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Center for International Higher Education

Campion Hall

Boston College

Chestnut Hill, MA 02467-USA

Tel: (617) 552-4236 Fax: (617) 552-8422

E-mail: [highered@bc.edu](mailto:highered@bc.edu)

<http://www.bc.edu/cihe>

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## Connectivity of National Systems of Higher Education: Evidence from the U21 Rankings

ROSS WILLIAMS

*Ross Williams is professor emeritus, Melbourne Institute: Applied Economic & Social Research, University of Melbourne, Australia. He leads the Universitas21 ranking project, details of which may be found at [www.universitas21.com](http://www.universitas21.com). E-mail: [rossaw@unimelb.edu.au](mailto:rossaw@unimelb.edu.au).*

There exists a global trend for governments and business to want universities to be more engaged with the external world. The reasons are clear. Links with industry foster economic growth, through research that facilitates the introduction of new technology to raise productivity, and through education and training that provide a skilled workforce to meet industry needs. International linkages facilitate the transfer of new technology in both directions. Further, the individual student experience is widened through international study and any given receiving country strengthens its international links when students return home.

Connectivity is one of the four modules in the Universitas21 (U21) project, which annually evaluates national systems of higher education in 50 countries. The other modules are Resources, Policy Environment, and Outcomes. The use of national rather than institutional data recognizes that what matters is the total contribution of the higher education system; different institutions can contribute in different ways. This article summarizes empirical findings on relative national connectivity from the 2019 U21 ranking.

### MEASURES OF CONNECTIVITY

Five measures of connectivity are used in the evaluation: the percentage of international students, the share of publications that have an international author, the share of scientific publications that are jointly produced with industry, a survey measure of the extent to which business rates the degree of knowledge transfer, and the webometrics measure of the number of external views of web material.

Overall, the countries ranked most highly for connectivity are Switzerland, Austria, and the United Kingdom. Connectivity is lowest in India, Iran, and Turkey. But the overall ranks hide important differences in the five component ranks and in the relationship between the compo-

nents. Saudi Arabia, for example, is a clear first on publications with international authors, encouraged by national policy, but is below median levels on the other four measures. Even the individual measures can hide differences in composition. For example, within countries, the share of international students increases markedly by level of tertiary education. At the bachelor's level, international students comprise between 14 and 18 percent of students in Austria, New Zealand, Australia, and the United Kingdom. In the United States, international students comprise only 4 percent of total enrollments at the bachelor's degree level, but 40 percent at the doctoral level.

#### RESEARCH LINKAGES

Not unexpectedly, international authorship links tend to be inversely related to population size. Countries with large scholarly communities are in less need of collaborators from other countries. The share of publications that are joint with international authors are well below median values for China, India, Japan, and the United States. In these countries, domestic coauthorship ranks well above median values. At the other end, Switzerland, Belgium, and Singapore are in the top four ranked countries for international coauthorship.

In 2017, for the 50 countries studied, the median share of publications with an international coauthor was 44.5 percent, an increase from 40.1 percent in 2010. Increases of over ten percentage points were recorded by Saudi Arabia, Greece, the Netherlands, the United Kingdom, Australia, Singapore, and Finland. Countries with increases below three percentage points included Germany and Korea.

Turning to research links with industry, the data on joint scientific research publications is provided by CWTS at Leiden University. The top four ranked countries are Austria, the Netherlands, Hungary, and Sweden. Again, there is a domestic-international split: small countries tend to link with foreign-based firms, while large countries see links with domestic firms. The business survey of knowledge transfer is conducted by the Institute for Management Development (IMD), Switzerland. We interpret this measure as encompassing both formal and informal links that may not be reflected in publications. Such links are strongest in Switzerland, the United Kingdom, and the United States. Some regional patterns emerge when the two measures of industry links are compared: in Eastern European countries, the rank on publications tends to be a good deal higher than the business rank, whereas for many East Asian countries (Malaysia, Singapore, China, Hong-Kong SAR, Taiwan), the reverse is true. Given the relative economic performance of the two regions, the data suggests that knowledge transfer in all its forms is more important for economic growth than activity geared to joint publications, which may be narrower

in scope. Of course, some countries perform well on both measures: those ranked in the top 12 on both measures are Austria, Denmark, Germany, the Netherlands, Sweden, and the United Kingdom.

The data suggests that the more diverse the authorship of research publications, the greater the influence. There is a positive correlation between citations and the shares of publications that have joint authorship with either international scholars or industry. This effect is not found for joint domestic authorship. Research links are encouraged by governments as a means of promoting economic growth. The U21 data supports this policy: there is significant positive correlation between each connectivity measure and gross domestic product (GDP) per capita. But there is some reverse causality: international research links require funding.

The Web indicator is primarily a measure of the demand for access to research material. Even after deflating by population, the United States ranks first, followed by Switzerland and Canada.

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#### POLICY IMPLICATIONS

Connectivity of the higher education sector tends to be greatest in countries with relatively small populations. In these countries, the tripartite links between universities, government, and the private sector are easier to develop and maintain—the relevant e-mail and telephone lists are much smaller. Examples include the Nordic countries and Singapore. Modest geographic size also seems to be of relevance, as exhibited by the high connectivity rating for the United Kingdom. In countries that are large in both population and area, the links are sometimes more complex and formal, and decision-making slower. These potential disadvantages can be mitigated by universities developing research links at the local or state level. For all countries, government policy is important. Engagement with industry can be promoted through financial incentive schemes for universities and taxation arrangements for industry. Immigration laws can be framed to promote both student and faculty exchanges. ■