U21 Ranking of National Higher Education Systems 2016

MELBOURNE INSTITUTE
of Applied Economic and Social Research

UNIVERSITAS 21
The leading global network of research universities for the 21st century

U21 Ranking of National Higher Education Systems

A project sponsored by *Universitas 21*

Ross Williams, University of Melbourne
Anne Leahy, University of Melbourne
Gaétan de Rassenfosse, EPFL, Switzerland
Paul Jensen, University of Melbourne

May 2016

The project is based at the
Melbourne Institute of Applied Economic and Social Research
University of Melbourne

Acknowledgements

The Steering Group for the project is:

Associate Professor Ying Cheng, Graduate School of Education, Shanghai Jiao Tong University
Professor Sir David Greenaway, Vice-Chancellor, University of Nottingham
Professor Don Fisher, Department of Educational Studies, University of British Columbia
Professor Simon Marginson, Institute of Education, University College London
Professor Ross Williams, Melbourne Institute, University of Melbourne

Simon Marginson played an important role in developing the structure of the early rankings.

The *Universitas 21* (U21) Secretariat has again provided invaluable assistance We especially thank Jane Usherwood, U21 Secretary General, and Ben Griffiths, U21 Administration Manager.

We are most grateful to Robert Tijssen and Alfredo Yegros-Yegros of CWTS, Leiden University, for providing us with data measuring joint publications of universities with industry. We thank Isidro Aguillo for providing the data from Webometrics and Félix de Maya Anegón for meeting our specific requests for SCImago data.

U21 Ranking of National Higher Education Systems 2016

Contents

Page 6	Executive Summary
Page 8	Overall Table of Rankings
Page 10	1. Introduction
Page 11	2. Changes from methodology and data from the 2015 Rankings
Page 12	3. Measures and Results
Page 22	4. Methodology of adjusting for levels of economic development
Page 23	5. Results after adjusting for levels of economic development
Page 29	6. Productivity and drivers of research
Page 32	7. Concluding remarks
Page 33	Appendix and References

Executive Summary

This report presents results for the 2016 Universitas 21 annual ranking of national systems of higher education and explains the methodology used to obtain the results. Our national ranking complements the plethora of rankings of institutions. The rationale for national rankings is that it is the higher education system as a whole, not only of research intensive universities, that matters for the economic and cultural development of a nation. Different institutions will contribute in different ways to achieving overall national objectives.

Fifty national systems of higher education, from all continents, are evaluated on the basis of 25 attributes. Variables are standardised for population size. Countries are ranked overall and in each of four areas: Resources, Environment, Connectivity and Output. Resources, whether public or private, are a necessary condition of 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. A consensus is emerging that the preferred environment is one where institutions are allowed considerable autonomy tempered by external monitoring and competition. The Environment module measures the extent to which national systems meet these criteria.

The Output measures 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 business and the rest of the community. International links are also important for the transmission of knowledge. Six such linkage measures are included in our Connectivity module.

The highest ranked countries for Resources are Denmark, Singapore, the United States, Canada and Sweden. The Environment for higher education is ranked best in the United States, Hong Kong SAR, Finland, New Zealand and the Netherlands. Switzerland is a clear leader in Connectivity followed by Denmark, Austria and the United Kingdom. For the Output module, the United States is ranked first, followed by the United Kingdom; then follow a group of five countries: Australia, Canada, Denmark, Sweden and Switzerland. The results for each module are combined into an overall ranking using weights of 40 per cent for Resources and 20 per cent for each of the other three modules. The top five countries in the overall ranking are, in order, the United States, Switzerland, Denmark, the United Kingdom and Sweden. The largest improvement over the 2015 rankings is shown by China.

An important aim of our work is to permit countries to benchmark performance against other countries at similar stages of development. In order to facilitate these comparisons, we present estimates of a country's performance relative to its level of GDP per capita. These adjusted estimates, based on deviations after regressing each series on GDP per capita, complement our main measures of performance.

By examining the relationship between inputs (Resources and Environment) and outcomes (Output and Connectivity) our data provide measures of productivity and insights into ways of improving outcomes. We find that our input modules explain around two-thirds of the variation in outcomes. Similar strong causality is found when looking at the effect of research funding and the policy environment on research outcomes.

U21 Ranking 2016

Rank	2015	Country	Score	2015
1	1	United States of America	100.0	100.0
2	2	Switzerland	87.2	87.1
3	3	Denmark	84.8	85.3
4	8	United Kingdom	84.3	80.6
5	5	Sweden	82.2	84.7
6	4	Finland	82.0	85.2
7	7	Netherlands	81.6	81.6
8	9	Singapore	80.6	80.3
9	6	Canada	79.6	82.8
10	10	Australia	77.6	77.1
11	11	Belgium	75.7	76.0
12	12	Norway	75.3	75.3
13	13	Austria	74.7	74.6
14	16	New Zealand	70.9	69.6
14	15	Hong Kong SAR	70.9	70.3
16	14	Germany	70.3	72.1
17	17	France	68.3	69.3
18	19	Israel	67.6	66.4
19	18	Ireland	65.2	68.8
20	20	Japan	64.2	65.6
21	21	Taiwan-China	62.4	63.6
22	23	Czech Republic	60.0	59.9
23	22	Korea	59.7	60.5
24	24	Spain	58.3	59.3
25	25	Portugal	56.6	58.4

The measures are grouped under four main headings:
Resources, Environment, Connectivity and Output.

National Higher Education Systems

Rank	2015	Country	Score	2015
26	26	Slovenia	56.0	57.0
27	28	Malaysia	54.4	55.4
28	30	Saudi Arabia	53.8	54.7
28	27	Italy	53.8	54.3
30	34	China	51.8	48.5
31	30	Hungary	51.6	53.4
32	32	Poland	50.8	50.7
33	31	Chile	49.7	50.9
34	33	Russian Federation	49.1	50.4
35	36	Slovakia	47.8	47.4
36	35	Greece	47.0	48.0
37	39	South Africa	45.6	45.0
38	40	Brazil	45.1	44.6
39	37	Serbia	43.9	45.9
40	38	Argentina	43.7	45.1
41	42	Romania	42.4	43.6
42	41	Ukraine	42.1	43.8
43	44	Mexico	41.3	41.7
44	46	Thailand	40.7	40.0
44	49	Turkey	40.7	38.1
46	45	Croatia	40.5	41.6
47	47	Iran	39.7	39.3
48	43	Bulgaria	39.2	42.1
49	50	India	38.0	37.8
50	48	Indonesia	36.9	38.8

1. Introduction

This report presents results for the fifth annual ranking of national systems of higher education undertaken under the auspices of the Universitas 21 (U21) group of universities. Our national rankings complement the plethora of rankings of institutions. The rationale for national rankings is that it is the higher education system as a whole, not only of research intensive universities, that matters for the economic and cultural development of a nation. Different institutions will contribute in different ways to achieving national objectives; they should not all be judged by the same criteria.

Some 50 countries are ranked overall and in each of four areas: Resources, Environment, Connectivity and Output. The Resources and Environment modules contain input measures. Outcomes are measured in the Output and Connectivity modules. By examining the relationship between inputs and outcomes our work provides measures of productivity and insights into ways of improving outcomes.

Resources, whether public or private, are a necessary condition of 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. A consensus is emerging that the preferred environment is one where institutions are allowed considerable autonomy tempered by external monitoring and competition. The Environment module contains measures of these characteristics that might be called 'state variables'.

Turning to outcomes, our output measures 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 business and the rest of the community. In the European literature this is frequently referred to as 'the third mission' -- in addition to teaching and research. Elsewhere (de Rassenfosse and Williams, 2015) we have argued that connectivity is a wider concept that covers not only engagement with industry but activities such as the movement of students across international borders and international research links. The Connectivity module includes variables which span this wider concept.

An important aim of our work is to permit countries to benchmark performance against other countries at similar stages of development. In order to facilitate these comparisons, we present estimates of a country's performance relative to its level of GDP per capita. These adjusted estimates complement our main measures of performance.

Our methodology is set out in detail in Williams, de Rassenfosse, Jensen and Marginson (2013) and in the reports published on the U21 website (www.universitas21.com). There are 25 variables in total. A description of each variable is given in the relevant section below and sources are given in Appendix 1. 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.

2. Changes in methodology and data from the 2015 Rankings

Most data are now published under the new ISCED 2011 education classification. This contains three levels for schooling, one level for post-secondary non-tertiary, and four levels for tertiary education: short-cycle tertiary (level 5), Bachelor's (level 6), Master's (level 7) and Ph.D. (level 8). In our ranking, the only variable altered by this change is the measure of diversity of institutions, which is now based on the number of students in all tertiary institutions, not just universities. The new definition of diversity is given in section 3.2.

In the Resources module, the OECD data for public expenditure on institutions of higher education in the United Kingdom has been revised upwards to cover previous omissions of funding through the HEFCE. Following this correction, OECD estimates of total expenditure on tertiary education in the United Kingdom have gone from 1.2 per cent of GDP in last year's rankings to 1.8 per cent in this year's rankings. Data for Australia now include capital expenditure.

We have made attempts to improve estimates of expenditure financed from private sources where no official figures exist. The difficulty in obtaining such estimates is that private expenditure in many countries is related only loosely to the mix of public and private universities. Nevertheless, approximate values have been obtained based on the percentage of enrolments that are private, the percentage of enrolments in the lower cost short courses (ISCED 5), and country information on tuition fees paid in both public and private institutions. Estimates constructed in this manner give a more accurate ranking than our previous method of using first quartile or median values obtained from countries where data exist.

In the Connectivity module, the source of the Webometrics data for full text files on the web is Google whereas in the previous year it was based on Google Scholar. To smooth the change we average over the two years (after scaling each series with maximum values equal 100).

There has been no change in the weights we use. It follows that apart from the effect of better data (which we flag) changes in rankings represent real changes.

New to this ranking are measures of productivity and of drivers of research performance.

3. Measures and Results

3.1 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. In the absence of quality of teaching measures that are comparable across countries, the measure of resources per student in part serves as a proxy. In order to measure the contribution of tertiary education to a nation's research effort we include measures of expenditure on R&D in tertiary institutions. In summary, our five measures of resources and their weights are:

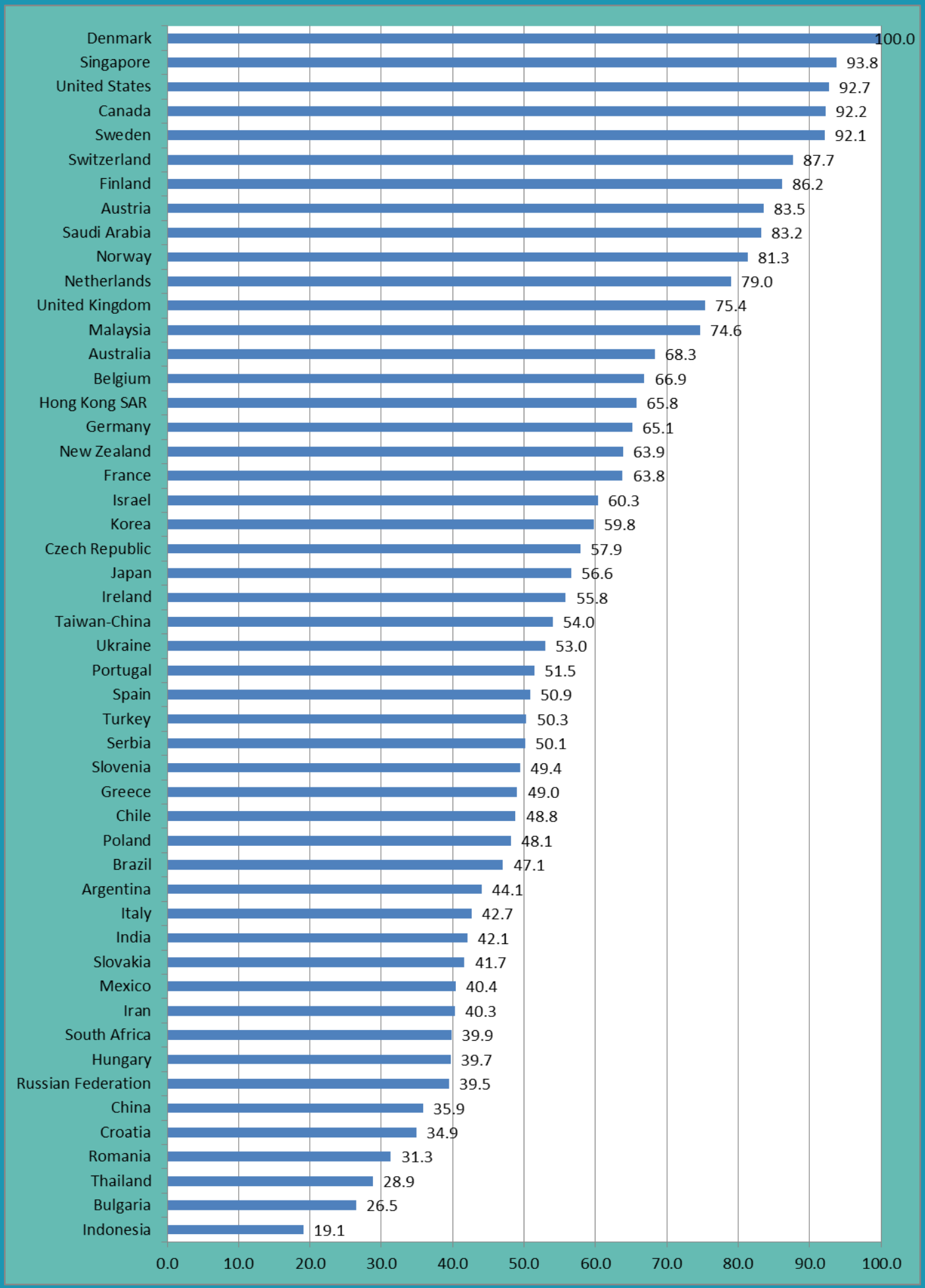
- R1: (5%) Government expenditure on tertiary education institutions as a percentage of GDP, 2012.
- R2: (5%) Total expenditure on tertiary education institutions as a percentage of GDP, 2012.
- R3: (5%) Annual expenditure per student (full-time equivalent) by tertiary education institutions in USD purchasing power parity, 2012.
- R4: (2.5%) Expenditure in tertiary education institutions for research and development as a percentage of GDP, 2013.
- R5: (2.5%) Expenditure in tertiary education institutions for research and development per head of population at USD purchasing power parity, 2013.

Expenditure financed by government averages 1.13 per cent of GDP and total expenditure 1.56, both almost the same as in the 2015 rankings. The highest ranked countries for resources in the 2016 rankings are Denmark, Singapore, the United States, Canada, Sweden and Switzerland, in that order.

Compared with the 2015 U21 rankings, the largest improvers are the United Kingdom, which rises from 26th to 12th as a result of the OECD correction for government expenditure, and Turkey, which rises from 43rd to 29th following the availability of much more recent data. New Zealand has risen from 27th to 18th following increases in both public and private expenditure. Significant falls occurred for Hungary (down six places to 43rd) and Ireland (down seven places to 24th).

The countries with the largest total expenditure (public plus private) on higher education as a percentage of GDP are the United States, Chile, Saudi Arabia and Canada. Resources per student, which includes research expenditure, are highest in Singapore, the United States, Switzerland and the United Kingdom. Denmark, Sweden and Switzerland continue to rank highest for research expenditure in tertiary institutions: for Denmark it is nearly one per cent of GDP, three times the average for all 50 countries.

Resources


Denmark 100.0
Singapore 93.8
United States 92.7
Canada 92.2
Sweden 92.1
Switzerland 87.7
Finland 86.2
Austria 83.5
Saudi Arabia 83.2
Norway 81.3
Netherlands 79.0
United Kingdom 75.4
Malaysia 74.6
Australia 68.3
Belgium 66.9
Hong Kong SAR 65.8
Germany 65.1
New Zealand 63.9
France 63.8
Israel 60.3
Korea 59.8
Czech Republic 57.9
Japan 56.6
Ireland 55.8
Taiwan-China 54.0
Ukraine 53.0
Portugal 51.5
Spain 50.9
Turkey 50.3
Serbia 50.1
Slovenia 49.4
Greece 49.0
Chile 48.8
Poland 48.1
Brazil 47.1
Argentina 44.1
Italy 42.7
India 42.1
Slovakia 41.7
Mexico 40.4
Iran 40.3
South Africa 39.9
Hungary 39.7
Russian Federation 39.5
China 35.9
Croatia 34.9
Romania 31.3
Thailand 28.9
Bulgaria 26.5
Indonesia 19.1
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

3.2 Environment (weight of 20%)

A consensus is emerging that for a quality higher education system, institutions need considerable autonomy in areas such as budgets and degree offerings, but there also needs to be appropriate competition between institutions, external monitoring of performance, and equality of opportunity. The degree to which national systems possess these characteristics is measured by the results of three survey findings complemented by four quantitative measures: female participation among both students and staff, a measure of diversity of institutions in the system, and the quality of data on higher education. The weights used in constructing the diversity measure recognise that autonomy of public universities matters less if there is a large private sector. The measures we use and their weights are:

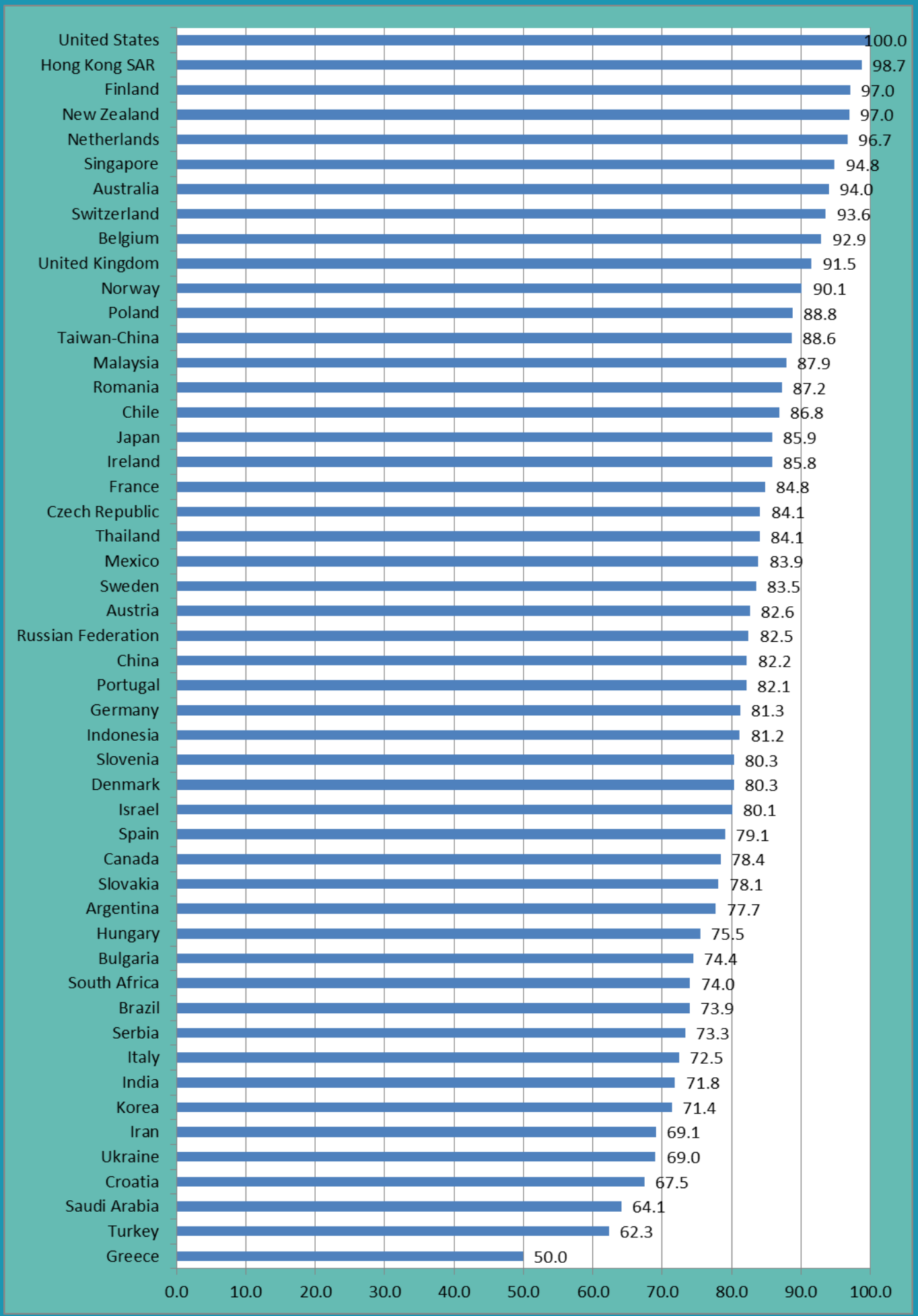
E1: (1%) Proportion of female students in tertiary education, 2013.
E2: (2%) Proportion of academic staff who are female in tertiary institutions, 2013.
E3: (2%) A rating for data quality. For each quantitative series, the value is 2 if the data are available for the exact definition of the variable; 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:
(4%) survey results for the policy and regulatory environment (see Appendix 2).
(4%) survey results for financial autonomy of public universities (see Appendix 2).
(2%) a measure of diversity of the system defined as
= 1 if less than 90 per cent of all tertiary students are enrolled in any one of the three OECD categories: public, government dependent private and independent private (modified to 0.5 if this does not also hold for university enrolments);
= 1.5 if between 50 and 90 per cent of students are enrolled in independent private institutions (percentage in all private institutions when OECD data not available);
= 0 if at least 90 per cent of students are enrolled in any one OECD category.
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?".

The top-ranked countries in the Environment module are the United States, Hong Kong SAR, Finland, New Zealand and the Netherlands, the same as in last year's rankings. Switzerland has risen nine places to eighth mainly due to the diversity measure now including all tertiary institutions, not just universities. Romania drops five places to 15th owing to a marked fall in its WEF-survey score.

For the qualitative index (E4), the top two ranked countries are Hong Kong SAR and the United States. The Netherlands is third followed by Taiwan-China.

Only in four countries for which data are available does the percentage of female staff in tertiary institutions exceed 50 per cent: Finland, Malaysia, Thailand and Russia. Business, as measured by the WEF survey, ranks the national education systems most highly in Switzerland, Singapore and Finland.

Environment



3.3 Connectivity (weight of 20%)

Connectivity encompasses the two-way flow of information between the higher education sector and the rest of society. 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. We use six measures:

C1: (4%) Proportion of international students in tertiary education, 2013.
C2: (4%) Proportion of articles co-authored with international collaborators, 2013.
C3: (2%) Number of open access full text files on the web, per head of population, July 2015.
C4: (2%) External links that university web domains receive from third parties, per head of population, 2015.

The data for C3 and C4 include all tertiary institutions ranked in the top 10,000 in the world.

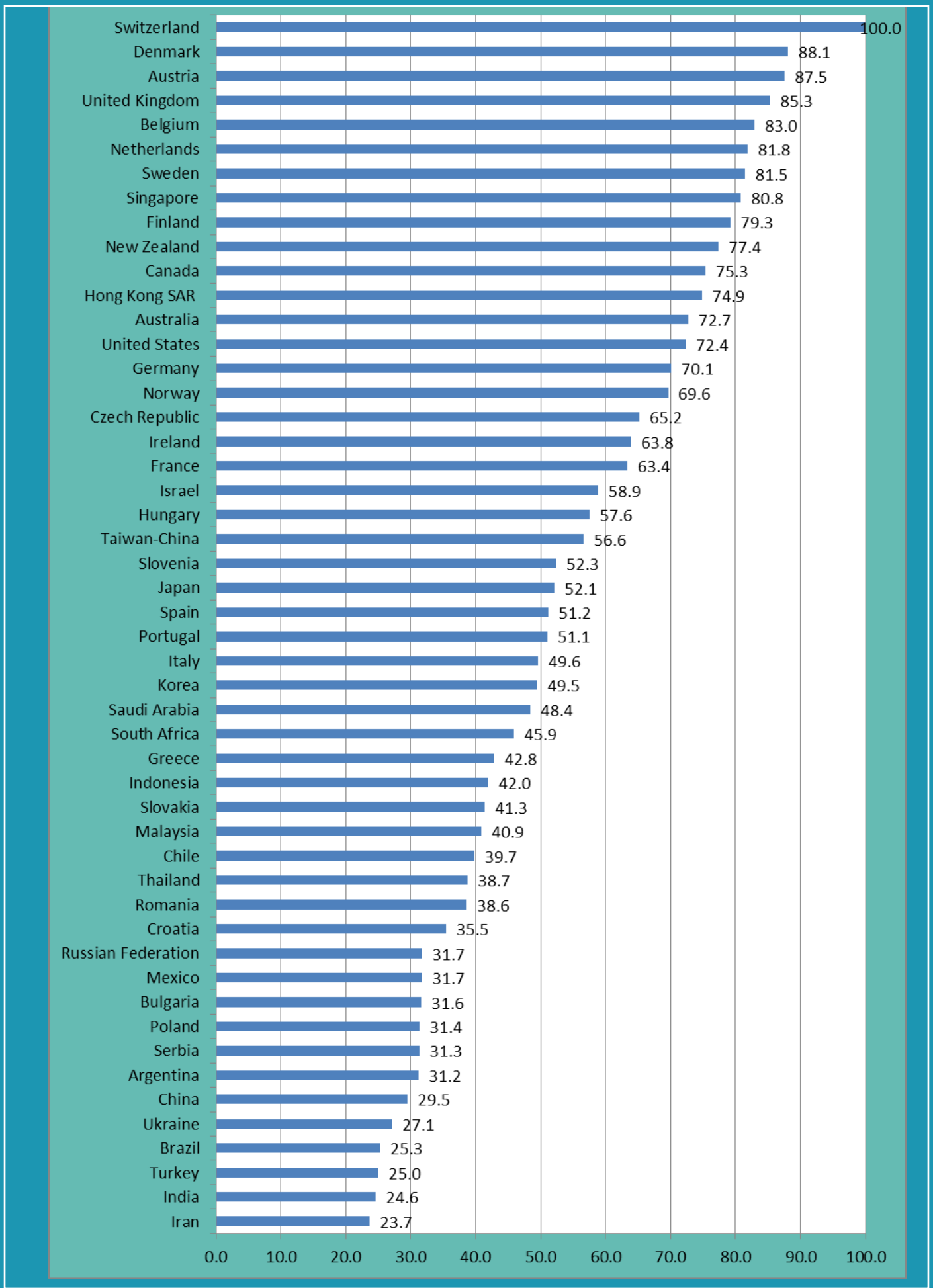
C5: (4%) Responses to question 'Knowledge transfer is highly developed between companies and universities', asked of business executives in the annual survey by IMD World Development Centre, Switzerland, 2015.
C6: (4%) Percentage of university research publications that are co-authored with industry researchers, 2011-13.

The top five nations in rank order are Switzerland, Denmark, Austria, the United Kingdom and Belgium. Belgium has risen from ninth in last year's rankings replacing Sweden (which has fallen to seventh) in the top five. Falls in rank include Bulgaria from 36th to 41st owing largely to a reduction in joint publications with international authors (C2). More accurate data for international students (C1) accounts for the falls in the rankings of South Africa (26th to 30th) and Ukraine (41st to 46th).

For our 50 countries, the proportion of articles co-written with an international collaborator (C2) again averages 41 per cent. The top four countries remain the same as in last year's rankings: Saudi Arabia (71 per cent), Hong Kong SAR (64 per cent), Switzerland (62 per cent) and Belgium (59 per cent). New Zealand and Singapore have improved three places in internationally co-written papers to tenth and fifth, respectively; Bulgaria has slipped ten places to 39th. There has been a slight decline in the percentage of articles co-written with industry (C6) from 4.6 per cent in last year's rankings to 4.3 per cent but little change in the rankings. (Note that two of the three years of data are common to both years of ranking.) The six most highly ranked countries are in order Denmark, Sweden, Japan, Austria, Belgium and the Netherlands, where the share ranges from 7.8 to 8.4 per cent. Bulgaria's rank has fallen seven places to 30th, reversing the improvement in last year's rankings.

The top countries for knowledge transfer in the IMD survey of business executives (C5) are, in rank order, Switzerland, Israel and in equal third place Canada and the United States. Canada has risen from 11th place in last year's rankings. Other countries to have risen in rank are New Zealand (22nd to 14th) the Czech Republic (40th to 30th) and Romania (32nd to 24th). Countries that fell in rank include Sweden (down seven places to 17th) and Hungary (down ten places to 36th). Singapore, Australia and the United Kingdom again have the highest proportion of international students (C1). The United States is ranked a clear first for web impact (C4) followed by Switzerland. Taiwan-China and the Czech Republic are ranked first for web presence (C3).

Connectivity



3.4 Output (weight of 40%)

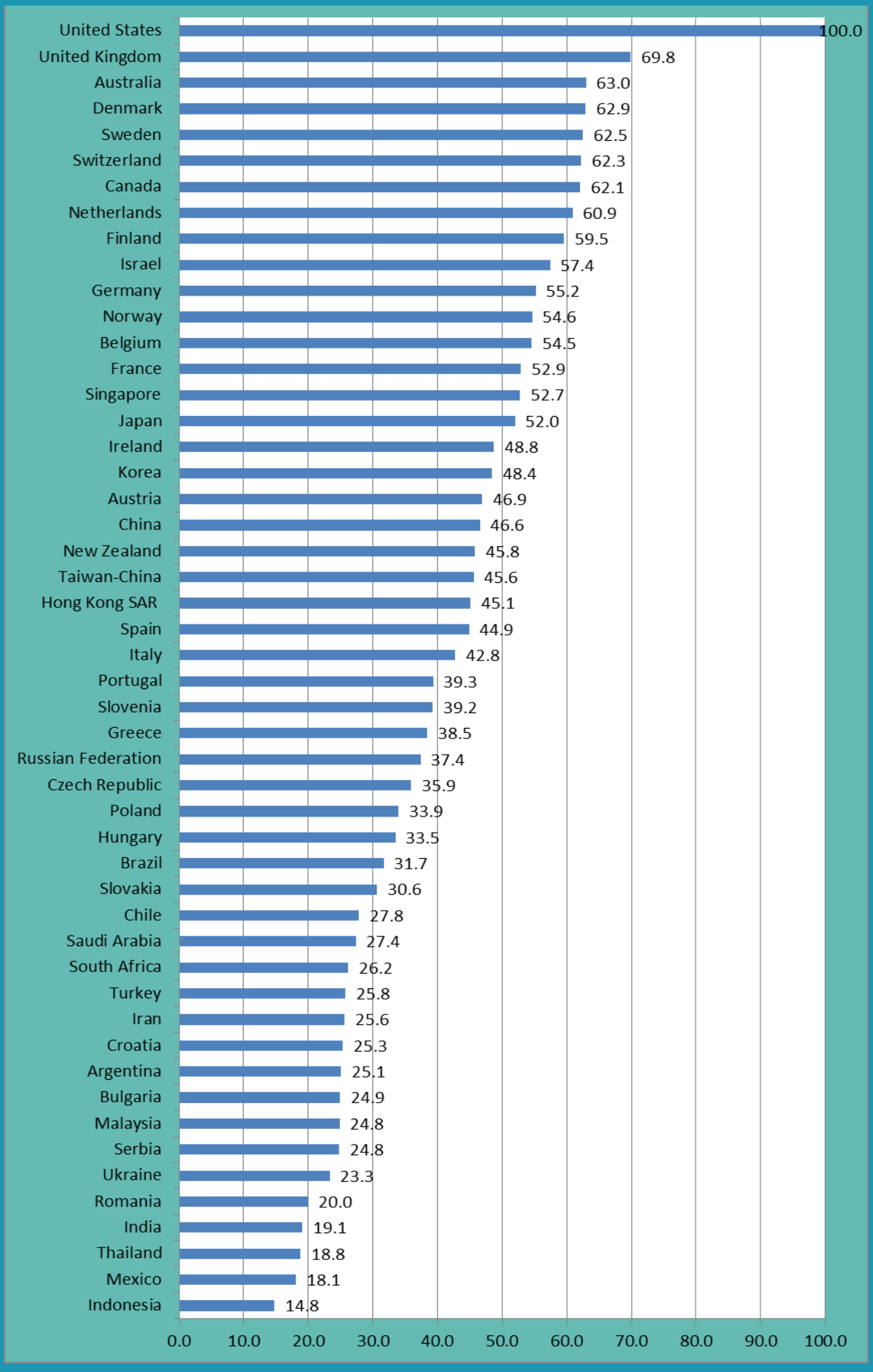
The measures used in this module encompass research output and impact, student throughput, the national stock of graduates and researchers, the quality of a nation's best universities, and employability of graduates. The variables are given below.

- O1: (10%) Total articles produced by higher education institutions, 2013.
- O2: (3%) Total articles produced by higher education institutions per head of population, 2013.
- O3: (5%) Average impact of articles as measured by citations in 2013 to articles published in previous years using the Karolinska Institute normalized impact factor.
- O4: (3%) The depth of world class universities in a country. This is calculated as a weighted average of the number of institutions listed in the top 500 according to the 2015 Shanghai Jiao Tong scores, divided by country population.
- O5: (7%) The excellence of a nation's best universities calculated by averaging the 2015 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, 2013.
- O7: (3%) Percentage of the population aged 25–64 with a tertiary qualification, 2014.
- O8: (3%) Number of researchers (full-time equivalent) in the nation per head of population, 2013.
- O9: (3%) Unemployment rates among tertiary educated aged 25–64 years compared with unemployment rates for those with only upper secondary or post-secondary non-tertiary education, 2013.

The top two countries in the output module are the United States and the United Kingdom. The scores for the next five ranked countries are very close together, but in order they are Australia, Denmark, Sweden, Switzerland and Canada. The rankings are similar to last year's rankings except that Australia and Canada have swapped positions. Israel has improved four places and is now ranked tenth. China has risen five places to 20th whereas Argentina has fallen five places to 41st.

The median increase in publications is 4.6% but much larger increases occurred in Indonesia (up 71% from a low base), Saudi Arabia (up 28%) and Russia (up 22%). Publications per head of population are now highest in Australia followed by Sweden, Denmark and Switzerland. The top two countries for average research impact of articles are Switzerland and the Netherlands. The next four countries have almost identical scores: in alphabetical order they are Denmark, Singapore, the United Kingdom and the United States. Malaysia's impact ranking has increased seven places to 34th; India and China have risen six places; Bulgaria and Russia have each fallen ten places. Participation rates (O6) are highest in Greece, Korea, Finland, the United States and Canada. Russia remains the country with the highest-qualified workforce, followed by Canada, Singapore, Japan and Israel. The national stock of researchers relative to population is highest in Israel, Denmark and Finland; equal fourth are Korea, Singapore and Sweden. Unemployment of the tertiary educated relative to school leavers (O9) is lowest in Hungary, South Africa, Russia, Poland and Czech Republic. In five countries unemployment is higher for those with a tertiary qualification: Malaysia, Mexico, Taiwan-China, Thailand and Saudi Arabia.

Output


United States 100.0
United Kingdom 69.8
Australia 63.0
Denmark 62.9
Sweden 62.5
Switzerland 62.3
Canada 62.1
Netherlands 60.9
Finland 59.5
Israel 57.4
Germany 55.2
Norway 54.6
Belgium 54.5
France 52.9
Singapore 52.7
Japan 52.0
Ireland 48.8
Korea 48.4
Austria 46.9
China 46.6
New Zealand 45.8
Taiwan-China 45.6
Hong Kong SAR 45.1
Spain 44.9
Italy 42.8
Portugal 39.3
Slovenia 39.2
Greece 38.5
Russian Federation 37.4
Czech Republic 35.9
Poland 33.9
Hungary 33.5
Brazil 31.7
Slovakia 30.6
Chile 27.8
Saudi Arabia 27.4
South Africa 26.2
Turkey 25.8
Iran 25.6
Croatia 25.3
Argentina 25.1
Bulgaria 24.9
Malaysia 24.8
Serbia 24.8
Ukraine 23.3
Romania 20.0
India 19.1
Thailand 18.8
Mexico 18.1
Indonesia 14.8
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

3.5 Overall Ranking

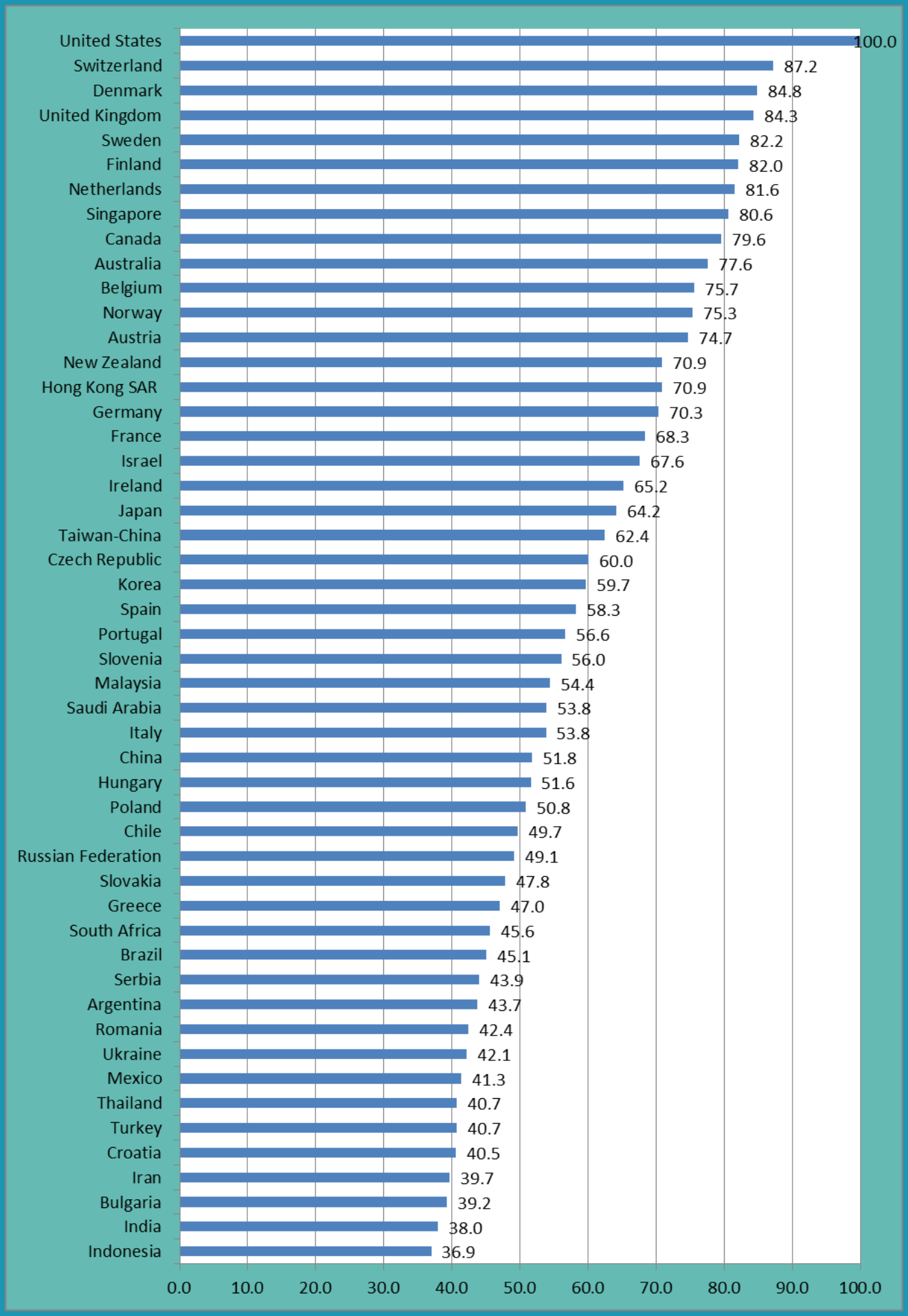
Using weights of 40 per cent on Output and 20 per cent on each of the other three modules, the top three countries, in order, are the United States, Switzerland and Denmark, the same as in last year's ranking. The United Kingdom is now ranked fourth, a rise of four places from last year's ranking, largely owing to the revised OECD data for government expenditure on higher education. Next in order are Sweden, Finland, the Netherlands and Singapore. Canada has fallen three places to ninth largely as a result of a fall of four places in its ranking on Output. Australia is tenth.

China has risen four places to 30th owing to its continual rise in the Output rankings. The largest fall is Bulgaria: down five places to 48th owing mainly to the fall in its ranking on Connectivity. The only other change of more than two places is Turkey, which has risen five places as a result of improved data on resources.

Comparing the change in rankings over the four-year period 2013 to 2016, China shows the greatest improvement, rising 12 places. South Africa has risen nine places and the United Kingdom six places. The largest falls have occurred for Bulgaria (down ten places) and Serbia (down seven places).

This data can be seen in table format on pages 7 and 8.

Overall Ranking



4. Methodology of adjusting for levels of economic development

In order to adjust for national levels of income we regress the values for each variable, in original units, on a function of GDP per capita using data for all 50 countries. The GDP we use is for 2013 in US dollars measured in Purchasing Power Parity (PPP) terms. Both linear and quadratic relationships are used. 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. Where data are missing we assume that the variable takes the expected value for that country's level of GDP per head, that is, we assume a deviation value of zero. For the two Output variables based on the Shanghai rankings (O4 and O5) the presence of zero values limits the use of regression, so instead we rank the countries by GDP per head and take a moving average of actual scores to derive more robust estimates of predicted values.

In aggregating over variables we express deviations from the regression line as a percentage of the average of the actual and predicted values and then sum. 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.

We use the same dependent variables and weights as described in section 3 with two exceptions. The exceptions are research expenditure (R4 and R5) and publication output (O1 and O2) where in each case we had variables expressed in two different forms. This becomes unnecessary when we control for differences in income levels. We delete R5 and move the weight to R4, so that each of the four resources measures 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.

5. Results after adjusting for levels of economic development

5.1 Resources

Expenditure levels are best described by a linear relationship with income except for research expenditure where a quadratic curve fits best. The top two countries devoting greater resources to higher education than is expected at their level of GDP per capita are Serbia and Malaysia, where the scores are 40 per cent above expected. Next, in order, are Denmark, Ukraine, India, Canada and Sweden, Finland and South Africa, where scores exceed 20 per cent above expected. The high values for Serbia and the Ukraine are at least partly explained by the combination of 'sticky' expenditure on higher education and falling GDP per capita, but the deviations from expected expenditure have declined significantly from last year's rankings. Compared with the non-adjusted rankings, China, India and South Africa each improve 33 places, China to 12th position.

Turning to the four variables that are included in the Resources module, total expenditure on higher education as a share of GDP shows only a very slight increase with GDP per head so the rankings are similar to those discussed in section 3.1. The highest ranked countries are Chile, Malaysia and the United States. Government expenditure shows a little more variation but the relationship is still quantitatively small: for every ten thousand dollar increase in GDP per head, government expenditure is estimated to increase by around 0.1 of a percentage point. The top countries for government expenditure after adjusting for GDP per capita are Ukraine, Saudi Arabia, India and Malaysia. Expenditure (which includes research expenditure) per student increases markedly with income levels: on average by around USD400 for each USD1,000 increase in GDP per capita (adjusted R2 = 0.759). The top eight countries on an income-adjusted basis are, in order, South Africa, Malaysia, the United Kingdom, Brazil (public institutions only), India, China, Sweden and the United States.

Research expenditure in higher education as a share of GDP increases with GDP per capita, but at a declining rate. The quadratic regression estimates imply that at GDP per head of USD 25,000 the expected expenditure on R&D is 0.35 per cent of GDP whereas the corresponding figure for GDP per head of USD 50,000 is 0.60. The top eight countries for research expenditure as a share of GDP are now Serbia, South Africa, China, Denmark, Turkey, Sweden, Portugal and Switzerland. The United States is ranked at 41, compared with 20th when no allowance is made for income levels, which largely accounts for the United States relatively low overall ranking for resources of 16th.

5.2 Environment

In principle, the creation of a favourable environment is independent of income levels so we do not carry out regression analysis. Instead, we deviate values from the mean level for each of the five components. In practice only the WEF survey results (E5) show a significant variation with GDP per capita. In order to be consistent with the treatment used in other modules this year we express the deviations from average as a ratio of the mean of actual plus expected (the average). The rankings are necessarily very similar to those for the unadjusted data. For missing data the deviations are put at zero.

The range of scores is lower for this module than for the other three modules because several variables have low variation across countries. The scores for the top four countries (the United States, Hong Kong SAR, New Zealand and Finland) are around 10 per cent above expected values.

5.3 Connectivity

The connectivity measures are quite strongly positively related to levels of GDP per head, with the adjusted R2 values lying in the range 0.3 to 0.5. However, even after allowing for income differences between countries, of the top five ranked nations, four are developed countries: the United Kingdom, New Zealand, Switzerland and Denmark. The highest ranked low-income country is South Africa, ranked at number three. The next highest ranked developing countries are Thailand (10th) and Indonesia (14th). South Africa ranks very highly in all but the Web-based measures of connectivity.

The strongest relationship with income levels is obtained for the ranking of 'knowledge transfer between industry and universities' (C5). Of course causality can run both ways: do high levels of connectivity between industry and higher education institutions raise GDP per head or do high levels of income enable universities to concentrate more on research and development? Malaysia and Israel top the income-adjusted performance level for knowledge transfer. The equation for international co-authorship (C2) implies that for every USD1,000 increase in GDP per capita the percentage of articles that have an international co-editor increase by 3.2 percentage points. The top three ranked countries are South Africa, Chile and Indonesia.

Joint authorship with industry (C6) flattens out at high income levels and is best approximated by a quadratic relationship. India and Indonesia perform well relative to their levels of GDP per head. After allowing for income differences China ranks in the top ten for Web impact (C4) and links with industry (C5, C6).

5.4 Output

All but one of the Output measures show a significant increase with levels of GDP per capita. The exception is the unemployment variable (C8) where we deviate from the average value. Two Output measures show a particularly strong relationship with GDP per capita (adjusted R2 > 0.6): 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 unlikely to be highly referenced despite its relevance for economic development. To illustrate, after allowing for income differences, Malaysia is ranked first for knowledge transfer (C5) but ranks only 35th for impact through citations. While both the number of researchers per head and tertiary enrolment rates increase with income levels they flatten out at the highest income levels.

The top three ranked countries for Output are Serbia, China and Israel, all nearly 40 per cent above expected values for their level of income. Next in order come the United Kingdom and Portugal. Turning to the components, Serbia, India and Portugal are the top three for publications relative to (total) GDP. India and South Africa do best for the average impact of publications (at around 40 per cent above the expected value) followed by the United Kingdom, Italy, the Netherlands and Indonesia. Relative to income levels, the quality of the best three universities is highest in China and the United States. Next in order are the United Kingdom, Brazil, Israel and South Africa.

After allowing for income levels, Ukraine is ranked first on participation rates (O6), qualification of the workforce (O7) and number of researchers (O8). Israel is third for both the qualification of the workforce and numbers of researchers. The countries ranked second are Russia (for qualification of the workforce) and China (for number of researchers).

5.5 Overall Ranking

The overall score is calculated by weighting the percentage deviations for each module. The weights are the same as for the unadjusted data: Resources (20%), Environment (20%), Connectivity (20%) and Output (40%). The aggregate percentage absolute scores are only indicative of absolute performance. The median aggregate score is minus eight per cent so that a score above this level can be interpreted as above average. Even this interpretation is dependent on our choice of 50 countries.

The top five countries in rank order are the United Kingdom, Serbia, Denmark, Sweden and China. China has improved from 16th in the 2015 rankings, even though its income levels are rising at above average rates that would otherwise lower the ranking. Of the other countries with per capita GDP below USD20,000 (PPP), South Africa is ranked seventh and India 15th . Malaysia and Brazil are above the median value but Thailand and Indonesia are in the bottom decile.

Compared with the original rankings, six countries are now ranked at least fifteen places higher. These countries are, in order of the ranking improvement, Serbia, India, South Africa, China, Portugal and Brazil.

Measures Adjusted for Levels of Economic Development

Rank	Resources	%dev	Environment	%dev	Connectivity	%dev	Output	%dev
1	Serbia	40.5	United States	10.1	United Kingdom	32.4	Serbia	39.3
2	Malaysia	39.6	Hong Kong SAR	9.3	New Zealand	29.4	China	38.5
3	Denmark	31.4	New Zealand	8.7	South Africa	26.9	Israel	35.3
4	Ukraine	26.4	Finland	8.7	Switzerland	26.4	United Kingdom	28.2
5	India	25.7	Netherlands	8.6	Denmark	24.1	Portugal	26.5
6	Canada	24.6	Singapore	7.5	Czech Republic	23.7	Sweden	20.0
7	Sweden	23.2	Australia	7.2	Hungary	23.1	Denmark	17.1
8	Finland	20.8	Switzerland	6.6	Austria	19.5	Australia	16.0
9	South Africa	20.3	Belgium	6.5	Belgium	17.9	Finland	13.5
10	Saudi Arabia	18.8	United Kingdom	5.8	Thailand	16.4	South Africa	11.0
11	Turkey	17.0	Norway	4.9	Finland	13.5	United States	8.7
12	China	16.8	Taiwan-China	4.7	Sweden	11.8	Canada	8.6
13	Brazil	14.2	Poland	3.6	Canada	11.3	Netherlands	7.5
14	United Kingdom	13.1	Malaysia	3.4	Indonesia	11.2	Switzerland	7.0
15	Austria	12.2	Romania	2.4	Netherlands	6.2	India	5.8
16	United States	8.9	Ireland	2.3	Ukraine	1.2	Brazil	4.0
17	Czech Republic	5.7	Chile	2.3	Australia	0.4	New Zealand	3.4
18	New Zealand	4.9	France	1.9	Portugal	-0.1	Greece	2.6
19	Netherlands	3.3	Japan	1.4	Romania	-0.6	Hungary	1.4
20	Switzerland	1.4	Czech Republic	1.1	India	-2.4	Belgium	-0.3
21	Israel	0.8	Sweden	1.0	Germany	-4.7	Slovenia	-0.5
22	Portugal	-2.5	Thailand	0.9	Hong Kong SAR	-7.7	Iran	-3.5
23	Poland	-2.9	Austria	0.4	Bulgaria	-13.6	Korea	-3.8
24	Belgium	-4.5	China	0.1	Slovenia	-13.7	Poland	-4.2
25	France	-6.5	Portugal	0.1	United States	-14.5	Singapore	-6.1
26	Australia	-7.6	Russia	-0.2	Spain	-16.5	Spain	-6.8
27	Korea	-8.5	Mexico	-0.4	Serbia	-16.7	Norway	-7.3
28	Mexico	-8.7	Indonesia	-0.5	Ireland	-17.8	France	-7.9
29	Germany	-10.0	Germany	-0.8	France	-17.8	Malaysia	-13.0
30	Iran	-10.4	Slovenia	-1.0	Greece	-19.0	Germany	-13.9
31	Singapore	-10.6	Israel	-1.3	China	-20.1	Chile	-15.2
32	Norway	-12.2	Denmark	-1.4	Singapore	-20.8	Czech Republic	-17.9
33	Japan	-15.8	Spain	-2.2	Israel	-20.8	Japan	-20.3
34	Greece	-16.1	Canada	-2.9	Slovakia	-21.9	Ireland	-20.5
35	Slovenia	-16.2	Argentina	-3.4	Norway	-26.9	Austria	-20.6
36	Spain	-17.0	Slovakia	-3.6	Italy	-27.7	Italy	-22.3
37	Chile	-21.5	Hungary	-4.7	Taiwan-China	-28.6	Taiwan-China	-22.5
38	Hong Kong SAR	-21.9	Bulgaria	-5.5	Malaysia	-30.3	Hong Kong SAR	-24.2
39	Argentina	-22.7	Serbia	-6.2	Japan	-37.5	Turkey	-30.6
40	Slovakia	-23.0	Italy	-6.6	Korea	-40.0	Ukraine	-43.4
41	Hungary	-23.7	Brazil	-6.8	Poland	-41.5	Russia	-45.2
42	Thailand	-25.0	India	-7.0	Chile	-44.5	Argentina	-46.1
43	Taiwan-China	-27.6	Korea	-7.1	Croatia	-45.5	Croatia	-47.5
44	Croatia	-29.7	South Africa	-7.3	Brazil	-46.4	Romania	-63.7
45	Ireland	-30.3	Iran	-8.8	Russia	-53.8	Mexico	-63.7
46	Russia	-35.4	Ukraine	-9.6	Mexico	-54.6	Slovakia	-63.8
47	Italy	-38.9	Croatia	-11.1	Saudi Arabia	-60.8	Bulgaria	-76.8
48	Romania	-41.1	Saudi Arabia	-13.3	Turkey	-62.1	Thailand	-80.8
49	Bulgaria	-56.3	Turkey	-15.5	Argentina	-72.4	Saudi Arabia	-84.7
50	Indonesia	-56.4	Greece	-28.5	Iran	-80.6	Indonesia	-116.4

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

Overall Ranking Adjusted

Rank	Country	% dev
1	United Kingdom	21.6
2	Serbia	19.2
3	Denmark	17.7
4	Sweden	15.2
5	China	14.8
6	Finland	14.0
7	South Africa	12.4
8	Portugal	10.1
9	Canada	10.0
9	New Zealand	10.0
11	Israel	9.8
12	Switzerland	9.7
13	Netherlands	6.6
14	Australia	6.4
15	India	5.6
16	United States of America	4.4
17	Belgium	3.9
18	Hungary	-0.5
19	Czech Republic	-1.1
20	Austria	-1.8
21	Malaysia	-2.7
22	Brazil	-6.2
23	Slovenia	-6.4
24	Singapore	-7.2
25	France	-7.6

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

for Levels of Economic Development

Rank	Country	% dev
26	Germany	-8.7
27	Norway	-9.7
28	Poland	-9.9
29	Spain	-9.9
30	Greece	-11.7
31	Korea	-12.6
32	Hong Kong SAR	-13.7
33	Ukraine	-13.8
34	Ireland	-17.4
35	Japan	-18.5
36	Chile	-18.8
37	Taiwan-China	-19.3
38	Iran	-21.4
39	Italy	-23.6
40	Turkey	-24.4
41	Romania	-33.4
42	Thailand	-33.8
43	Slovakia	-35.2
44	Russia	-36.0
45	Croatia	-36.3
46	Argentina	-38.2
46	Mexico	-38.2
48	Saudi Arabia	-44.9
49	Bulgaria	-45.8
50	Indonesia	-55.7

6. Productivity and Drivers of Research

The relationships between inputs (Resources and Environment) and outcomes (Output and Connectivity) provide measures of productivity of the higher education sector. Through capable management or strongly motivated academics, a country's tertiary institutions may be able to offset to some degree limited funding or onerous government controls.

Current outcomes need to be compared with past input settings to allow for lags in behaviour. Increases in research funding will take several years to be reflected in an increase in publications and citations; the full effect of a government funding an increase in the participation rate will occur only when the first cohort graduates. While we now have five years of U21 ranking data, substantial improvements were made in the early years to data quality and variables included. The oldest comparable data we have are those for the 2013 rankings for Resources, and the 2015 data for Environment. We use the original outcomes data as described in section 3, except that in measuring productivity it is appropriate to omit total publications (O1) from the total Output module and confine empirical work to measures standardised for country size. But outcomes also include domestic and international connectivity. Our second outcome measure thus combines results for both the Output and Connectivity modules, using weights of 40 and 20 per cent respectively. (This year's OECD correction of the data for the United Kingdom has been backcast to 2013.)

In order to measure productivity we first regress each of the two outcome measures on the scores for Resources and Environment. The results are as follows (standard errors are in parentheses beneath the coefficients):

Output = -29.80 + 0.756 Resources + 0.506 Environment, R2 = 0.731, n =50
(13.0) (0.085) (0.171)

Output + Connectivity = -37.56 + 0.785 Resources + 0.638 Environment, R2 = 0.760, n=50
(13.0) (0.085) (0.171)

The regression results show that around three-quarters of the variations in the outcomes are explained by the inputs, with both the Resources and the Environment scores significant at the 1 per cent level. The effect of resource levels is quantitatively a little larger than that of environment. (All variables are scaled to a maximum value of 100.) Interestingly, Connectivity exhibits a very similar relationship with Resources and Environment as does Output.

The predicted values from the equations give an estimate of the average outcome score for a given level of resources and policy environment settings. The actual score for each country can then be compared with the predicted value given the resource levels and policy settings for the country. Actual scores above predicted values indicate above-average efficiency of the nation's higher education institutions, and conversely for actual scores that are less than predicted. However, there still remains a timing issue with some measures where the lags are very long, such as the qualifications of the workforce. The results also depend crucially on what we include in our measures of the policy environment and outcomes. In particular, insofar as our Environment module does not include relevant policy variables, the productivity results will reflect, in part, government policy as well as institutional productivity. With this and other caveats in mind, we present the results only by

quintiles. Within each quintile countries are arranged alphabetically. Countries appearing in the top quintile for both definitions of outcomes are, in alphabetical order, Australia, Greece, Germany, Israel, Italy, Slovakia, South Africa and the United Kingdom. Interestingly, the top quintile includes Greece, which ranks last for Environment, and South Africa, even though its scores are low for long-term outcome measures such as qualifications of the work force.

We conclude by quantifying the drivers of research performance. Specifically, we look at how research publications and their impact (as measured by citations) are related to research expenditure and the policy environment. We first use as an outcome measure the sum of publications and citations. But research expenditure may be financed from industry and our second measure adds in joint publications with industry in an attempt to pick up the industry effect. The expenditure series used as an explanatory variable is research expenditure as a share of GDP (R4). Specifically, the outcome variables are:

PUBS 1 = publications per head (O2) and average citation rates (O3) added together using our earlier weights (scaled to maximum value = 100).

PUBS 2 = PUBS 1 plus the percentage of publications co-authored with industry (C6), again using our earlier weights (the aggregate is scaled to maximum value = 100).

The estimated equations, using R4 data from the 2013 rankings, are given below (R4 data for Brazil and Saudi Arabia are not available; all coefficients are significant at the 1 per cent level):

PUBS 1 = -24.8 + 0.715 R4 + 0.676 Environment R2 = 0.795, n = 48
(13.3) (0.068) (0.168)

PUBS 2 = -15.0 + 0.697 R4 + 0.556 Environment R2 = 0.742, n =48
(14.6) (0.074) (0.184)

The results show that research funds and the policy environment explain around three-quarters of the national variations in research performance. At mean values, a 10 per cent increase in research funding is estimated to increase publications and citations (PUBS 1) by nearly 5 per cent.

We can again measure outcomes relative to inputs by looking at deviations around the regression line. When research performance as measured by PUBS 1 is used, the top ten performers relative to inputs are, in alphabetical order, Australia, Belgium, Greece, India, Italy, Slovakia, Slovenia, South Africa, the United Kingdom and the United States. When joint publications with industry are added in to the research performance measure (PUBS 2), the top ten countries are Belgium, Croatia, Greece, Hungary, Italy, Korea, Slovakia, Slovenia, South Africa and the United Kingdom. The United States is eleventh.

Productivity Measures

	Outcome=Output	*Outcome=Output + Connectivity*
First quintile (rank 1-10)	Australia	Australia
	Germany	Czech Republic
	Greece	Germany
	Israel	Greece
	Italy	Hungary
	Korea	Israel
	Slovakia	Italy
	Slovenia	Slovakia
	South Africa	South Africa
	United Kingdom	United Kingdom
Second quintile (rank 11-20)	Belgium	Austria
	Croatia	Belgium
	Czech Republic	Croatia
	France	Indonesia
	Hungary	Japan
	Japan	Korea
	Spain	Slovenia
	Taiwan-China	Switzerland
	Turkey	Taiwan-China
	United States	Turkey
Third quintile (rank 21-30)	Brazil	Denmark
	Denmark	France
	Iran	Hong Kong SAR
	Ireland	Netherlands
	Netherlands	New Zealand
	New Zealand	Norway
	Norway	Spain
	Russia	Sweden
	Sweden	Thailand
	Switzerland	United States
Fourth quintile (rank 31-40)	Austria	Brazil
	Bulgaria	Bulgaria
	Canada	Canada
	China	China
	Finland	Finland
	Hong Kong SAR	Iran
	Poland	Ireland
	Portugal	Portugal
	Singapore	Russia
	Thailand	Singapore
Fifth quintile (rank 41-50)	Argentina	Argentina
	Chile	Chile
	India	India
	Indonesia	Malaysia
	Malaysia	Mexico
	Mexico	Poland
	Romania	Romania
	Saudi Arabia	Saudi Arabia
	Serbia	Serbia
	Ukraine	Ukraine

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

7. Concluding Remarks

By definition, the rankings reflect the relative performance of countries, but in order to look at general trends over time it is necessary to look at absolute values of our various measures. It is convenient to do this by comparing median absolute values for selected variables from the 2016 ranking with those from the 2013 ranking, the first year that covered 50 countries. Since most of our measures are positively related to GDP per capita the absolute median values are best thought of as relating to countries at middle levels of income. Nevertheless, most trends are world-wide so that movements in median values are more generally applicable.

As a share of GDP, the median level of government expenditure has increased from 1.10 to 1.19 per cent of GDP but research expenditure has fallen from 0.40 to 0.35 per cent of GDP. The extra government spending seems to have gone into teaching and learning: median participation rates have increased from 64.3 to 66.9 per cent. The gap between enrolment rates and the educational qualifications of the labour force has narrowed, particularly for developing countries: the median percentage of the labour force with a tertiary qualification has increased from 20.9 to 27.5 per cent. The gender balance among staff is slowly changing: the percentage of female staff has increased from 41.1 to 43.0 per cent, at median values.

Research outcomes have improved. The median number of articles published per million of population has risen nearly 50 per cent from 1028 to 1504, although this is really over a five-year period rather than three as in the 2013 rankings we used a five-year average of publications. Similarly, median citation rates have increased by 12 per cent.

The data reflect growing internationalisation of higher education. Student movement has increased: the median percentage of international students has risen from 3.5 to 3.9 per cent. At the median value, the percentage of articles with an international co-author has increased from 38.8 to 41.5.

In our rankings we make considerable effort to recognise that national priorities in higher education vary with levels of economic development and the structure of the economy. Some of the measures used in the main U21 ranking, such as journal publications and expenditure per student, primarily reflect the priorities of the education systems of developed countries, systems which all countries may aspire to as economic development proceeds. An auxiliary ranking shows how a country is performing in relative terms given its level of income per capita. A third ranking attempts to measure productivity of the tertiary education sector given its resources and government policies. Together, the different approaches present a rounded picture of the strengths and weaknesses of each of the 50 national systems we evaluate.

Appendix & References

Appendix 1: Sources

R1 and R2: OECD, Education at a Glance, 2015, Table B2.3 and UNESCO, Institute for Statistics (www.uis.unesco.org)

R3: OECD, Education at a Glance, 2015, Table B1.1a; 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 2015, Table C1.4b; UNESCO; surveys as described in Appendix 2

E5: World Economic Forum, The Global Competitiveness Report 2015-16, Table 5.03

C1: OECD, Education at a Glance 2014, Table C4.1; UNESCO

C2: SCImago data, Scopus data bank (www.scimagoir.com)

C3 and C4: Webometrics (www.webometrics.info), July 2015 version.

C5: IMD World Competitiveness Yearbook 2015, Table 4.3.23, World Competitiveness Center, Institute for Management Development, Lausanne, Switzerland.

C6: Professor Robert Tijssen and Alfredo Yegros-Yegros, CWTS, Leiden University

O1, O2 and O3: SCImago data, Scopus data bank (www.scimagoir.com)

O4 and O5: Shanghai Jiao Tong University Rankings, 2015 (www.shanghairanking.com)

O6: UNESCO, Institute for Statistics

O7: OEDC, Education at a Glance, 2015, Table A1.3a, ILOSTAT data base (www.ilo.org), UNESCO, Institute for Statistics

O8: UNESCO, Institute for Statistics

O9: OECD, Education at a Glance, 2015, Table A5.4a and ILOSTAT data base (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 questionaries. 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. The responses have been updated as 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).

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 Information on the U21 Rankings

de Rassenfosse, G. and Williams, R., 'Rules of Engagement: Measuring Connectivity in National Systems of Higher Education', Higher Education, Vol. 70, No. 6, 2015, pp. 941-956.

Williams, R., de Rassenfosse, G., Jensen, P. and Marginson, S. 'The Determinants of Quality National Higher Education Systems', Journal of Higher Education Policy and Management, 35(6), 2013, pp. 599–611.

Williams, R. and de Rassenfosse, G., 'Pitfalls in Aggregating Performance Measures in Higher Education', Studies in Higher Education, Vol. 41, Nos. 1-2, 2016, pp. 51-62.

Williams, R., National Systems of Higher Education: The U21 Rankings, International Higher Education, No. 84, Winter 2016, pp. 6-7 (English and Portuguese).

Universitas 21

The leading global network of research-intensive universities, working together to foster global citizenship and institutional innovation through research-inspired teaching and learning, student mobility, connecting our students and staff, and wider advocacy for internationalisation.

University of Amsterdam • University of Auckland • University of Birmingham
University of British Columbia • Pontificia Universidad Católica de Chile
University of Connecticut • University of Delhi • University College Dublin
University of Edinburgh • Fudan University • University of Glasgow
University of Hong Kong • University of Johannesburg • Korea University
Lund University • University of Maryland • McGill University
University of Melbourne • Tecnológico de Monterrey • UNSW Australia
University of Nottingham • The Ohio State University • University of Queensland
Shanghai Jiao Tong University • National University of Singapore

Universitas 21
c/o Strathcona 109
University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK

T +44 (0)121 415 8870
F +44 (0)121 415 8873
u21@universitas21.com
www.universitas21.com

Designed by Ben Griffiths
May 2016