 per cent of GDP are, commencing with lowest funding, Japan, India, the United Kingdom, Italy and Ireland. Total expenditure as a share of GDP is highest in Chile, the United States, Canada, Saudi Arabia, Malaysia, Norway and Australia in that order. The four lowest ranked countries for total expenditure as a share of GDP are, in alphabetical order, Greece, Indonesia, Ireland and Italy. Expenditure per student, which includes research expenditure, is estimated to be highest in Singapore followed by the United States, Switzerland, Hong Kong SAR, Sweden and the United Kingdom, in that order. Research expenditure by tertiary institutions as a share of GDP is highest in the Nordic countries, Switzerland and Austria. On a per capita PPP basis, research expenditure is highest in Singapore and Switzerland. On both research measures the countries ranked lowest are Indonesia, Ukraine and India.

Below:

## Resources Ranking

Rank	Country	Score
1	Norway	100.0
2	Singapore	98.2
3	Switzerland	97.9
4	Denmark	97.6
5	Sweden	94.2
6	Canada	93.0
7	Austria	89.9
8	Saudi Arabia	88.9
9	Finland	86.3
10	United States	86.2
11	Netherlands	79.3
12	Belgium	74.4
13	Hong Kong SAR	72.9
14	Australia	71.8
15	Malaysia	71.0
16	France	66.5
17	Turkey	66.3

Rank	Country	Score
18	Germany	65.7
19	United Kingdom	65.5
20	Chile	62.3
21	New Zealand	60.5
22	Brazil	56.6
22	Israel	56.3
24	Japan	53.9
25	Korea	53.9
25	Portugal	53.1
27	Ukraine	52.6
28	Spain	50.8
29	Taiwan-China	50.2
30	Serbia	49.1
31	Poland	48.6
32	South Africa	45.5
33	Iran	44.5
34	Slovenia	44.4

Rank	Country	Score
35	India	44.1
36	Argentina	44.0
37	Czech Republic	43.4
38	Mexico	43.2
39	Ireland	42.3
40	China	42.2
41	Croatia	42.2
42	Italy	41.2
43	Slovakia	41.2
44	Hungary	40.4
45	Russia	37.7
46	Romania	37.3
47	Greece	32.9
48	Bulgaria	32.1
49	Thailand	30.8
50	Indonesia	21.1

## 2.2 Environment (weight of 20%)

The policy environment under which tertiary institutions operate is an important determinant of outcomes. We define a good policy environment as one where institutions enjoy considerable financial and academic autonomy combined with transparent external monitoring of performance, and where policy settings foster diversity and competition between institutions. The degree to which national systems possess these characteristics is measured by the results of three survey findings complemented by four quantitative measures.

The measures we use and their weights are:

**E1:** (1%) Proportion of female students in tertiary education (capped at 50%), 2017.

**E2:** (2%) Proportion of academic staff in tertiary institutions who are female (capped at 50%), 2017.

**E3:** (2%) A rating for data quality. For each quantitative series, the value is 2 if the data are available for the exact definition of the variable; 1 if some data are available which relate to the variable but some informed adjustment is required; and 0 otherwise.

**E4:** (10%) Qualitative measure of the policy environment comprising:

**E4.1** (2%) Diversity of the system comprising two components of equal weight: the percentage of tertiary students enrolled in private institutions (capped at 50 %) and the percentage of students enrolled in ISCED level 5 courses, 2017.<sup>§</sup>

**E4.2** (4%) Survey results for the policy and regulatory environment (see Appendix 2).

**E4.3** (4%) Survey results for the financial autonomy of public universities (see Appendix 2).

**E5:** (5%) Responses to WEF survey question (7-point scale): "How well does the educational system in your country meet the needs of a competitive economy?" (2018).

The top-ranked countries in the Environment module are the United States, Australia, New Zealand, Hong Kong SAR, Finland, United Kingdom and Singapore. Changes are small. Argentina fell four places to 36th owing to a reduction in the level 5 enrolment share (these enrolments also fell in Australia but not by enough to change ranking).

For the qualitative index (E4), the top-ranked countries are the United States, Australia, New Zealand, Hong Kong SAR, Finland and the United Kingdom.

Only in five countries for which data are available does the percentage of female staff in tertiary institutions exceed 50 per cent: Finland, Malaysia, Romania, Russia and Thailand. The largest increases occurred in France and Japan where better data became available, but Japan is still ranked lowest at 28 per cent. As measured by the WEF survey, business ranks national education systems most highly in Switzerland, Singapore, Finland, the United States, the Netherlands and Ireland.

Below:

## Environment Ranking

Rank	Country	Score
1	United States	100.0
2	Australia	96.0
3	New Zealand	93.8
4	Hong Kong SAR	93.0
5	Finland	91.5
6	United Kingdom	89.8
7	Singapore	88.6
8	Netherlands	88.0
9	Malaysia	86.9
10	Belgium	85.3
11	Taiwan-China	85.2
12	Switzerland	83.9
13	Canada	83.4
14	Sweden	82.9
15	Ireland	82.2
16	Japan	81.8
17	Poland	81.6

Rank	Country	Score
18	China	81.3
19	Norway	81.2
20	Israel	80.8
21	Chile	79.9
22	France	79.7
23	South Africa	79.3
24	Denmark	79.2
25	Mexico	78.7
26	Austria	78.5
27	Thailand	77.4
28	Germany	77.1
29	Russia	77.0
30	Indonesia	75.8
31	Romania	75.7
32	Spain	75.4
33	Czech Republic	74.5
34	Portugal	74.1

Rank	Country	Score
35	Slovenia	73.5
36	Argentina	73.2
37	India	71.5
38	Italy	71.1
39	Ukraine	70.6
40	Slovakia	69.2
41	Iran	67.4
42	Brazil	67.0
43	Bulgaria	66.0
44	Korea	65.9
45	Saudi Arabia	65.1
46	Hungary	62.1
47	Croatia	61.0
48	Turkey	60.2
49	Serbia	59.2
50	Greece	48.0

## 2.3 Connectivity (weight of 20%)

The worth of a national higher education system is enhanced if it is well connected with the rest of the nation's society and is linked internationally in education and research. Connectivity promotes technical change and economic growth. International connectivity is particularly important for small countries. There are five measures each with equal weight:

**C1:** (4%) Proportion of international students in tertiary education, 2017.

**C2:** (4%) Proportion of articles co-authored with international collaborators, 2018.

**C3:** Webometrics TRANSPARENCY is not used.

**C4:** (4%) Webometrics VISIBILITY index. The number of external links that university web domains receive divided by country's population. Cut off is top 10,000 tertiary institutions, July 2019 edition.

**C5:** (4%) Responses to question 'Knowledge transfer is highly developed between companies and universities', asked of business executives in the annual survey by IMD World Development Centre, Switzerland, 2019.

**C6:** (4%) Percentage of university scientific research publications that are co-authored with industry researchers, 2015–17.

Switzerland is clearly the top nation for Connectivity followed by Austria. Then come three countries with similar scores: Singapore, the United Kingdom and the Netherlands. The countries with lowest connectivity are, in alphabetical order, Brazil, India, Iran

and Turkey. Slovakia is up six places reversing last year's fall. Ukraine has improved five places; Belgium has fallen four places. International students are relatively most important in Singapore, Australia, New Zealand, the United Kingdom and Switzerland. The median value for the share of publications which include an international author is 46 per cent and is highest in Saudi Arabia (73 per cent), Switzerland (67 per cent) and Belgium (64 per cent). The lowest share is for Indonesia (18 per cent), but the international share is only around 20–25 per cent in China, India, Iran and Turkey.

The share of scientific research publications that have a co-author from industry is highest in Austria (10.2 per cent), followed by Sweden (8.8 per cent), the Netherlands and Denmark (each 8.7 per cent), and Hungary (8.4 per cent). In contrast, the shares are below 2 per cent in India, Iran, Malaysia, and Turkey. Compared with the 2019 rankings, increases in the share of scientific publications that have industry co-authors are greatest in Slovakia and Ukraine, reversing last year's fall.

The top seven countries for knowledge transfer in the IMD survey of business executives (C5) are, in rank order, Switzerland, the Netherlands, the United States, Singapore and Israel. Relations with business improved markedly in Bulgaria, Poland and New Zealand, but worsened noticeably in Japan and the United Kingdom. Web visibility/impact is greatest in the United States followed by Switzerland, Canada, Finland, the United Kingdom and Ireland.

Below:

## Connectivity Ranking

Rank	Country	Score
1	Switzerland	100.0
2	Austria	94.1
3	Singapore	85.9
4	United Kingdom	85.4
5	Netherlands	85.3
6	Denmark	84.0
7	Finland	83.3
8	Sweden	82.4
9	Canada	80.1
10	New Zealand	79.3
11	Ireland	77.2
12	Australia	76.8
13	United States	76.2
14	Belgium	75.3
14	Germany	72.9
16	Norway	71.2
17	France	67.3

Rank	Country	Score
18	Hungary	65.6
19	Hong Kong SAR	63.7
20	Israel	61.0
21	Czech Republic	59.7
22	Portugal	57.0
23	Slovenia	55.0
24	Taiwan-China	54.3
25	Greece	53.7
26	Saudi Arabia	53.2
27	Italy	52.1
28	Japan	50.5
29	Spain	50.2
30	Slovakia	48.4
31	Malaysia	46.6
32	Chile	45.5
33	Korea	44.8
34	South Africa	42.6

Rank	Country	Score
35	Bulgaria	42.5
36	Thailand	41.9
37	Poland	40.6
38	Ukraine	40.4
39	Serbia	39.4
40	Croatia	38.0
41	Romania	36.5
42	Argentina	34.4
43	China	34.3
44	Indonesia	32.0
45	Mexico	31.8
46	Russia	29.9
47	Brazil	28.6
48	Turkey	28.5
49	India	25.5
50	Iran	25.0

## 2.4 Output (weight of 40%)

The measures used in this module encompass research output and its impact, student throughput, the national stock of graduates and researchers, the quality of a nation's best universities, and employability of graduates. The variables are given below.

- O1:** (10%) Total number of research documents produced by higher education institutions, 2018.
- O2:** (3%) Total number of research documents produced by higher education institutions per head of population, 2018.
- O3:** (5%) Average impact of articles as measured by the Category Normalised Citation Impact for documents published 2014–18.
- O4:** (3%) The depth of world-class universities in a country. This is calculated as the total scores for a nation's universities in the Shanghai Jiao Tong top 1000 institutions, divided by population; 2019 ranking.
- O5:** (7%) The excellence of a nation's best universities calculated by totalling the 2019 Shanghai Jiao Tong scores for the nation's three best universities.
- O6:** (3%) Enrolments in tertiary education as a percentage of the eligible population, defined as the five-year age group following on from secondary education, 2017.
- O7:** (3%) Percentage of the population aged 25–64 with a tertiary qualification, 2018.
- O8:** (3%) Number of researchers (full-time equivalent) in the nation per million of population, 2017.
- O9:** (3%) the inverse of the unemployment rate among tertiary educated aged 25–64 years divided by the unemployment rate for those with only upper secondary education, 2018 or latest.

The top country in the Output module is clearly the United States. The United Kingdom is second, followed by Australia, Denmark, Switzerland, Sweden, Canada and the Netherlands. China has improved the most from last year's rankings: up six places to 16th. Hong Kong SAR and Austria have each improved three places, to 15th and 17th, respectively. The largest fall is by five places to 20th by Ireland, but this is due to factors external to higher education performance: official revisions to data on number of researchers (O8) and a reduction in the unemployment rate for school leavers relative to graduates (O9). Slovenia and Ukraine have fallen four places and Russia three places.

The United States and China lead on total publications with China's output now equal to 70 per cent of the US total. The leading five countries for publications per head of population are, in rank order, Denmark, Switzerland, Australia, Sweden and Norway. Switzerland is clearly the top country for the average impact of publications. The next countries, in rank order, are the Netherlands, Denmark, Hong Kong SAR and Singapore. Indonesia and Ukraine are the only countries without a university in the top 1000. The United States and the United Kingdom clearly dominate the 'best three universities' (O5), followed by Switzerland, Japan and Canada. Then follow seven countries with similar scores: in alphabetical order these are Australia, China, Denmark, France, Germany, the Netherlands and Sweden. The variable O4 measures the depth of world-class universities relative to population. Switzerland is the highest ranked followed by Denmark, Sweden and Australia.

The top four countries with the most qualified workforces (O7) are Canada, Russia, Japan and Israel. The national stock of researchers relative to population is highest in Israel followed by Denmark, Sweden, Korea, Singapore and Finland. Unemployment of the tertiary educated relative to school leavers (O9) is lowest in South Africa, Ukraine, Hungary, Poland, the United States and Russia. Unemployment remains higher for those with a tertiary qualification in seven countries but most noticeably in India, Saudi Arabia and Thailand.

Below:

## Output Ranking

Rank	Country	Score
1	United States	100.0
2	United Kingdom	72.9
3	Australia	67.8
4	Denmark	67.8
5	Switzerland	67.5
6	Sweden	65.1
7	Canada	64.1
8	Netherlands	62.4
9	Finland	60.9
10	Norway	59.9
11	Singapore	59.0
12	Belgium	57.3
13	Israel	56.8
14	Germany	55.1
15	Hong Kong SAR	53.2
16	China	52.3
17	Austria	52.0

Rank	Country	Score
18	France	51.9
19	Korea	51.8
20	Ireland	51.7
21	New Zealand	51.2
22	Japan	50.1
23	Spain	47.3
24	Taiwan-China	45.1
25	Italy	43.9
26	Greece	42.3
27	Slovenia	41.5
28	Portugal	41.2
29	Russia	41.1
30	Czech Republic	37.9
31	Poland	36.3
32	Hungary	34.6
33	Saudi Arabia	33.5
34	Chile	31.6

Rank	Country	Score
35	South Africa	31.1
36	Argentina	30.4
37	Croatia	30.1
38	Slovakia	29.8
39	Turkey	29.5
40	Brazil	29.3
41	Iran	29.1
42	Ukraine	28.7
43	Bulgaria	28.4
44	Serbia	28.3
45	Malaysia	27.6
46	Romania	24.6
47	Thailand	22.7
48	India	21.0
49	Mexico	19.5
50	Indonesia	16.5

## 2.5 Overall Ranking

An overall ranking is obtained by summing the module scores out of 100 using weights of 40 per cent on Output and 20 per cent on each of the other three modules. The top three countries, in order, are the United States, Switzerland and Denmark. The other seven countries that make up the top ten have scores within a narrow band of 82 to 84. In rank order these seven countries are Singapore, Sweden, the United Kingdom, Canada, Finland, Australia and the Netherlands. Among the top ten countries, Denmark has improved two places. Singapore has risen three places this year and five places over the past two rankings.

The United Kingdom has fallen three places owing to a fall in the Resources rank.

Turning to countries outside the top ten, the largest increase is a rise of three places for Turkey (to 39th) owing to an increase in government expenditure. The largest fall was five places by Slovakia where government expenditure has fallen. The Czech Republic fell three places. Overall, the changes in ranks outside the top ten were smaller than in recent years.

Overleaf:  
Summary Ranks of  
Countries 2020

Country	Overall	Resources	Environment	Connectivity	Output
Argentina	40	36	36	42	36
Australia	9	14	2	12	3
Austria	12	7	26	2	17
Belgium	13	12	10	14	12
Brazil	41	22	42	47	40
Bulgaria	45	48	43	35	43
Canada	7	6	13	9	7
Chile	31	20	21	32	34
China	26	40	18	43	16
Croatia	43	41	47	40	37
Czech Republic	29	37	33	21	30
Denmark	3	4	24	6	4
Finland	8	9	5	7	9
France	17	16	22	17	18
Germany	16	18	28	15	14
Greece	37	47	50	25	26
Hong Kong SAR	14	13	4	19	15
Hungary	33	44	46	18	32
India	49	35	37	49	48
Indonesia	50	50	30	44	50
Iran	47	33	41	50	41
Ireland	19	39	15	11	20
Israel	18	23	20	20	13
Italy	30	42	38	27	25
Japan	20	24	16	28	22
Korea	24	25	44	33	19
Malaysia	27	15	9	31	45
Mexico	48	38	25	45	49
Netherlands	10	11	8	5	8
New Zealand	14	21	3	10	21
Norway	11	1	19	16	10
Poland	32	31	17	37	31
Portugal	25	26	34	22	28
Romania	44	46	31	41	46
Russia	35	45	29	46	29
Saudi Arabia	22	8	45	26	33
Serbia	42	30	49	39	44
Singapore	4	2	7	3	11
Slovakia	38	43	40	30	38
Slovenia	28	34	35	23	27
South Africa	34	32	23	34	35
Spain	23	28	32	29	23
Sweden	5	5	14	8	6
Switzerland	2	3	12	1	5
Taiwan-China	21	29	11	24	24
Thailand	46	49	27	36	47
Turkey	39	17	48	48	39
Ukraine	36	27	39	38	42
United Kingdom	6	19	6	4	2
United States	1	10	1	13	1

### 3. Methodology of adjusting for levels of economic development.

In our main rankings, the performance of a country is measured against world-best, usually high-income countries. But it is neither possible nor desirable for low-income countries to match the performance of rich countries. Comparisons of performance needs also to be made with that of countries at similar levels of economic development. More precisely, how well does a country perform on each of our criteria relative to its level of GDP per capita? To adjust for national levels of income we regress the values for each variable, in original units, on GDP per capita using data for all 50 countries. The GDP we use is for 2017 in US dollars measured in Purchasing Power Parity (PPP) terms. Both linear and quadratic relationships were tried. Logarithmic models performed less well. Given the tenfold range in GDP per capita across our 50 countries, values for countries at the very top and bottom ends of the income range show some sensitivity to functional form. The values of all but one of our 19 variables in the Resources, Connectivity and Output modules increase with GDP per head (the only exception is the unemployment variable, O9). The coefficient on the quadratic term was always negative, implying some tapering of increases at high levels of GDP per capita. For one measure, the proportion of articles that are written jointly with international authors (C2), we add population (in log form) as an additional explanatory variable: the larger the research body in a country, the less the need for foreign co-authors. Population has the expected negative coefficient.

The fitted equation gives the expected value of a variable for a nation's level of income. The difference between the actual and expected value will be positive or negative depending on whether a country performs above or below the expected value. In the few cases where data are missing, we assume that the variable takes the expected value for that country's level of GDP per capita, that is, we assume a deviation value of zero.

In aggregating over variables, we first express deviations from

the regression line as a percentage of the average of the actual and predicted values. To use the percentage deviations from the line would ignore the fact that the predicted values below the line are capped at 100 per cent whereas there is no limit above the line. Our method ensures symmetry in that values that are half what is expected at a given level of GDP per capita have the same influence as values that are double those expected. By construction, our calculated deviations lie in the range –200 per cent to +200 per cent. The average deviation for each module is a weighted sum of the deviations for each of the measures within the module. The method of measuring deviations needs to be borne in mind when interpreting the weighted average numerical scores for each module and for the overall ranking.

Annual changes in ranking depend on changes in both the performance of the higher education sector and changes in GDP per capita. Thus, a country showing improvement in higher education can fall back in the adjusted rankings if economic growth has been exceptionally fast. Conversely if economic growth has been slow or negative, a country can rise in the adjusted rankings because of built-in lags in the higher education system.

We use the same dependent variables and weights as described in the previous section, with two exceptions. The exceptions are research expenditure (R4 and R5) and publication output (O1 and O2), where in each case we had a measure expressed in two different forms. This becomes unnecessary when we regress on GDP per head of population. We delete R5 and move the weight to R4 (R&D expenditure as a share of GDP), so that each of the four measures of Resources has a weight of 5 per cent in the overall ranking. In the output module, we use as a single publication measure the number of articles divided by (total) GDP, thus combining O1 and O2 (the weights are summed).

## 4. Results after adjusting for levels of economic development

### 4.1 Resources

Expenditures are best described by a linear relationship with GDP except for research expenditure where a quadratic curve fits best. Tertiary education expenditure (both government and total) as a share of GDP exhibits only a small increase with income levels. The relationship has become flatter with each successive year of ranking. This implies some convergence across countries at different levels of development in the level of resources devoted to higher education. The highest ranked countries for resources are South Africa and Malaysia, where expenditures are over 30 per cent more than what is expected given their income levels. Resources devoted to higher education are 25 to 30 per cent more than expected in Brazil, Canada, Denmark, Serbia and Sweden. Compared with the non-adjusted rankings, the largest improvers are South Africa (up 31 places to first), Serbia (up 25 places to fifth), India (up 24 places to 11th) and China (up 22 places to 18th).

Turning to the four variables that are included in the Resources module, for each thousand-dollar increase in GDP per capita, government and total expenditure are each estimated to increase by 0.05 per cent of GDP. The top five countries for the level of government expenditure after adjusting for GDP per capita are

Saudi Arabia, Ukraine, Finland, Austria and Norway. The highest ranked countries for total expenditure as a share of GDP are Chile, the United States, Canada and Malaysia. Expenditure (which includes research expenditure) per student increases markedly with income levels: on average by around USD349 (PPP) for each USD1,000 (PPP) increase in GDP per capita. The top two countries on an income-adjusted basis are Brazil (public institutions only) and South Africa. Then, in rank order, are India, the United Kingdom, the United States, Canada and Malaysia. The caveat is that the Indian data are estimates only.

Research expenditure in higher education as a share of GDP increases with GDP per capita, but at a declining rate. The regression estimates imply that at GDP per capita of USD50,000 the expected expenditure on R&D is 0.53 of GDP. The top ten countries for research expenditure as a share of GDP are now South Africa, Serbia, Denmark, Portugal, Sweden, Malaysia, Switzerland, Finland, Austria and Israel.

## 4.2 Environment

In principle, the creation of a favourable environment is independent of income levels so we do not carry out regression analysis. Instead, we use average values for expected values and calculate the percentage deviation from expected as was done in other modules. The rankings are necessarily almost the same as those for the unadjusted data.

The scores for the top four countries (the United States, Australia, New Zealand and Hong Kong SAR) are around 20 per cent above expected values.

## 4.3 Connectivity

All five Connectivity measures are positively related to levels of GDP per head. The relationship with income levels is weaker for joint international publications because population size is also important: researchers in large countries such as China and the United States have a larger internal population to undertake joint work. To correct for this, we use both income and (log) population to explain joint publications. The explanatory power of the equations for each of the five Connectivity measures varies from 37 to 54 per cent.

The top countries for Connectivity, after adjusting for income levels, are, in rank order, Ukraine, the United Kingdom, Austria, New Zealand, Switzerland, Hungary, Finland, Canada, South Africa and India. Compared with the unadjusted data it is of course lower income countries such as India, South Africa and Ukraine that show the greatest improvement in rank. Conversely,

at the high-income end, Norway, Saudi Arabia and Singapore all fall by over 20 places.

The top three countries for international co-authorship are Saudi Arabia, South Africa and Chile, where values are around one-third higher than expected given their income levels. Population size has a significant negative effect on international co-authorship and is more important than GDP per capita as an explainer of national differences.

Knowledge transfer is rated most highly by business (C5) in Indonesia, Israel, Malaysia, Finland, China and the Netherlands. Joint publications with industry are highest in Ukraine, Hungary, Austria and South Africa after allowing for levels of income.

## 4.4 Output

All but one of the output measures (unemployment, O9) show a significant increase with levels of GDP per capita, but for most measures the increase flattens out at high-income levels. Two output measures show a particularly strong relationship with GDP per capita (explanatory power of 65 per cent): impact as measured by citations (O3) and researchers per head of population (O8). The impact measure picks up not only the quality of research but its nature: applied research in developing countries is less likely to be highly referenced despite its relevance for economic development.

The top eight ranked countries for Output are the United Kingdom, Denmark, Israel, Serbia, Australia, South Africa, Finland and Sweden. For these countries Output is more than 20 per cent above expected values for their levels of income. Compared with the unadjusted rankings, the countries that increase by more than 20 places are, in rank order, Serbia, South Africa, India and Brazil. The largest falls in rank compared with the original data occur for Singapore, Germany, Taiwan-China, the United States, Ireland and Japan, each down by 16 to 20 places.

Turning to the components, the top ten countries for publications (measured as the number of research documents deflated by total GDP) are now, in rank order, Serbia, Ukraine, Denmark, Croatia, Portugal, South Africa, New Zealand, Australia, Slovenia and Finland. After adjusting for differences in income levels, the impact of publications (O3) is highest for South Africa, India, Belgium, Denmark, China and Greece. China is clearly ranked first for the quality of the best three universities; next in rank order are the United States, the United Kingdom, Brazil, South Africa and Japan.

After allowing for income levels, Ukraine is ranked first on participation rates (O6), followed by Greece, Argentina, Turkey and Chile. Ukraine also comes first on tertiary qualifications of the workforce (O7), followed in rank order by Russia, Israel, Canada, Japan and Korea. Israel and Serbia are first for researchers per head of population; next in rank are Korea, Denmark, Sweden and Finland.

## 4.5 Overall Ranking

The overall score is calculated by weighting the percentage deviations for each module using the same weights as for the unadjusted data: Resources (20%), Environment (20%), Connectivity (20%) and Output (40%). The median aggregate score is -7% so that a score above this level can be interpreted as being above average for the 50 countries we consider.

The top ranked countries after allowing for income levels are Finland, South Africa, the United Kingdom and Denmark. In these countries, the scores imply an overall performance of 20 per cent above the average level of achievement for countries at their income levels. Next in rank order are Canada, Sweden, Australia and New Zealand.

Compared with the original rankings in Section 2, India, Serbia

and South Africa improve by around 30 places; Brazil and Ukraine improve by 20 places. Five countries improve by between seven and ten places: Portugal, Iran, Croatia, China and Finland.

The largest fall in rank compared with the Section 2 results is that of Saudi Arabia. The United States is measured as performing above expected values but nevertheless falls to 18th position. Similarly, Singapore, the country with the highest income levels, now ranks only 23rd. Ireland falls substantially but is disadvantaged by our use of Gross Domestic Product as a measure of income levels. Foreign ownership is relatively large in Ireland and a better measure of domestic income levels for this country would be Gross National Income.

Overleaf:

# National Rankings Controlling for Levels of Economic Development

Rank	Resources	%dev	Environment	% dev	Connectivity	%dev	Output	%dev
1	South Africa	40.1	United States	26.2	Ukraine	70.2	United Kingdom	29.3
2	Malaysia	30.9	Australia	22.0	United Kingdom	34.9	Denmark	28.4
3	Brazil	29.9	New Zealand	19.8	Austria	31.1	Israel	28.2
4	Canada	28.3	Hong Kong SAR	18.4	New Zealand	29.6	Serbia	24.4
5	Serbia	27.6	Finland	17.2	Switzerland	24.8	Australia	23.8
6	Denmark	26.5	United Kingdom	15.3	Hungary	24.1	South Africa	22.9
6	Sweden	26.0	Singapore	14.0	Finland	21.5	Finland	22.3
8	Finland	24.5	Netherlands	13.3	Canada	20.6	Sweden	20.5
9	Ukraine	23.1	Malaysia	12.0	South Africa	19.1	Portugal	17.6
10	Saudi Arabia	23.0	Belgium	9.9	India	17.2	New Zealand	16.9
11	India	21.6	Taiwan-China	9.9	Denmark	15.6	Canada	15.4
12	Austria	21.4	Canada	7.6	Netherlands	14.5	Switzerland	13.3
13	Turkey	21.4	Switzerland	7.3	Australia	11.6	Greece	12.9
14	Switzerland	16.3	Sweden	7.1	Portugal	10.0	Belgium	11.0
15	Norway	13.0	Ireland	5.8	Sweden	9.4	Netherlands	10.2
16	Belgium	8.4	Japan	5.4	Czech Republic	9.1	China	5.5
17	Netherlands	6.5	China	5.2	Serbia	6.8	Brazil	1.2
18	China	5.8	Poland	4.5	Belgium	5.3	United States	-0.8
19	Chile	1.8	Israel	4.4	Greece	5.2	Slovenia	-0.9
20	Portugal	1.3	Norway	4.3	Germany	4.2	Croatia	-1.8
21	United States	0.8	France	3.0	France	3.6	Spain	-3.6
22	France	0.5	Chile	2.1	Bulgaria	-3.2	India	-5.5
23	Australia	-1.0	Denmark	2.0	United States	-6.7	Austria	-8.0
24	New Zealand	-3.1	Austria	1.4	Thailand	-7.2	Norway	-8.5
25	Iran	-4.6	South Africa	-0.5	Israel	-8.6	Czech Republic	-9.9
26	Israel	-5.0	Mexico	-0.6	Slovenia	-12.4	Korea	-10.1
27	United Kingdom	-6.1	Thailand	-0.7	Ireland	-14.3	Italy	-11.8
28	Singapore	-7.1	Germany	-1.3	Slovakia	-15.7	France	-11.9
29	Poland	-8.1	Russia	-1.4	Italy	-16.9	Iran	-13.3
30	Germany	-8.3	Indonesia	-2.6	Singapore	-17.1	Hong Kong SAR	-13.6
31	Mexico	-9.0	Spain	-3.2	Spain	-21.0	Singapore	-13.9
32	Hong Kong SAR	-11.2	Czech Republic	-4.3	Hong Kong SAR	-22.3	Poland	-16.5
33	Croatia	-14.9	Romania	-4.9	Romania	-23.1	Germany	-16.9
34	Argentina	-15.6	Portugal	-5.3	Poland	-23.4	Hungary	-17.2
35	Spain	-17.8	Slovenia	-5.8	China	-23.8	Ukraine	-20.0
36	Korea	-19.9	Argentina	-7.4	Malaysia	-24.8	Chile	-23.1
37	Japan	-22.3	India	-8.7	Japan	-29.5	Ireland	-26.4
38	Czech Republic	-27.5	Italy	-9.2	Argentina	-30.7	Japan	-27.9
39	Slovenia	-28.5	Ukraine	-10.2	Taiwan-China	-30.8	Bulgaria	-31.5
40	Hungary	-28.5	Slovakia	-14.0	Norway	-30.8	Russia	-32.8
41	Thailand	-28.9	Iran	-14.1	Chile	-37.2	Argentina	-36.3
42	Slovakia	-30.9	Korea	-17.0	Indonesia	-38.2	Taiwan-China	-37.6
43	Italy	-36.9	Brazil	-17.1	Brazil	-42.8	Malaysia	-42.9
44	Taiwan-China	-37.2	Bulgaria	-18.5	Russia	-46.2	Romania	-44.9
45	Russia	-40.5	Saudi Arabia	-18.6	Korea	-47.3	Turkey	-47.9
46	Romania	-42.1	Hungary	-24.9	Croatia	-51.0	Slovakia	-49.2
47	Greece	-43.8	Croatia	-27.9	Mexico	-58.5	Thailand	-50.6
48	Indonesia	-49.6	Turkey	-29.0	Saudi Arabia	-59.0	Saudi Arabia	-72.8
49	Bulgaria	-52.8	Serbia	-31.0	Turkey	-67.3	Mexico	-79.5
50	Ireland	-71.7	Greece	-55.6	Iran	-76.2	Indonesia	-95.9

%dev = percentage deviation from expected value at nation's level of GDP per capita.

Below:

## Overall Ranking Controlling for Level of Economic Development

Rank	Country	% dev
1	Finland	21.6
2	South Africa	20.9
3	United Kingdom	20.6
4	Denmark	20.2
5	Canada	17.4
6	Sweden	16.7
7	Australia	16.0
8	New Zealand	16.0
9	Switzerland	15.0
10	Netherlands	10.9
11	Serbia	10.4
12	Israel	9.5
13	Belgium	9.1
14	Ukraine	8.6
15	Portugal	8.2
16	Austria	7.6
17	India	3.8

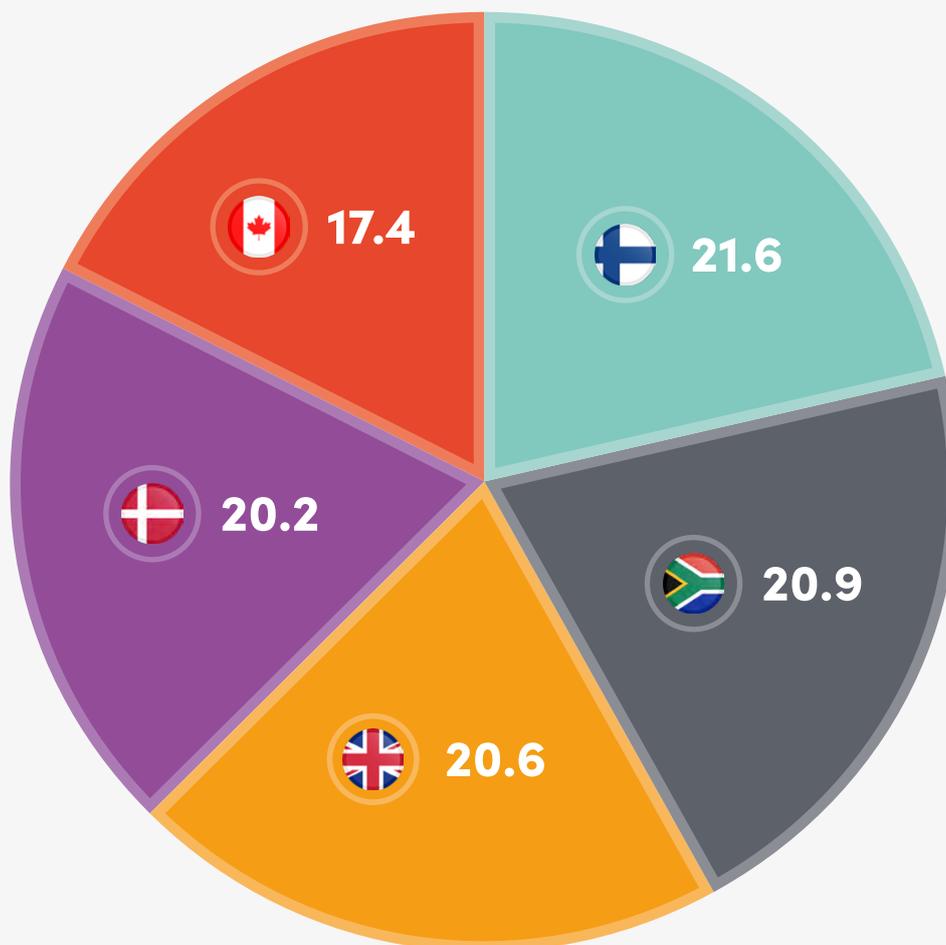
Rank	Country	% dev
18	United States	3.7
19	China	-0.3
20	France	-3.3
21	Brazil	-5.5
22	Norway	-6.1
23	Singapore	-7.6
24	Germany	-7.8
25	Hong Kong SAR	-8.4
26	Czech Republic	-8.5
27	Slovenia	-9.7
28	Spain	-9.8
29	Poland	-12.0
30	Hungary	-12.7
31	Malaysia	-13.5
32	Greece	-13.7
33	Chile	-15.9
34	Italy	-17.3

Rank	Country	% dev
35	Croatia	-19.5
36	Japan	-20.5
37	Korea	-20.9
38	Iran	-24.3
39	Argentina	-25.2
40	Ireland	-26.6
41	Taiwan - China	-26.7
42	Bulgaria	-27.5
43	Thailand	-27.6
44	Russia	-30.7
45	Slovakia	-31.8
46	Romania	-32.0
47	Turkey	-34.1
48	Saudi Arabia	-40.0
49	Mexico	-45.4
50	Indonesia	-56.4

% dev = percentage deviation from expected value at nation's level of GDP per capita.

Below:

## Top 5 Ranking Controlling for Level of Economic Development



Finland | Rank 1

South Africa | Rank 2

United Kingdom | Rank 3

Denmark | Rank 4

Canada | Rank 5

## 5. Attributes of Graduates

It is a daunting task to make international comparisons of graduate attributes. The difficulties are both conceptual and practical. Notwithstanding, in this section we use two surveys to throw light on some attributes of graduates: a World Economic Forum (WEF) survey on business views of graduates and findings from the OECD's Programme for the assessment of Adult Competencies (PIAAC).

As part of the WEF Global Competitiveness Report 2019, the following question (6.04b) was asked of business:

*In your country, to what extent do university graduates possess the skills needed by businesses?*

*[1 = not at all; 7 = to a great extent]*

The scores are given in the table headed Business Ratings of Graduates (p28). The countries where business is most satisfied with the skills of graduates are Switzerland, Singapore, Finland and the Netherlands. Some indication of the characteristics of higher education systems that produce good graduates in the eyes of business can be obtained by correlating the WEF scores with relevant quantitative measures in our main ranking. The scores are most highly correlated ( $r = 0.76$ ) with our weighted measure of university scores in the Shanghai top 1000 universities divided by population (O4). Recall that this variable is designed to measure the depth of quality universities, albeit it is largely based on research activity. The other high correlation is with expenditure per student (R3). The two measures taken together explain over 60 per cent of the variation in the WEF scores. The measure with the weakest correlation with the WEF scores is the percentage of students in private universities (an uncapped version of the data used in E4.1(i)).

The WEF results presumably reflect a combination of discipline and generic skills. The OECD data from PIAAC measure generic competencies. We first present the findings for levels of numeracy and literacy. In particular, we look at mean recorded scores for people aged 20 to 24, distinguishing between (i) those who are attending a tertiary institution or have a tertiary qualification and (ii) non tertiary educated. Data are available for only 31 of our 50 countries. The data for Hungary, Mexico and the United States were collected in 2017; data for Singapore, Slovenia, New Zealand, Greece, Israel, Turkey and Chile were collected in 2014–15 and for the remaining countries the surveys were for 2011–12.

In the table, countries are ranked first by the score for those with a tertiary background. Note that there is a very high correlation between the scores for numeracy and literacy ( $r = 0.94$  for the tertiary educated). The six highest scoring countries for numeracy are Austria, Finland, Belgium, the Netherlands, Sweden and Germany. For literacy, the top six remain the same except that Japan replaces Germany which falls to seventh.

The scores for numeracy and literacy are always higher than for non-tertiary 20–24 year-olds but the differences are not uniform. The PIAAC table also contains the ranks for these differences. In numeracy, the tertiary educated perform much better in Hungary, France, Chile, Belgium, the United Kingdom and Singapore. The differences for literacy are greatest in Hungary, France, Germany, Spain, Belgium and Italy. The median difference is similar for numeracy and literacy.

The absolute scores are a measure of output quality and do not measure value added. The comparison between the scores for the tertiary educated with those for the non-tertiary educated do provide a comparator measure, but the difference can be attributable to factors such as levels of incoming skills and tertiary participation rates. (Although there is no significant correlation between the ranks for difference scores and participation rates.) In earlier work, Williams (2019) found that PIAAC scores for numeracy and literacy were largely determined by intake scores, i.e. scores at the end of schooling.

A third set of attributes measured in the PIAAC survey relate to what is labelled 'proficiency levels in problem solving in technology-rich environments'. In the last column of our PIAAC table we present ranks for the percentage of tertiary qualified persons aged 25–65 who scored at the highest level (grade 3). Data are not available for Japan, the Netherlands and Germany. The median percentage of tertiary educated adults achieving level 3 is 10.1 compared with 1.3 for those adults with only upper secondary schooling. As the scores for the latter show little variation across countries from the median value it follows that the ranks for the differential effect of tertiary education are almost the same as for the levels given in the table. We conclude that the ranks of proficiency levels for the tertiary-educated are very much reflecting the value added by tertiary education, both through initial training and the ability to subsequently learn on the job.

Below:

## PIAAC Ranks for Generic Skills

Rank	Numeracy		Literacy		Problem Solving
	Tertiary students 20-24 yrs	Tertiary above non-tertiary 20-24 yrs	Tertiary students 20-24 yrs	Tertiary above non-tertiary 20-24 yrs	All tertiary qualified
1	Austria	Hungary	Finland	Hungary	Sweden
2	Finland	France	Netherlands	France	New Zealand
3	Belgium	Chile	Sweden	Germany	Czech Republic
4	Netherlands	Belgium	Japan	Spain	Japan
5	Sweden	United Kingdom	Austria	Belgium	Netherlands
6	Germany	Singapore	Belgium	Italy	Germany
7	Hungary	Austria	Germany	Austria	Finland
8	Czech Republic	Norway	Norway	Mexico	Singapore
9	Norway	Mexico	Denmark	Norway	Australia
10	Denmark	Canada	France	Singapore	Norway
11	Japan	Germany	Korea	United Kingdom	Denmark
12	Singapore	United States	Hungary	Slovenia	Belgium
13	Slovakia	Poland	Czech Republic	Canada	Hungary
14	Slovenia	Spain	Australia	Netherlands	Canada
15	France	Slovenia	Poland	Chile	United Kingdom
16	Canada	Netherlands	New Zealand	New Zealand	Israel
17	Poland	New Zealand	Singapore	Poland	United States
18	New Zealand	Ireland	Canada	Denmark	Poland
19	Korea	Denmark	Slovak Republic	Greece	Slovenia
20	Australia	Greece	United States	Sweden	Austria
21	United Kingdom	Italy	Slovenia	Ireland	Slovakia
22	Ireland	Finland	United Kingdom	United States	Ireland
23	Spain	Slovakia	Ireland	Slovakia	Greece
24	United States	Czech Republic	Spain	Finland	Chile
25	Russia	Turkey	Italy	Czech Republic	Korea
26	Greece	Sweden	Russia	Australia	Turkey
27	Italy	Australia	Israel	Israel	Mexico
28	Israel	Japan	Greece	Japan	Russia
29	Turkey	Korea	Mexico	Korea	
30	Mexico	Israel	Chile	Turkey	
31	Chile	Russia	Turkey	Russia	

## 6. University–Business Research Connectivity

In this section we extend our work on the links between higher education and business and examine research funding.

The contribution that higher education makes to the national research effort, as measured by financial resources used, are given for 46 countries in the first panel of the Research Funding table. Data are taken from the UNESCO data bank and relate to 2017 or latest available year. Data are not available for Brazil, Indonesia, Saudi Arabia and Taiwan–China. The higher education share of research activity varies from 51 per cent for Hong Kong SAR to 4 per cent for India. The share is also over 40 per cent for Portugal, Chile and Canada and below 10 per cent for Russia, Korea, Ukraine, China and Bulgaria. We now exam how this research effort is funded.

Research in higher education can be financed both externally and internally. External sources are business, government, not-for-profits and foreigners. Internal sources include student fees and endowments. Government funding of student places that is used to fund research straddles external and internal sources. The second panel of the table shows the contribution of business

enterprises to the funding of research in higher education. The data are again sourced from UNESCO and relate to 2017 or the most recent year. The percentage share of research financed by business varies from 28 per cent for China and Russia to 1 per cent or less for Malaysia, Mexico and Argentina. The high shares for China and Russia reflect the importance of state enterprises.

What is noticeable about the table is the relatively strong negative correlation ( $r = -0.63$ ) between the results in the two panels: high relative business funding tends to be associated with a less important contribution by the higher education sector to the national research effort. The explanation is that in countries where R&D is predominantly undertaken by the business sector that sector also funds universities relatively well. To illustrate, in Germany and Korea the business sector itself undertakes around 70 per cent of national research but it is also an important funder of university research. At the other extreme, in Chile the business sector undertakes only 40 per cent of national R&D and in Canada and Portugal the figure is only 50 per cent.

Overleaf:

Research Funding

Share of Higher Ed in national R&D expenditure			Business funding of R&D in Higher Ed	
Rank	Country	Percent	Country	Percent
1	Hong Kong SAR	50.9	China	28.5
2	Portugal	42.6	Russia	28.2
3	Chile	41.8	Bulgaria	21.5
4	Canada	41.1	Germany	13.8
5	Serbia	36.2	Korea	13.7
6	Malaysia	34.2	Ukraine	13.5
7	Turkey	33.5	Belgium	12.9
8	Norway	33.3	Thailand	12.2
9	Denmark	33.0	Slovenia	10.6
10	Poland	32.9	Israel	10.3
11	South Africa	32.7	Switzerland	9.8
12	Australia	30.6	Hungary	9.6
13	Netherlands	29.8	Greece	8.3
14	Croatia	29.3	Canada	7.9
15	Singapore	29.1	South Africa	7.8
16	Greece	28.4	Netherlands	7.8
17	New Zealand	28.0	Singapore	7.3
18	Spain	27.1	Romania	6.2
19	Mexico	26.8	United States	5.3
20	Thailand	26.7	Austria	5.3
21	Switzerland	26.7	Spain	5.1
22	Argentina	25.8	Australia	5.1
23	Sweden	25.7	Czech Republic	5.1
24	Finland	25.4	United Kingdom	4.4
25	Ireland	24.7	Sweden	4.0
26	Slovakia	24.7	Finland	3.7
27	Italy	24.2	New Zealand	3.5
28	United Kingdom	23.7	Ireland	3.2
29	Austria	22.2	Norway	3.1
30	Belgium	20.8	Poland	3.0
31	France	20.7	Japan	2.9
32	Indonesia	19.9	Chile	2.9
33	Czech Republic	19.6	France	2.8
34	Germany	17.3	Denmark	2.6
35	Hungary	13.3	Croatia	2.0
36	United States	13.0	Slovakia	1.9
37	Japan	12.0	Portugal	1.8
38	Israel	11.4	Serbia	1.5
39	Slovenia	11.2	Italy	1.3
40	Romania	10.6	Turkey	1.3
41	Russia	9.0	Malaysia	1.0
42	Korea	8.5	Mexico	0.8
43	Ukraine	7.3	Argentina	0.3
44	China	7.2		
45	Bulgaria	5.7		
46	India	3.9		

## 7. Concluding Remarks

It is natural that institutions like to be judged according to criteria they themselves set. Universities and other tertiary institutions are not exempt from this general rule. In the current era, universities place greatest emphasis on research output, both its quantity and quality. Research that is internationally recognised is particularly valued. There are several reasons for this. The international rankings of universities are heavily based on research performance. University leaders strive for high rankings to attract students and talented staff. The emphasis on research performance is strongly supported by academic staff, many of whom want to maximize their international mobility. The most common measure of research quality and performance is impact using citations in some form. But citations largely reflect the importance of research as perceived by the tertiary sector. Evaluation by other stakeholders such as government, business and not-for-profits is desirable. Similarly, external evaluation of the outputs of the teaching and training functions of universities is important.

In the U21 rankings the measures used do include some external views of the university sector in each of our 50 countries. The Environment module includes the general views of business on the higher education sector, the Connectivity module includes data on joint research with industry and on how business rates the extent of knowledge transfer. In this year's report we also look at how business rates the quality of graduates. But what is lacking in this and other rankings are wider measures of research and its impact and appropriateness. For example, frontier research is more important for high-income countries whereas for low-income countries applied research on issues facing the nation is more appropriate: developing countries need to balance expenditure on higher education against other pressing needs, such as healthcare and schooling.

A wider issue is the distribution of research activity within the higher education sector. Some specialisation across institutions is required, but how much? Is there a role for institutions that cover teaching and scholarship but not research? The U21 rankings recognise that performance needs to be evaluated at a national level.

In conclusion, what are the six most important findings after nine years of ranking?

1. There is a strong relationship between research funding and performance.
2. The mix between public and private funding is of little importance for performance,
3. Countries with small population benefit from the ease with which strong informal links between tertiary institutions, business and government can be developed.
4. There is a trade-off between the amount of government control and the level of government funding, and the worst systems combine tight government control with limited government funding.
4. There is a negative relationship between international connectivity and population size.
5. There is a positive relationship between connectivity and research performance.

Below:

## Business Ratings of Graduates (WEF Survey)

Rank	Country	Score
1	Switzerland	6.01
2	Singapore	5.72
3	Finland	5.69
4	Netherlands	5.61
#5	Austria	5.50
#5	Belgium	5.50
#5	Denmark	5.50
#5	Sweden	5.50
9	Israel	5.44
10	United States	5.42
11	Ireland	5.38
12	Hong Kong SAR	5.36
13	Canada	5.32
#14	Germany	5.25
#14	Norway	5.25
16	Chile	5.23
#17	New Zealand	5.14

Rank	Country	Score
#17	Saudi Arabia	5.14
#19	Australia	5.06
#19	Portugal	5.06
21	United Kingdom	5.05
22	France	5.01
23	Malaysia	5.00
24	Indonesia	4.98
25	Spain	4.86
26	Korea	4.82
27	Argentina	4.74
28	Taiwan	4.62
29	Japan	4.60
30	Italy	4.59
#31	China	4.58
#31	Czech Republic	4.58
#31	Greece	4.58
#31	Slovenia	4.58

Rank	Country	Score
35	Mexico	4.52
36	Thailand	4.40
37	Ukraine	4.39
38	Hungary	4.23
39	Serbia	4.22
40	Russia	4.17
41	South Africa	4.09
42	Turkey	4.04
43	Bulgaria	4.02
44	Poland	3.96
#45	Romania	3.88
#45	Slovakia	3.88
47	India	3.82
48	Brazil	3.51
49	Croatia	3.48
50	Iran	3.23

# Appendix 1. Sources

**R1** and **R2**: OECD, *Education at a Glance, 2019, Table C2.2* and UNESCO, *Institute for Statistics* ([www.uis.unesco.org](http://www.uis.unesco.org))

**R3**: OECD, *Education at a Glance, 2019, Table C1.2*; UNESCO, *Institute for Statistics*; and IMF, *Data and Statistics*. UNESCO student numbers converted to full-time equivalents using average for countries where both sets of student data exist.

**R4** and **R5**: UNESCO, *Institute for Statistics* and IMF, *Data and Statistics*.

**E1** and **E2**: UNESCO, *Institute for Statistics*.

**E4**: OECD, *Education at a Glance 2019*; UNESCO; surveys as described in Appendix 2.

**E5**: World Economic Forum, *The Global Competitiveness Report 2016–17*, Table 5.03.

**C1**: OECD, *Education at a Glance 2019*, Table B6.1; UNESCO.

**C2**: *InCites* based on *Web of Science* databank ([www.clarivate.com/products/incites](http://www.clarivate.com/products/incites))

**C4**: Webometrics ([www.webometrics.info](http://www.webometrics.info)).

**C5**: *IMD World Competitiveness Report 2019*, Table 4.3.23, World Competitiveness Center, Institute for Management Development, Lausanne, Switzerland.

**C6**: CWTS, Leiden University.

**O1**, **O2** and **O3**: *InCites* based on *Web of Science* databank ([www.clarivate.com/products/incites](http://www.clarivate.com/products/incites))

**O4** and **O5**: Shanghai Jiao Tong University Rankings, 2019 ([www.shanghairanking.com](http://www.shanghairanking.com))

**O6**: UNESCO, *Institute for Statistics*.

**O7**: OECD, *Education at a Glance, 2019, Table A1.1*; ILOSTAT ([www.ilo.org](http://www.ilo.org)); UNESCO, *Institute for Statistics*.

**O8**: UNESCO, *Institute for Statistics*.

**O9**: OECD ([www.stats.oecd.org](http://www.stats.oecd.org)) and ILOSTAT ([www.ilo.org](http://www.ilo.org)).

# Appendix 2: The Survey

## Components of E4: Qualitative measure of the environment

The qualitative measures of the Environment are based on responses to questionnaires. Replies were obtained from U21 representatives, government agencies and educational research institutes. The survey for E4.2 was originally carried out in 2012; the survey for E4.3 was undertaken in 2015 with a major update 2017. Other responses have been updated where appropriate.

**E4.2:** The eight survey questions cover the following areas:

- Are there agencies that monitor standards of public tertiary institutions?
- If agencies exist are their findings made public?
- Are there agencies that monitor standards of private tertiary institutions?
- If agencies exist are their findings made public?
- The degree to which academics in public tertiary institutions are not government employees.
- Are academics in public research universities free to move to another university without government approval?
- Degree of freedom institutions have in choosing the CEO of a public research university.
- Degree of freedom to appoint foreign academics to ongoing positions.

**E4.3:** This was a survey primarily of the financial autonomy of publicly funded institutions. The categories of responses draw on those used by the European University Association (EUA) given on the EUA Autonomy in Europe website ([www.university-autonomy.eu](http://www.university-autonomy.eu)).

The six survey questions cover the following areas:

- To what extent is core public funding untied?
- Can institutions make market-adjustment allowances for academic staff in high demand?
- To what extent are institutions permitted to keep cash surpluses?
- What ability do institutions have to borrow money?
- To what extent can public institutions levy tuition fees for national (domestic) students?
- What freedom do institutions have over Bachelor degree programs offered?

# References and Further Reading

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# Country Summaries

## March 2020

### Argentina

Argentina ranks equal 40th overall, which combines ranks of 36 in Resources, 36 in Environment, 42 in Connectivity and 36 in Output. In the Resources category, the level of government expenditure on higher education as a share of GDP is ranked at 14 but total expenditure per student is ranked much lower at 45. The difference is explained by the high enrolment rate, ranked at five. Research expenditure by tertiary institutions as a share of GDP is ranked 40th. In links with the private sector, Argentina is ranked 38th for knowledge transfer and 46th for articles written jointly with researchers from industry. Both published articles per head and their average impact are ranked 45th. The quality of its best three universities is ranked 36th. When the rankings are adjusted for differences in GDP per capita Argentina is ranked at 39; its overall score is below that expected for its level of income.

### Australia

Australia ranks ninth overall, which combines ranks of 14 for Resources, 2 for Environment, 12 for Connectivity and 3 for Output. The Resources rank has fallen two places since last year's rankings. The ranking for Resources is pulled down by the low ranking (34th) for government expenditure on higher education, although the official data do not reflect the full cost of the student loans scheme. Private expenditure exceeds public expenditure and total expenditure as a share of GDP is ranked seventh. Expenditure per student, which includes research expenditure, is ranked 18th. In the Connectivity measures, Australia ranks second on the share of international students. Links with the private sector are at median levels: 30th for joint publications with industry and 23rd for knowledge transfer. Web connectivity is ranked ninth. The university sector is ranked fourth for its depth. Australia is ranked 7th on total publications and 12th on their average impact. On a per capita basis, it ranks third on research publications compared with tenth on research expenditure. In the share of publications with an international co-author Australia ranks 14th. Australia ranks 12th for the (tertiary) educational qualifications of the labour force, but enrolment rates are ranked much higher. On a per capita basis, the national stock of researchers is ranked 15th. The

employment rate for graduates compared with school leavers is ranked 33rd. Australia is ranked seventh when levels of GDP per capita are taken into account and the score is well above that expected at its income level.

### Austria

Austria ranks 12th overall, which combines ranks of 7 for Resources, 26 for the Environment, 2 for Connectivity and 17 for Output. In Connectivity it ranks in the top six for three measures: the share of international students, articles co-authored with international researchers and articles co-authored with industry researchers. Austria ranks third for government expenditures and tenth for total expenditure as a share of GDP. It ranks 15th on published articles per head of population, which compares unfavourably with research expenditure per head which is ranked sixth. Publications rank 11th on their average impact. Tertiary enrolment rates are ranked 11th, a higher rank than the tertiary qualifications of the workforce (24th). The depth of its university sector is ranked tenth. Graduates are ranked in the top four for both numeracy and literacy. When the rankings are adjusted for levels of GDP per capita, Austria's ranking is 16th, but its score is above what is expected at its income level.

### Belgium

Belgium ranks 13th overall, which combines ranks of 12 for Resources, 10 for Environment, 14 for Connectivity and 12 for Output. Compared with last year's ranking, the ranks for Resources and Output have improved but the Connectivity rank has fallen. Total expenditure as a share of GDP is ranked 21st but government expenditure is ranked tenth and expenditure per student is ranked 13th. Within the Connectivity module, Belgium is ranked third for the proportion of articles co-authored with international collaborators. It has good links with industry: ranked sixth for joint publications and 14th for knowledge transfer. In Output, Belgium is ranked 14th for publications per head and sixth for their average impact. It is ranked 13th on the quality of its top three universities. It is ranked 17th for the tertiary qualifications of the workforce. Graduates are ranked in the top six for both

numeracy and literacy. Belgium's overall ranking is 13th when performance is adjusted for levels of GDP per capita and its score is above that expected for a country at its level of income.

### **Brazil**

Brazil ranks 41st overall, which combines ranks of 22 for Resources, 42 for Environment, 47 for Connectivity and 40 for Output. The absence of official data on private expenditure and R&D expenditure means that the ranking for Resources is only an approximation. Government expenditure on higher education as a share of GDP is ranked 22nd. Links with industry are limited: ranked 48th by business and 42nd for joint publications. International research links are rated 39th. In the Output module, Brazil is 13th on total publications but only 43rd on publications per head and 46th for their average impact. The country ranks 25th for the quality of its best three universities but is in the bottom 20 per cent for participation rate and the qualification of its workforce. When the country standings are adjusted for levels of GDP per capita, Brazil rises to 21st in the rankings and its score is around that expected at its income level.

### **Bulgaria**

Bulgaria ranks 45th overall, which combines a ranking of 48 for Resources, 43 for Environment, 35 for Connectivity and 43 for Output. It ranks 44th for government expenditure on higher education as a share of GDP and 40th for total expenditure. Enrolment rates and the educational attainments of its workforce are around median levels. Publications per head are ranked at 37 and their average impact at 36. Joint publications with international authors rank 39th and joint publications with industry 28th, but business ranks knowledge transfer with tertiary institutions at a low 44th. Taken together, these results imply that Connectivity is limited to specialised groups. Bulgaria is ranked 9th for employment rates of those with a tertiary qualification relative to school leavers. When account is taken of the level of GDP per capita in each country, Bulgaria is ranked 42nd and its score is below the expected level.

### **Canada**

Canada is ranked seventh overall, which combines ranks of 6 for Resources, 13 for Environment, 9 for Connectivity and 7 for Output. In Resources, Canada ranks third for total expenditure as a share of GDP and seventh for expenditure per student. It is ranked in the top ten for research expenditure as a share of GDP and fourth for the share of national R&D performed by higher education. In the Output category, Canada is ranked sixth for total publications and 12th for publications deflated by population. The average impact of publications is ranked 13th. Its best three universities are ranked fifth. Canada is ranked first for the formal educational qualifications of its workforce. In Connectivity, Canada ranks third for web impact and 20th for the share of publications that are joint with international authors. Engagement with industry is above average: ranked tenth for knowledge transfer and 19th for joint publications. When levels of GDP per capita are taken into account, Canada ranks fifth overall and the score is well above that expected at its income level.

### **Chile**

Chile ranks 31st overall, which combines ranks of 20 for Resources, 21 for Environment, 32 for Connectivity and 34 for Output. The rank for Resources has improved five places from last year's ranking. In the Resources category, as a share of GDP Chile is ranked 24th for government expenditure but first for total expenditure owing to the importance of private expenditure. Expenditure per student is ranked 38th reflecting the high participation rate (ranked seventh). Research expenditure as a share of GDP is also ranked 38th and Chile is ranked third for the share of national R&D expenditure carried out by higher education. In the Connectivity category, Chile ranks tenth in the share of articles co-authored with international collaborators but 41st in joint articles with industry. The score by business on the extent of knowledge transfer has improved to 29th. In Output, Chile ranks 34th for published articles per head of population and 29th for their average impact. When levels of GDP per capita are allowed for, Chile ranks 33rd which is a little below that expected at its income level.

# Country Summaries

## (continued)

### China

China ranks 26th overall, a rise of 13 places over the last eight years. The overall rank combines ranks of 40 for Resources, 18 for Environment, 43 for Connectivity and 16 for Output. The Output rank has improved six places from last year's ranking. In the Resources category, as a share of GDP total expenditure on higher education is ranked 29th and research expenditure 37th. Within the Connectivity category, knowledge transfer with business is ranked 24th and the share of articles co-authored with industry is ranked 38th. Along with other countries with a large domestic research base, articles with international collaborators represent a low share of publications (ranked 46th). In Output, China is ranked second on total publications but 44th when population is allowed for. China is ranked eighth for the quality of its best three universities. When levels of GDP per capita are taken into account, China's overall rank improves to 19th and its score is above that expected at its income level.

### Croatia

Croatia ranks 43rd overall, which combines ranks of 41 for Resources, 47 for Environment, 40 for Connectivity and 37 for Output. As shares of GDP, public expenditure on higher education is ranked 23rd, total expenditure 44th and research expenditure 33rd. External joint publications are the highest ranked components in Connectivity: international co-authored papers are ranked at 30 and those co-authored with industry are ranked at 24. However, knowledge transfer with business is ranked at 50, suggesting that external links are with specialised groups. The Output category includes a rank of 26 for publications per head and their average impact is ranked 39th. Enrolment rates are around median levels. Croatia's overall rank improves to 35 when allowance is made for income differences across countries, but its overall score is less than expected at its level of income.

### Czech Republic

The Czech Republic ranks 29th overall, which combines ranks of 37 for Resources, 33 for Environment, 21 for Connectivity and 30 for Output. As a share of GDP, public expenditure on higher education has fallen substantially to be ranked 37th (26th in last year's rankings), total expenditure has fallen to 45th and research expenditure to 33rd. In Connectivity, the Czech Republic ranks eighth for international student share. Joint publications with international authors rank 27th. The Czech Republic is ranked 21st for joint publications with industry but business views on knowledge transfer give a lower rank of 40 a fall from last year's 28th. Publications per head of population are ranked 20th and their average impact 39th. The employment rate for those with a tertiary qualification compared with school leavers is ranked 12th. Graduates are ranked third for problem solving skills. When levels of GDP per capita are taken into account the Czech Republic is ranked 26th and its score is around that expected at its level of income.

### Denmark

Denmark is ranked third overall, which combines ranks of 4 for Resources, 24 for Environment, 6 for Connectivity and 4 for Output. Within the Resources category, it is ranked 5th for government expenditure as a share of GDP and 16th for total expenditure (public plus private) per student. Denmark is ranked first for spending on research and development by tertiary institutions (as a share of GDP) and second for the number of national researchers per head of population. In the Connectivity module, Denmark is ranked seventh by business for knowledge transfer, fourth for joint publications with industry, and seventh for joint publications with international authors. In Output it is ranked first for publications per head of population and third for their average impact. Denmark is ranked second for the overall quality of its universities. Denmark is ranked fourth in overall ranking when adjustment is made for different levels of GDP per capita. Its score is well above that expected at its level of income.

### **Finland**

Finland ranks eighth overall, which combines ranks of 9 for Resources, 5 for Environment, 7 for Connectivity and 9 for Output. It ranks fourth in government expenditure on higher education as a share of GDP and 16th on total expenditure (public plus private) per student. Allowing for population, Finland ranks sixth on publications which is the same as its rank on research expenditure. The average impact of papers is ranked ninth. It ranks sixth in the number of national researchers per head of population. Enrolment rates are ranked eighth which compares with a rank of 13 for the tertiary qualifications of the workforce. In Connectivity, Finland is ranked fourth for web impact and 6th by business for knowledge transfer. In joint publications it is ranked ninth for those with international authors and eighth for those with industry. Graduates are ranked in the top five for both literacy and numeracy, and the business score places them third. When levels of GDP per capita are taken into account Finland is ranked first and its score is well above what is expected given its level of income.

### **France**

France ranks 17th overall, which combines ranks of 16 in Resources, 22 in Environment, 17 in Connectivity, and 18 in Output. Within the Resources category it is ranked 13th for government expenditure as a share of GDP, 17th for total expenditure per student and 16th for research expenditure. In Connectivity, France ranks 12th for joint publications with industry, for joint publications with international authors, and for the share of international students but only 25th on Web connectivity. In the Output module, France is ranked sixth for the standing of its best three universities. The total number of publications by the country's universities is ranked 10th but this falls to 28th when adjusted for population. The average impact of publications is ranked 21st. France is ranked 17th for researchers per head. The enrolment rate is ranked 32nd and the tertiary education qualifications of the workforce 22nd. When levels of GDP per capita are taken into account, France's overall rank is 20th and its score is around the level expected at its level of income.

### **Germany**

Germany is ranked 16th overall, which combines ranks of 18 for Resources, 28 for Environment, 15 for Connectivity and 14 for Output. In the Resources category it ranks 35th on total expenditure (public plus private) as a share of GDP but 15th on expenditure per student. The difference is explained by the lower rank (25th) for the participation rate in higher education. In Connectivity, Germany performs well on links with industry: ranked tenth for joint publications and ninth for knowledge transfer. It ranks 23rd for the share of publications that have international co-authors. In Output, German universities are ranked fourth for total publications, 23rd for publications deflated by population and 16th for average impact even though research expenditure is ranked 11th. The share of research funded by business is high (ranked fourth) and as a consequence research output is much wider than publications. Germany ranks seventh for the standing of its best three universities. In the tertiary qualifications of the work force, Germany is ranked 26th. The Environment score is pulled down in part because the points awarded for national policy disadvantages federations. When levels of GDP per capita are taken into account Germany's overall ranking falls to 24th but its score is around the level expected given its level of income.

### **Greece**

Greece is ranked equal 37th overall, which combines ranks of 47 for Resources, 50 for Environment, 25 for Connectivity and 26 for Output. The Resources rank has fallen four places since last year's ranking. Greece ranks 39th for government expenditure on higher education as a share of GDP but 48th for expenditure per student. This difference is explained by the high recorded participation rate in tertiary education (ranked equal first). The low Environment rank occurs because of an excessively centralised system and a low grade from business. In Connectivity, Greece is ranked 16th for joint publications with industry but the tertiary system is rated lower by business for knowledge transfer (47th). The share of publications with an international co-author is ranked 21st. Other than for the

# Country Summaries

## (continued)

highly-ranked participation rate, the rankings for all the Output measures lie around median values: ranging from a rank of 22 for the average impact of research articles to 33rd for the quality of its best three universities. On a per head basis, the rank for publications (25th) roughly matches that for research expenditure (28th). When account is taken of levels of per capita GDP, Greece's overall ranking improves to 32nd but it is a little below that expected at its level of income.

### **Hong Kong SAR**

Hong Kong SAR is ranked 14th overall, which combines ranks of 13 for Resources, 4 for Environment, 19 for Connectivity and 15 for Output. The Environment score is high reflecting a system that gives significant autonomy to institutions while maintaining overall surveillance. Government expenditure on higher education as a share of GDP is ranked 20th; total expenditure per student is ranked fourth. It ranks first for contribution to national R&D effort. In Connectivity, the higher education sector is ranked 13th for business satisfaction with the extent of knowledge transfer but is ranked lower at 34th for articles written with industry. Web-based connectivity is ranked 12th. In the Output category, Hong Kong SAR is ranked 10th on publications per head and 4th on the average impact of articles. When account is taken of levels of GDP per capita Hong Kong's ranking falls to 25th but its score is around the level expected at its relatively high income level.

### **Hungary**

Hungary is ranked 33rd overall, which combines ranks of 44 for Resources, 46 for Environment, 18 for Connectivity and 32 for Output. Government expenditure on higher education as a share of GDP ranks 40th and total expenditure per student ranks 27th. Research expenditure as a share of GDP is ranked 36th. The Connectivity ranking includes fifth in joint publications with industry but business ranks knowledge transfer lower at 32nd. Joint publications with international authors rank 19th. Within the Output category, Hungary is ranked third for the tertiary qualifications of the workforce compared with school leavers. It is ranked 31st on publications per head and 24th for

their impact. When account is taken of relative levels of GDP per capita, Hungary's ranking is 30th and its score is a little below that expected at its income level.

### **India**

India is ranked 49th overall, which combines ranks of 35 for Resources, 37 for Environment, 49 for Connectivity and 48 for Output. It is ranked 17th for government expenditure on higher education as a share of GDP. In common with other large countries with a sizeable domestic research base, India ranks well down for joint publications with international authors (49th). Joint publications with industry are ranked 47th, but India is scored higher by business on knowledge transfer (ranked 33rd). India rates lowly for web connectivity. Within the Output category, India ranks 9th on total publications but 50th on publications per head, similar to the research expenditure rank of 47. The average impact of articles is ranked 44th. When account is taken of relative levels of GDP per capita, India's overall ranking rises to 17th owing mainly to a large increase in the ranking for Resources (now 11th). India's GDP-adjusted overall score is around the level expected at its income level.

### **Indonesia**

Indonesia is ranked 50th overall, which combines ranks of 50 for Resources, 30 for Environment, 44 for Connectivity and 50 for Output. It is ranked 49th for government expenditure on higher education as a share of GDP. In Connectivity, Indonesia ranks 39th for the share of publications with a co-author from industry and 20th for knowledge transfer with business. Total publications rank 30th and the share which is joint with international authors is ranked 50th. In all other Output measures other than graduate unemployment, Indonesia is ranked in the lowest decile. It loses points for not having a university in the Shanghai top 1000. When allowance is made for levels of per capita GDP, Indonesia's overall ranking remains at 50 and the score is well below that expected at its income level.

### **Iran**

Iran is ranked 47th overall, which combines ranks of 33 for Resources, 41 for Environment, 50 for Connectivity and 41 for Output. An increase in government funding has led to an improvement of six places in the Resources rank from last year. Government expenditure on higher education as a share of GDP is now ranked 19th. Connectivity remains very low. Iran ranks 50th for joint publications with industry and 47th for joint publications with international authors. Web-based impact is ranked 45th. Iran is ranked 16th for total publications, but when population is allowed for, the rank falls to 39th. The average impact of articles is ranked 40th. Iran ranks 27th for enrolment rates and 40th for the (tertiary) educational qualifications of its workforce. When account is taken of levels of GDP per capita, the rank for Output improves to 29th; the overall rank improves a little to 38th but it is below that expected at Iran's level of income.

### **Ireland**

Ireland is ranked 19th overall, which combines ranks of 39 for Resources, 15 for Environment, 11 for Connectivity and 20 for Output. Government expenditure as a share of GDP is ranked 46th and research expenditure at 32nd. Expenditure per student is ranked 22nd. In Connectivity, the business rating of knowledge transfer is ranked highly at sixth; joint publications with industry (up nine places) and with international authors are each ranked 14th. Web connectivity is ranked sixth. Under Output, Ireland is ranked ninth on publications per head of population and 14th on their average impact. It ranks 10th for the tertiary educational levels of its workforce. Official revisions to the data on the number of researchers and a reduction in unemployment for school leavers are responsible for a fall of five places in the Output rank. When account is taken of relative levels of GDP per capita the overall ranking is 40th, but because of the importance of foreign firms in Ireland the rank would be much improved if Gross National Income was used as a measure of income levels.

### **Israel**

Israel is ranked 18th overall, which combines ranks of 23 for Resources, 20 for Environment, 20 for Connectivity and 13 for Output. Israel ranks 33rd for government expenditure on higher education as a share of GDP, which improves to 24th when private expenditure is added. Expenditure per student is ranked 29th. Expenditure by tertiary institutions on R&D as a percentage of GDP is ranked 14th. Israel is ranked first for the number of researchers in the country per head of population and fourth for the tertiary qualifications of the workforce. It is ranked 12th for the depth of quality universities. Research output per head of population is ranked 17th and the average impact of articles is ranked 18th. Israel is ranked fifth for knowledge transfer with business and 25th for joint articles with industry. It is ranked 24th for international co-authorship of publications. Web impact is ranked 19th. When account is taken of relative levels of GDP per capita, the overall ranking improves to 12th and the score is above that expected at Israel's income level.

### **Italy**

Italy is ranked 30th overall, which combines ranks of 42 for Resources, 38 for Environment, 27 for Connectivity and 25 for Output. Government expenditure on higher education as a share of GDP is ranked 46th; total expenditure per student (including research and private expenditure) is ranked 25th. Research expenditure by tertiary institutions as a share of GDP is ranked 26th. In Connectivity, joint publications of academics with industry are ranked 22nd and joint publications with international authors 25th. Knowledge transfer with firms is ranked 30th. In the Output category, Italian tertiary institutions publish the eighth largest number of journal articles but this falls to 22nd when deflated by population size. The average impact of articles is ranked 16th. The three best performing universities are ranked 20th. Italy ranks 42nd on the education qualifications of its workforce and 33rd on number of researchers per head of population. When account is taken of relative levels of GDP per capita, Italy's ranking falls to 34th and its score is below expected at its income level.

# Country Summaries

## (continued)

### Japan

Japan is ranked 20th overall, which combines ranks of 24 for Resources, 16 for Environment, 28 for Connectivity and 22 for Output. Japan is ranked last for government expenditure as a share of GDP but total expenditure (of which two-thirds is private) is ranked 28th. Because the participation rate is below median levels, expenditure per student is ranked 11th. Connectivity is predominantly internal: Japan ranks 7th for the percentage of articles written jointly with industry collaborators but 42nd for articles written with foreign co-authors. The business ranking for knowledge transfer is 36th, a fall of 14 places from last year's ranking. In Output, Japan ranks 5th on total articles published but 33rd when population size is allowed for, lower than the rank for research expenditure of 20. The average impact of articles is ranked 41st. Japan ranks fourth on the quality of its best three universities. It ranks third on the educational qualifications of its workforce and ninth for the number of researchers in the country. Graduates are ranked fourth for both literacy and problem-solving ability. When account is taken of relative levels of GDP per capita, Japan's rank falls to 36th and is below the level expected at its income level.

### Korea

Korea is ranked 24th overall, which combines ranks of 25 for Resources, 44 for Environment, 33 for Connectivity and 19 for Output. Government expenditure on higher education as a share of GDP is ranked 42nd but total expenditure is ranked 13th -- total expenditure per student ranks much lower at 34th because Korea has the fourth highest participation rate. The rank for Environment is pulled down by the relatively low proportion of students and staff who are female. Korean links with industry are ranked 17th for joint publications and 28th for knowledge transfer. Joint publications with international authors are ranked 43rd. In the Output category, Korea ranks 12th on total publications but 24th when adjusted for population size, a similar rank as for research expenditure. The average impact of publications ranks 33rd. Korea ranks sixth on the education qualifications of its workforce and fourth on total researchers in the nation (adjusted for population). It is ranked fifth for the importance of business

funding of research. When account is taken of relative levels of GDP per capita, Korea's overall rank falls to 37 and is below that expected at its income level.

### Malaysia

Malaysia is ranked 27th overall, which combines ranks of 15 for Resources, 9 for Environment, 31 for Connectivity and 45 for Output. As a share of GDP, government expenditure on higher education is ranked 15th but adding in private expenditure, total expenditure is ranked fifth. Expenditure on R&D in tertiary institutions as a share of GDP is ranked 15th, an improvement of seven places from last year's ranking. In Connectivity, Malaysia is ranked 18th for knowledge transfer with business, but 49th for joint publications with industry. Joint publications with international authors are ranked 29th, an improvement of three places. Malaysian institutions are ranked 25th for total publications, 36th for publications per head of population and 34th for the average impact of articles. The country is ranked 38th for the educational attainment of the workforce and 32nd for the number of researchers in the nation (adjusted for population). When account is taken of relative levels of GDP per capita, Malaysia's overall ranking is 31st and the estimated overall score is a little below that expected at its income level.

### Mexico

Mexico is ranked 48th overall, which combines ranks of 38 for Resources, 25 for Environment, 45 for Connectivity and 49 for Output. As a share of GDP, government expenditure is ranked 26th and total expenditure 30th, but research expenditure is ranked lower at 41st. Expenditure per student is ranked 40th. In Connectivity, Mexico ranks 45th for joint publications with industry and 41st for knowledge transfer. Joint publications with international authors are ranked 35th. Web connectivity is well below average. In Output, Mexico is ranked 33rd for total publications but 48th when adjusted for population. Tertiary enrolment rates are ranked 47th. When account is taken of levels of GDP per capita Mexico's overall rank is 49 and the overall score is well below that expected at Mexico's level of income.

### **Netherlands**

The Netherlands is ranked tenth overall, which combines ranks of 11 for Resources, 8 for Environment, 5 for Connectivity and 8 for Output. It is ranked 12th for total expenditure on higher education (which is 70 per cent government funded) as a share of GDP. Expenditure per student is ranked tenth as is R&D expenditure as a share of GDP. The Netherlands ranks highly for Connectivity with business: third for publications and second for knowledge transfer. The share of joint publications that have international co-authors is ranked eighth and web connectivity is above average. In Output, the Netherlands ranks seventh for publications adjusted for population and their average impact is ranked second. The participation rate is ranked 12th, an improvement of seven places from last year's ranking, and the education qualifications of the workforce is ranked 19th. The standing of its universities is high: ranked 8th for depth and 12th for its best three universities. Graduates are ranked in the top five by business and for all three generic competencies: literacy, numeracy and problem solving. The Netherlands ranks 13th for the national stock of researchers per head. When account is taken of levels of GDP per capita the overall rank is 10 and the scores for each of the four broad categories and overall are above those expected at the Netherlands' income level.

### **New Zealand**

New Zealand is ranked 14th overall, which combines ranks of 21 for Resources, 3 for Environment, 10 for Connectivity and 21 for Output. For expenditure as a share of GDP, New Zealand is ranked 28th for government expenditure, 12th for total expenditure and 23rd for R&D expenditure (a fall in rank from last year). In Connectivity, New Zealand's highest score is for the percentage of students who are international, where it is ranked third. It is ranked 13th for publications with international researchers and 26th for publications with industry. The rank for business views on knowledge transfer has improved to 19th. Web connectivity is ranked tenth. New Zealand is ranked 13th for publications per capita, and 15th on their average impact. New Zealand's tertiary enrolment rate is ranked 16th and the tertiary

educational qualifications of its workforce 18th. Graduates are ranked second for problem-solving abilities. When account is taken of relative levels of GDP per capita, New Zealand's rank improves to eighth and its score is well above the level expected at its income level.

### **Norway**

Norway is ranked 11th overall, which combines ranks of 1 for Resources, 19 for Environment, 16 for Connectivity and 10 for Output. The Resources rank has improved five places over last year. In expenditure as a share of GDP, Norway is ranked second for public expenditure (95 per cent of total expenditure), sixth for total expenditure and fourth for R&D expenditure. Expenditure per student is ranked eighth. In Connectivity, co-authorship with international collaborators is ranked 11th and with industry 15th. Web connectivity is ranked eighth. Norway ranks fifth for research publications per head and eighth for their average impact. It is ranked 17th for participation rates in higher education, 15th for the tertiary educational qualifications of the workforce and 7th for the number of national researchers per head. Norway's overall rank falls to 22nd when account is taken of levels of GDP per head and the overall score is around that expected at its high-income level.

### **Poland**

Poland is ranked 32nd overall, which combines ranks of 31 for Resources, 17 for Environment, 37 for Connectivity and 31 for Output. In expenditure as a share of GDP, Poland is ranked 25th for public expenditure (a fall of eight places from last year), 36th for total expenditure and 28th for research expenditure. Connectivity with industry is below average: Poland ranks 36th for joint articles and 31st for knowledge transfer with business. In joint articles with international collaborators Poland is ranked 40th. Web connectivity is around median levels. In Output, Poland is ranked 18th on published articles but this falls to 30th when adjusted for population. The average impact of articles is ranked 32nd. Participation rates are ranked 28th and the tertiary educational qualifications of the workforce 27th. Poland performs well (fourth) on the employment rates of those with

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a tertiary qualification compared with school leavers. Poland's rank improves to 29th when account is taken of levels of GDP per capita but is a little below that expected at its income level.

### **Portugal**

Portugal is ranked 25th overall, which combines ranks of 26 for Resources, 34 for Environment, 22 for Connectivity and 28 for Output. The Resources rank has fallen four places from last year. For expenditure as a share of GDP, Portugal is ranked 32nd for public expenditure and 38th for total expenditure. The higher education share of national R&D expenditure is ranked second highest. Under the heading of Connectivity, Portugal is ranked 17th for joint publications with international researchers and 39th for publications with industry. Knowledge transfer with business is ranked 26th. In Output, publications per head are ranked 18th, matching the rank for research expenditure per capita. Portugal ranks 32nd in the tertiary educational qualifications of its workforce. After allowing for population, Portugal ranks 19th for the number of researchers in the country. When account is taken of relative levels of GDP per capita, Portugal's ranking improves to 14th and its score is above that expected at its level of income.

### **Romania**

Romania is ranked 44th overall, which combines ranks of 46 for Resources, 31 for Environment, 41 for Connectivity and 46 for Output. Total expenditure as a share of GDP is ranked 37th; research expenditure is ranked 43rd. The Environment measure benefits from institutions having a relatively high percentage of female staff. In the Connectivity measures, joint publications with international authors are ranked 44th and those with co-authors from industry are ranked 37th. Transfer of knowledge with business is ranked 39th. Romania is ranked 35th on research articles per head and 42nd on their average impact. When account is taken of relative levels of GDP per capita Romania's overall rank is 46th and its score is well below that expected at its level of income.

### **Russia**

Russia is ranked 35th overall, which combines ranks of 45 for Resources, 29 for Environment, 46 for Connectivity and 29 for Output. The Output rank has deteriorated by three from last year's ranking. In expenditure as a share of GDP, Russia is ranked 36th for public expenditure, 39th for total expenditure and 42nd for research expenditure. In the Connectivity module, Russia universities are relatively weak on interactions with industry: ranked 44th for joint publications with industry and 46th for knowledge transfer with firms. Russia ranks 45th for joint publications with international researchers. In Output, total research publications rank 15th, publications per head 42nd and their average impact 43rd. Its best three universities are ranked 24th. Russia is ranked second for the educational qualifications of its workforce and sixth for the employment rates of those with a tertiary qualification compared with school leavers. When account is taken of relative levels of GDP per capita the rank is 44 and the GDP adjusted score for Russia is well below that expected at its income level.

### **Saudi Arabia**

Saudi Arabia is ranked 22nd overall, which combines ranks of 8 for Resources, 45 for Environment, 26 for Connectivity and 33 for Output. It is ranked first for government expenditure on higher education as a share of GDP. In the Connectivity module (where the rank has improved three places from last year) Saudi Arabia is ranked first for the share of publications that have an international co-author, but it is ranked only 40th for joint publications with industry. The business evaluation of knowledge transfer is ranked at 22. Web connectivity is in the lowest decile. The highest score in the Output module is for the quality of its best three universities which are ranked 19th. Saudi Arabia is ranked 38th for publications per head and 20th for their average impact. Unemployment amongst graduates is higher than for school leavers. Saudi Arabia's high level of GDP per capita inevitably means that its ranking falls (to 48th) when income levels are allowed for. The GDP adjusted score for Saudi Arabia is well below that expected at its income level.

### **Serbia**

Serbia is ranked 42nd overall, which combines ranks of 30 for Resources, 49 for Environment, 39 for Connectivity and 44 for Output. Government expenditure on higher education as a share of GDP is ranked 16th and expenditure by institutions on R&D is ranked 25th. The share of national R&D expenditure undertaken by the higher education sector is ranked fifth highest. Serbia ranks 43rd on joint publications with industry and 26th on joint publications with international authors. In the Output module, Serbia ranks 32nd in publications per head and 37th in their average impact. It is ranked 39th for the tertiary education qualifications of the work force and 31st for the tertiary enrolment rate. In per capita terms, Serbia ranks 35th for the national stock of researchers. When account is taken of relative levels of GDP per capita Serbia's rank jumps to 11th place and the score is well above that expected for its level of income.

### **Singapore**

Singapore is ranked fourth overall, which combines ranks of 2 for Resources, 7 for Environment, 3 for Connectivity and 11 for Output. The ranks for all modules except Environment have improved from last year and the overall rank is up three places. Singapore ranks 21st for government expenditure on tertiary education as a share of GDP but first for total expenditure (public plus private) per student. The Singapore higher education sector ranks first for R&D expenditure per head of population and this is reflected in the ranking of eighth for publications per head and fifth for their average impact. In the Connectivity category, it ranks first for the relative importance of international students and fourth for joint publications with international authors. In engagement with the private sector, Singapore ranks fourth for knowledge transfer with firms but 31st for joint scientific publications with industry. Its graduates score the second highest rating by business. The (tertiary) educational qualifications of the workforce and the number of national researchers per head are both ranked fifth. When allowance is made for national levels of GDP per head Singapore's ranking falls to 23rd, but the score is around what is expected at its high-income level.

### **Slovakia**

Slovakia is ranked 38th overall, which combines ranks of 43 for Resources, 40 for Environment, 30 for Connectivity and 38 for Output. The OECD expenditure data has now returned to the levels of the 2018 ranking with a consequent deterioration in the rank for Resources and the overall rank compared with the 2019 rankings. As a share of GDP, total expenditure is ranked 32nd, government expenditure 16th and research expenditure 25th. Slovakia is ranked 29th for publications per head and 28th for their average impact. Within the Connectivity module, Slovakia is ranked 13th for joint publications with international researchers, 31st for joint scientific publications with industry and 49th for knowledge transfer with firms. On a per capita basis, the national stock of researchers ranks 30th. Slovakia ranks seventh for the employment rate of those with a tertiary qualification compared with school leavers. When account is taken of relative levels of GDP per capita, Slovakia is ranked 45th and its score is well below that expected at its income level.

### **Slovenia**

Slovenia is ranked 28th overall, which combines ranks of 34 for Resources, 35 for Environment, 23 for Connectivity and 27 for Output. It is ranked around the median level for many of the indicators. Government expenditure on higher education as a share of GDP is ranked 27th but because private expenditure is low (15 per cent) total expenditure is ranked 42nd. On a per capita basis, publications rank 16th, a creditable performance given that R&D expenditure by tertiary institutions ranks only 35th. In the Connectivity module, joint scientific papers with industry are ranked 23rd and business ranks knowledge transfer at 27th. The share of publications that are joint with international authors is ranked 18th. The participation rate in higher education is ranked 21st and the tertiary qualification rate of the labour force is ranked 25th. On a per capita basis Slovenia is ranked 16th for the number of researchers in the nation. When allowance is made for levels of GDP per capita, Slovenia is ranked 27th and the score is around that expected at its income level.

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### South Africa

South Africa is ranked 34th overall, which combines ranks of 32 for resources, 23 for Environment, 34 for Connectivity and 35 for Output. Government expenditure on higher education as a share of GDP is ranked 35th and research expenditure 31st. In Connectivity, South Africa is 22nd for the percentage of joint publications with international researchers; 33rd for joint publications with industry, and 37th for knowledge transfer with firms. But web-based connectivity is very low. In Output, the tertiary education sector is ranked 24th for total publications, 41st for publications per head and 23rd for their average impact. Both enrolment rates and the educational qualifications of the workforce are in the bottom decile. It ranks first for the employment of those with a tertiary qualification compare with school leavers. When allowance is made for differences in GDP per head, South Africa is ranked second, and the score is well above that expected at its level of income.

### Spain

Spain is ranked 23rd overall, which combines ranks of 28 for Resources, 32 for Environment, 29 for Connectivity and 23 for Output. As a share of GDP, Spain is ranked 31st for government expenditure on higher education (about two-thirds of total expenditure), 34th for total expenditure and 27th for research expenditure. In engagement with the private sector, Spain ranks 27th for joint scientific publications with industry and 35th for knowledge transfer. Joint publications with international collaborators are ranked 28th. Spain's tertiary institutions are ranked 21st for web connectivity. In Output, Spain is ranked 11th for total publications and 21st on a per capita basis. The average impact of published articles is ranked 27th. In the educational qualifications of the workforce Spain is ranked 21st but it is ranked sixth on enrolments. On a per capita basis, the national stock of researchers is ranked 28th. When allowance is made for differences in GDP per head, Spain's rank is 28 and its score is around that expected at its level of income.

### Sweden

Sweden is ranked fifth overall, which combines ranks of 5 for Resources, 14 for Environment, 8 for Connectivity and 6 for Output. The rank for Resources has fallen three places from last year. As a share of GDP, Sweden is ranked 7th for government expenditure (about 90 per cent of total expenditure), 18th for total expenditure and 3rd for research expenditure. Expenditure per student is ranked fifth. Sweden's lowest rank is for the policy Environment, which owes to its score for institutional autonomy being only around median values. Sweden performs well in engagement with industry: it ranks 2nd for joint publications and 12th for knowledge transfer. It ranks sixth for joint publications with international researchers. It is in the top ten for web connectivity. In Output, Sweden is ranked fourth for publications per head and seventh for their average impact. Sweden's university sector is ranked third for its average quality. Graduates score the highest rating of attributes by business and are in the top five for all three generic skill levels: literacy, numeracy and problem solving. The country is ranked 16th for the tertiary educational qualifications of its workforce. On a per capita basis, Sweden ranks third for the number of researchers in the nation. When allowance is made for levels of GDP per capita, Sweden is ranked sixth overall and its score is well above that expected at its level of income.

### Switzerland

Switzerland maintains its second rank overall, which combines ranks of 3 for Resources, 12 for Environment, 1 for Connectivity and 5 for Output. Government expenditure on higher education as a share of GDP ranks ninth and expenditure per student third. Switzerland dominates the Connectivity category. It is rated first for knowledge transfer with firms, ninth for joint publications with industry, and second for joint publications with international researchers. It is fifth for the proportion of students who are international. Web-based impact is ranked second. On a per capita basis, Switzerland is ranked second for publications which reflects its number two rank for R&D expenditure. It is ranked first for both the average impact of publications and for the average quality of its universities. Switzerland ranks 14th for the

tertiary educational qualifications of its workforce and 10th for the number of researchers in the nation per head of population. Its graduates score the highest rating by business. When levels of GDP per capita are taken into account, Switzerland is ranked ninth and its score is well above that expected at its level of income.

#### **Taiwan–China**

Taiwan–China is ranked 21st overall, which combines ranks of 29 for Resources, 11 for Environment, 24 for Connectivity and 24 for Output. Expenditure on higher education as a share of GDP is ranked 26th, of which a little over one-half is private. In Connectivity, knowledge transfer with firms is ranked 17th but joint scientific publications with industry are ranked lower at 32nd. Joint publications with international researchers are ranked 37th. Taiwan–China ranks 15th for Web connectivity. In Output, it is ranked 21st for total publications and 35th for their average impact. It is ranked seventh for the tertiary educational qualifications of its workforce and 14th for the enrolment rate in higher education. Taiwan–China is well provided with researchers per head of population, where it is ranked eighth. When levels of GDP per capita are taken into account, Taiwan–China slips to 41st in the ranking and is below the level expected at its income level.

#### **Thailand**

Thailand is ranked 46th overall, which combines ranks of 49 for Resources, 27 for Environment, 36 for Connectivity and 47 for Output. Government expenditure on higher education as a share of GDP is ranked 45th and expenditure on R&D is ranked 39th. In Connectivity, knowledge transfer with industry is ranked 25th and joint publications with industry 35th. Joint articles with international researchers are ranked 31st. Publications per head are ranked 46th and their average impact 38th. It is ranked 46th for the tertiary educational qualifications of its workforce. When levels of GDP per capita are taken into account, Thailand ranks 43rd and the adjusted score is well below that expected at its level of income.

#### **Turkey**

Turkey is ranked 39th overall (a rise of three places from last year), which combines ranks of 17 for Resources, 48 for Environment, 48 for Connectivity and 39 for Output. Increased expenditure in higher education has seen the Resources rank improve five places from last year. Calculated as shares of GDP, both government and total expenditure on higher education rank eighth and research expenditure 29th. Connectivity is weak for the included indicators: knowledge transfer as viewed by business is ranked 34th; joint articles with international authors and with industry are each ranked 48th. In Output, Turkish institutions of higher education rank 17th for total publications but 40th for publications per head. Citations per article are ranked 48th. Participation rates are ranked third but it will take time for this to flow through fully to the educational qualifications of the workforce (currently ranked 41st). On a per capita basis, the number of researchers is ranked 37th. When levels of GDP per capita are taken into account, Turkey's rank is 47th and its score is well below that expected at its level of income.

#### **Ukraine**

Ukraine is ranked equal 36th, which combines ranks of 27 for Resources, 39 for Environment, 38 for Connectivity and 42 for Output. Ukraine is ranked sixth for government expenditure on higher education as a share of GDP. However, because of the relatively high participation rate (ranked 15th) total expenditure per student is in the lower decile. R&D expenditure by tertiary institutions as a share of GDP has a low ranking of 46. In Connectivity, Ukraine ranks 18th for joint scientific publications with industry but only 46th for knowledge transfer. It ranks 35th for joint publications with international authors and 45th for knowledge transfer with business. In Output, Ukraine loses points for not having a flagship university in the Shanghai top 1000. Ukraine ranks 45th for total publications, 47th for publications per head of population, and 50th for their average impact. The level of (tertiary) educational qualifications of its workforce is ranked eighth. Unemployment of graduates is very low when

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compared with the rate for school leavers. Using per capita figures, the number of national researchers is ranked 41st. When levels of GDP per capita are taken into account, Ukraine's overall ranking improves to 14th and its score is above that expected at its income level.

### **United Kingdom**

The United Kingdom is ranked sixth overall, which combines ranks of 19 for Resources, 6 for Environment, 4 for Connectivity and 2 for Output. The rank for Resources has fallen six places from last year's ranking and consequently the overall rank has fallen three places. As a share of GDP, government expenditure ranks 48th. Expenditure per student is ranked sixth, which reflects the lower than average participation rate (ranked 38th). Connectivity with industry is relatively strong: the United Kingdom ranks 15th for knowledge transfer with business (a fall from last year's second) and 11th for joint scientific publications. In the share of publications with an international author, the United Kingdom ranks 16th. It ranks fourth for the percentage of students who are international and fifth for the number of times external users access websites. In the Output category, the United Kingdom ranks third for total publications and tenth for their average impact. On a per capita basis, research publications rank 11th compared with a rank of 19 for research expenditure – implying an above-average level of efficiency. The United Kingdom ranks second for the quality of its best three universities. It is ranked tenth for the (tertiary) educational qualifications of the workforce. In per capita terms, the United Kingdom ranks 18th for the national stock of researchers. When levels of GDP per capita are taken into account, the United Kingdom is ranked third and its score is well above the level expected at its income level.

### **United States**

The United States is ranked first overall, which combines ranks of 10 for Resources, 1 for Environment, 13 for Connectivity and 1 for Output. Expenditure on higher education as a share of GDP is ranked second (public expenditure has fallen to one-third of the total) as is expenditure per student. Links with the private sector are strong: knowledge transfer is rated third and joint scientific publications 20th. However, as is expected for other large countries, the percentage of publications that are joint with international authors ranks much lower at 38. Although the United States has the largest absolute number of international students, as a share of its total students it ranks only 23rd. It ranks first for the number of times external users access websites of tertiary institutions even when adjusted for population. In Output, the United States is first for total publications but on a per capita basis it ranks 19th for publications, a lower rank than that for research expenditure of 14. The United States ranks ninth for both participation rates and the (tertiary) educational credentials of its workforce. It is ranked first for the quality of its best three universities. On a per capita basis it is ranked 18th for the national stock of researchers. When levels of GDP per capita are taken into account, the overall rank for the United States falls to 18th but its score is above the level expected at its income level.





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