

The Rise of East Asian Higher Education and Science

Written by Simon Marginson

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SIMON MARGINSON, JUL 6 2014

In the last decade, the Post-Confucian countries in East Asia have emerged as the world's third great zone of university education, science, and innovation, joining North America and Western Europe. This is the century of the rise of Asia in human affairs, but, in that very large continent, developments are uneven. While educational participation is growing in much of Southeast Asia and India, and Iran and Saudi Arabia in the Middle East have stepped up investment in research, there is a special dynamism in the East Asian nations. At one and the same time, they are moving forward rapidly in the growth of mass enrolment in tertiary education, the emergence of 'world-class' universities, the growth of scientific output, the production of world-leading science, and technological innovation in industry. They are able to do this within the framework of relatively low tax/spend polities because the household shares with the state the cost of learning in secondary and tertiary education

The Dragon is Back

Here 'East Asia' refers to the countries and systems that have been shaped by Chinese (Sinic) civilisation: mainland China, Hong Kong SAR, Taiwan, South Korea, and Japan in Northeast Asia, and Singapore in Southeast Asia. Arguably, this civilisation was the strongest in the world until 1500. The dragon is now returning to the front rank.

The East Asian countries can be understood as 'Post-Confucian' because their contemporary institutions are a hybrid of tradition and Western-induced modernisation, in the colonial period and after. In recent university design, whilst the British and German systems have been influential, the American university has been the dominant model. The pattern of cross-border influence is sealed by state-supported international collaboration, benchmarking, offshore PhD training, and inducements to publish in English-language science journals. As Post-Confucian political economy and higher education move to a leading global role, it is likely that the indigenous cultural elements will become more obvious. China or regional East Asia have yet to devise a distinctive 'Idea of a University', but some of the potential elements are already in place: a more extensive and constructive relationship between universities and government than is the case in Western Europe, especially the limited liberal states of the English-speaking world, and a practice of academic freedom that emphasises public responsibility as much as private freedom from coercion.

While there are many differences between the Post-Confucian countries in East Asia, including language and political system, they share a common heritage in the long Han state tradition and Confucian educational cultivation in the home. Though relations between China and Japan are currently tense and have been so for more than four hundred years, with long periods of no diplomatic contact, the early evolution of Japan was shaped by influences from Tang China that passed through Korea, notably Confucian and Buddhist ideas, and Chinese written language, philosophy, law, architecture, art, and city design. Japan shares the distinctive commitment to education that is a strong feature of Sinic families and societies. Japan's accelerated modernisation dates back to the Meiji restoration in 1868, and its emergence as a leading country in higher education, research, and Nobel-prize winning science took place in the 1970s and 1980s. In the other East Asian countries, accelerated modernisation is largely a post-1960 phenomenon, and the takeoff in higher education and science occurred in the 1990s and after, just at the time when Japan was moving from accelerated growth to stasis in higher education.

The last cab off the rank was China, where the great economic opening up began at the end of the 1970s, and growth in participation in higher education, and the rise of science, accelerated from the end of the 1990s. However,

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such is the scale and rate of the development of universities and research in China, that it is already the second system in the world in quantitative terms and on track to exceed the United States. The tertiary student enrolment in China is already the largest in the world. India's higher birthrate and larger school leaver population ensures that it will eventually overtake China in terms of numbers, though not in the quality of institutions.

Towards Universal Tertiary Enrolment

According to the UNESCO Institute of Statistics, the Gross Tertiary Enrolment Rate (GTER) in China was 24 per cent in 2011, still below the world average, but more recent data suggest that the GTER has risen to 30 per cent and is on track to meet the national target of 40 per cent by 2020. China is still extending secondary and tertiary education infrastructure to rural areas. In the rest of East Asia, participation is already high, exceeding 90 per cent in Korea, 80 per cent in Taiwan, and 60 per cent in Hong Kong SAR and Japan [1] (Singapore's data is withheld by the authorities).

The starting competence of East Asian tertiary students is exceptional. In the 2012 round of the OECD's periodic comparison of student learning achievement at age 15, PISA, East Asian schooling systems held the top seven places for mathematics, and Shanghai led the world in all of reading, mathematics, and science. In Shanghai, 55.4 per cent of all students were in the top two levels in PISA mathematics, compared to 17.5 per cent in Germany, 11.8 per cent UK, and 8.8 per cent in the USA [2]. These high levels of secondary student achievement are sustained by the status of the teaching profession, as well as household investment in 'shadow schooling' in the form of extra classes after formal school, and individual tutoring designed to help student children in the fierce competition for access to the top universities. In East Asia, it is believed that hard work, rather than talent, is the key to educational success. Even very poor families invest as much in education as they can. One systemic problem in East Asia is that once the all-important selection at the end of school has taken place, students work less hard in first degrees than they did in upper secondary school. But there is a common tendency towards universal tertiary participation in East Asian nations, among families rich and poor, enhancing the potential productivity of the workforce. Even more extraordinary, though, is the fluorescence of science in the region.

The Rapid Growth of Research

In 2011, the Post-Confucian countries of East Asia between them invested \$448 billion in R&D, a third of the global total and just below the \$453 billion spent in the United States and Canada. Almost half of this investment was in China, which had increased R&D funding by more than 18 per cent a year in real terms, year by year, for the previous ten years. China allocated \$208 billion in 2011, compared to \$429 billion in the United States. In 2011, Japan housed the world's third highest R&D investment. Korea was fifth and its investment in R&D in 2011 was 4.03 per cent of GDP, second highest rate of investment in the world after Israel, and well ahead of Finland, the leader in Europe. Japan was at 3.39 per cent of GDP. China's investment was 1.84 per cent in 2011, which was above the UK. That year, the United States allocated 2.85 per cent of GDP to R&D. But China's investment is growing by 0.1 per cent of GDP a year and at that rate it will pass the USA in a decade [3]. By then its GDP will also be considerably higher than that of the United States, if present trends are maintained.

The East Asian approach to research policy has two distinctive features. First, the growing investment in scientific capacity—including programmes that subsidise the return salaries of expatriates who have graduated with foreign PhDs or are working abroad—is concentrated in the physical sciences, engineering, and related disciplines, including materials, chemistry, electronics, and computing. Funding of life sciences and medicine is much lower than in Western Europe and the English-speaking world, except in agricultural research. China has focused on the science that supports infrastructure development, urban construction, transport, communications, energy, and environmental technologies: all fields that support accelerated modernisation. The most recent development is a surge in activity in bioscience, but it is from a low base [4].

Second, a higher proportion of R&D funding goes to industry R&D than in the USA, the UK, and Western Europe. In Korea, the government-supported national research institutes play a key role in applied fields, as do the research laboratories of major companies such as Samsung and LG. In China, less than 9 per cent of R&D funding is received

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by universities, compared to twice that level in the US. In China, most of R&D money goes to large state-controlled enterprises. Nevertheless, the total investment in science and technology is growing so rapidly that it is able to support the rapid development of leading research universities along with industry. China has implemented two major programs focused on lifting the top universities to 'world-class' level, the 211 program and the 985 program. Special resources are channeled into the top nine institutions, led by Tsinghua and Peking Universities in Beijing.

Published science is growing almost as quickly as R&D funding. Between 1995 and 2011, the number of journal articles from China rose by an amazing 16.5 per cent a year, and reached almost half of the US level. Over the same time period, published journal articles grew 13.6 per cent a year in Korea, 9.6 per cent in Singapore, and 7.9 per cent in Taiwan. These are remarkable rates of sustained increase. The improvement in quality is equally striking. The US National Science Foundation data show that in the year 2000, China published just 0.6 per cent of the world's papers that were ranked in the top 1 per cent of Chemistry by citation rate. Twelve years later in 2012, China published 16.3 per cent of leading papers in Chemistry, half as many as the US [5]. Furthermore, its total number of published papers in Chemistry exceeded that of the US. There are similar patterns in Engineering, Physics, and, to a lesser extent, in Mathematics. In Computing, China now publishes more top 1 per cent papers than the US. Taiwan is also very strong in research in computing, consistent with the fact that, like Korea, it is home to a number of large firms in electronics, such as ACER.

Rising in the Rankings

University rankings are primarily driven by research performance. Research publications and citations, collaborations in research publishing, and income for research purposes, are among the few items that can be measured with validity on a comparative international basis. Aside from those global university rankings that are shaped by reputational surveys—rankings that are volatile, vulnerable to fashion and vigorous marketing, and are essentially meaningless—changes in ranking position are normally slow. There is a strong correlation between national investment in university research and the position in research-based rankings, such as the Shanghai Academic Ranking of World Universities (ARWU) and the Leiden ranking, but it takes time to show itself. There are lags between investment in capacity and scientific output, between publication and citation, and between citation and ranking.

Given that, the rise of universities in China, Hong Kong, Singapore, Korea, and Taiwan has been especially significant. The number of Chinese universities in the ARWU top 500 rose from 8, in 2005, to 28, in 2013 only eight years later. In Taiwan, that same number rose from five to nine. However, there were only five Chinese universities in the top 200, and 19 Asian institutions altogether. The ARWU tends to understate the position of Asian universities, because 30 per cent of the ranked position is determined by the history of Nobel Prizes and there have been few Nobels in Asia. The Leiden ranking, which provides a number of single indicators related to research quantity, and quality as measured by citation rates, is probably more useful.

One Leiden indicator ranks universities on the basis of the number of scientific articles produced by each university that are in the top 10 per cent of their research field on the basis of citation numbers. On that measure, in the 2104 Leiden ranking there were 28 Asian universities in the world top 200 on the basis of research papers published in 2009-2012, compared to the 19 universities in the 2013 ARWU top 200. This is slightly up from 26 in the first Leiden ranking three years before. The highest placed Asian institutions were the University of Tokyo (1389 top 10 per cent papers, 29th in the world), National University of Singapore at 30, and Tsinghua in China at 49 [6]. These are not remarkable figures. It is hard to break into the world top 50. However, the current ARWU and Leiden rankings reflect the investments in research of the 1995-2005 period. It is certain that when the last decade of investments is realised in the rankings there will be many more East Asian universities in the world top 200 than at present, and several more universities will be pushing up the top 50.

The position of East Asia as a front rank region in science and technology is already an accomplished fact and this fact will loom larger in the future. It will take a bit longer for world opinion, in universities and elsewhere, to understand that a major change has occurred. University reputation is path-dependent and tends to be conservative. For some time to come, the US, UK, and the strong systems in Central and Northwestern Europe, such as Germany,

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Netherlands, Switzerland, Sweden, Denmark, and Finland, will continue to command greater prestige and attract a higher-than-average share of talented doctoral students and career faculty. The English-language countries have a special advantage in educating international students because English is the one global language of business, the professions, and science. Nevertheless, in the long run, objective production is irresistible, in higher education and science as in many other fields of human endeavour. With a growing proportion of new knowledge coming from East Asia, the world will come to realise that the dragon has arrived, and power in the knowledge economy has become more plural.

Notes

[1] United Nations Educational, Scientific and Cultural Organisation (2014). *Educational Statistics*. UNESCO Institute for Statistics. <http://www.uis.unesco.org/Pages/default.aspx>

[2] Organisation for Economic Cooperation and Development, (2014). *PISA 2012 Results in Focus. What 15 year olds know and what they can do with what they know*. Paris: OECD

[3] National Science Foundation, United States (2014). *Science and Engineering Indicators 2014*. <http://www.nsf.gov/statistics/seind14/>

[4] *Nature Publishing Index* (2014). <http://www.natureasia.com/en/publishing-index/>

[5] National Science Foundation, *op cit*.

[6] Leiden University (2014). Centre for Science and Technology Studies, CWTS. *The Leiden Ranking 2014*. <http://www.leidenranking.com/default.aspx>

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Simon Marginson is Professor of International Higher Education at the Institute of Education in London. His work is focused on higher education, and comparative and international education, in the context of globalization. He is the 2014 Clark Kerr lecturer at the University of California. Forthcoming books include *The Age of STEM* and *Higher Education in Vietnam*. For details of previous publications, see his biography.