

Trends in Higher Education in Science and Engineering

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For several decades, countries have strengthened their higher education system in science and engineering fields as a strategy for development, based on the assumption that knowledge would bolster their economies. In the 1990s this assumption became widespread and most industrial and developing countries began improving their higher education systems, particularly in science, mathematics, engineering, and technology. This was generally intended to prepare the country for a knowledge economy, one in which there is within-country capacity for breakthrough research leading to innovative products and success in world markets. This trend is highlighted through three major trends in science and technology education: the increasing institutional capacity for advanced training in many countries; increasing flows of foreign students to advanced countries to offset demographic trends of a declining college-age population in all advanced countries; and expanding options for mobility by foreign doctoral recipients to remain abroad, return home, or circulate between home and abroad during their careers.

Trends in Doctoral Degrees

The development of increasing capacity to provide doctoral science and engineering education is seen in trends on the number of earned degrees in selected countries in Europe and Asia. China, Japan, Korea, and Taiwan have established new institutions for graduate science and engineering education and expanded existing programs in national universities by several orders of magnitude. China now has the largest capacity for science and engineering doctoral degree production in the Asian region, and Japan has doubled its degree production at the doctoral level within the last decade. France, Germany and the United Kingdom have more than doubled their doctoral science and engineering degrees in the last two decades, with slight declines in 1998. After two decades of expansion, the number of science and engineering doctoral degrees in the United States declined for the first time in 1999.

This growing capacity for doctoral level education in science and engineering makes some Asian developing countries less dependent on the United States for their advanced training. For example, in the last five years, Chinese and Korean students earned more doctoral science and engineering degrees in their respective countries than in U.S. universities. And in 1999, Taiwanese students, for the first time, earned more

doctoral science and engineering degrees from Taiwanese universities than from U.S. universities. Another implication of these trends is a shift in the proportion of such degrees earned outside the United States, which may eventually translate into a corresponding shift in research capacity, scientific output, and innovative capacity.

Demographic Trends and Flows

The declining number of U.S. doctoral science and engineering degrees relates in part to a significant decrease in the college-age population, a decrease that has occurred in all major industrial countries. The U.S. college-age population decreased by 20 percent from 1980 to 1997. Europe is having an even steeper decline in its college-age population, a reduction of 27 percent from 1985 to 2005. Japan's college-age population will decrease by 30 percent by 2015. These trends partly explain the need of Western and Japanese universities to augment the number of graduate students entering science and engineering departments, as well as the increasing flow of foreign students from countries such as China and India, each of which have around 90 million young people in their college age cohort.

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There is some evidence of an increasing flow of foreign science and engineering graduate students to a number of industrialized countries. Enrollments of foreign students at the graduate level at U.K. universities increased from 28.9 percent in 1995 to 31.5 percent in 1999. Foreign student enrollment is at an all-time high in the United States, representing around 40 percent of all graduate students in engineering, math, and computer sciences. The increasing amount of academic research in industrialized countries and the declining college-age populations are some of the factors that have fostered the flow of science and engineering students to advanced countries. The traditional host countries for large numbers of foreign students (the United States, France, and the United Kingdom) now include Japan and Germany. Japan's goal of 100,000 foreign students is once again being discussed as a serious target. In 1999, 22,000 foreign students were enrolled in graduate programs in Japan, mainly from China and South Korea, representing 10 percent of the graduate students in science and engineering fields. Germany is also recruiting foreign students from India and China to fill their research universities, par-

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ticularly in engineering and computer science.

Expanding Options for Mobility

An increasing trend is reverse flow of scientists and engineers back home, as countries are increasing science and engineering employment opportunities—expanding their institutions of higher education and research capacity. In 1998, the majority of foreign doctoral recipients in science and engineering fields from universities in the United Kingdom.

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returned home after earning degrees. In fact, 2 among the 10 top countries of origin, Malaysia and Turkey, had all doctoral recipients return home. Ireland is the only exception, with less than half (45 percent) returning to Ireland as their first destination after receiving a doctoral science and engineering degree. The return flow of science and engineering doctoral recipients from U.S. universities differs by country of origin. Mexico and Brazil have the highest return flow, India and China the lowest.

Besides returning home for employment, there are

many other options for contributing to the home-country's science infrastructure. Foreign doctoral recipients who remain abroad are contributing to the diffusion of science and engineering knowledge from cooperative research, short-term visits, and networking of scientists.

Conclusion

The demographic downturn in industrial countries provides an opportunity for more foreign students to enter graduate science and engineering programs for cutting edge knowledge and research in advanced nations. Subsequently, this provides greater circulation and diffusion of S&E knowledge as foreign students return home or maintain contact with the science and engineering community in their home country. Global diffusion of science and engineering knowledge and expansion of doctoral education abroad imply that a larger share of academic research and development and scientific knowledge will be generated outside the United States. This challenges the United States to devise effective forms of collaboration and information exchange to benefit from, and link with, the other countries' and regions' expanding scientific capabilities.

Author's Note: Data and analyses of these trends will be published in the National Science Board report: Science & Engineering Indicators—2002 (forthcoming).

International Diploma Mills Grow with the Internet

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International education in its positive sense is one of the best parts of modern higher education. The kind of cross-pollination available through transnational utility of degrees and academic experiences is good for all parties. However, there are weevils lurking in the mix of international degrees.

International quality control of degrees is becoming a major issue as more diploma mills are flushed out of the United States or appear spontaneously in countries with little oversight of private colleges. Some of these entities send out bulk e-mails offering “prestigious unaccredited degrees” for a fee, no questions asked, no work required. Others require nominal work or a one-month residency

on some tropical isle in order for the degree to be awarded. A recent trend among unaccredited U.S. institutions is to go to foreign countries—almost always small ones—for “accreditation.” Some startups intentionally seek out weak points in the international higher education oversight framework.

International Mystery Colleges

Columbia Pacific University was closed by the California courts at the request of the state attorney general. It has reappeared in Montana, which has no laws governing private college operations, as Columbia Commonwealth University and has been “accredited” by the government of Malawi. It now claims that its Malawi-approved degrees are good throughout the Commonwealth. If Malawi lists it with UNESCO, how should its degrees be treated?

Berne University has offices in New Hampshire but is “accredited” by St. Kitts, notorious for its willingness to accredit anything with a pulse. This is the country