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International Mobility of Doctoral Recipients from U.S. Universities

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Panel on Survey of Earned Doctorates: Mobility of Doctoral Recipients

International Mobility of Foreign Doctoral Recipients

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Introduction

The mobility of foreign doctoral recipients reported in the NSF Survey of Earned Doctorates can be most effectively understood by first looking at some global trends in science and engineering (S&E) education. This provides the context for international mobility patterns of foreign students earning doctoral degrees.

For several decades, countries have strengthened their higher education in science and engineering fields as a strategy for development, based on the assumption that resulting knowledge would bolster their economies. In the 1990's this goal became widespread with most industrial and developing countries seeking to improve their higher education systems to prepare for a "knowledge economy." This was particularly true for science and engineering. The knowledge economy they seek is one in which there is within-country capacity for breakthrough research that leads to innovative products, sustainable development and success in world markets. This presentation addresses this movement towards S&E education for development by presenting some indicators of three major trends:

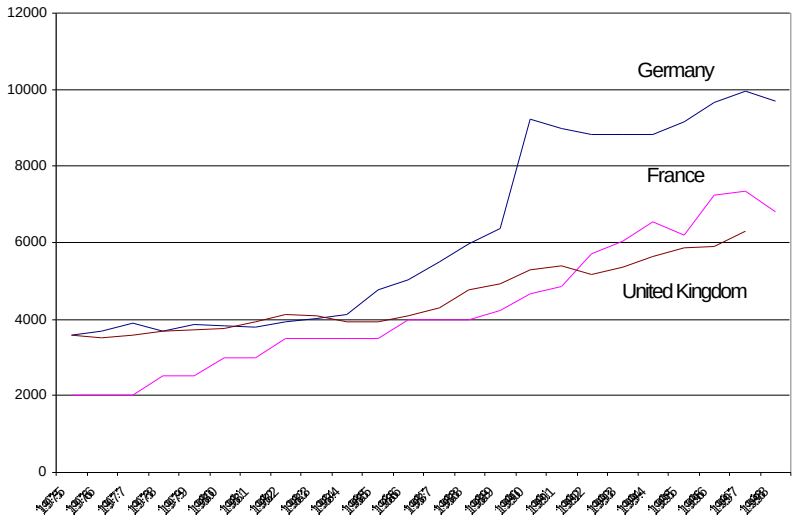
1) the increasing institutional capacity for advanced training in S&E in many countries;
2) increasing flows of students and postdocs among countries; and
3) new patterns of mobility by foreign S&E doctoral recipients in remaining abroad, returning home, or circulating between home and abroad during their careers.

These trends may indicate a changing global position of the United States in the education of scientists and engineers.

Accelerated capacity

The development of increasing institutional capacity to provide doctoral science and engineering education is indicated in trend data for earned degrees in selected countries of Europe and Asia. The major countries of Europe, France, Germany and the United Kingdom have more than doubled their doctoral S&E degrees in the last two decades, with slight declines in 1998.

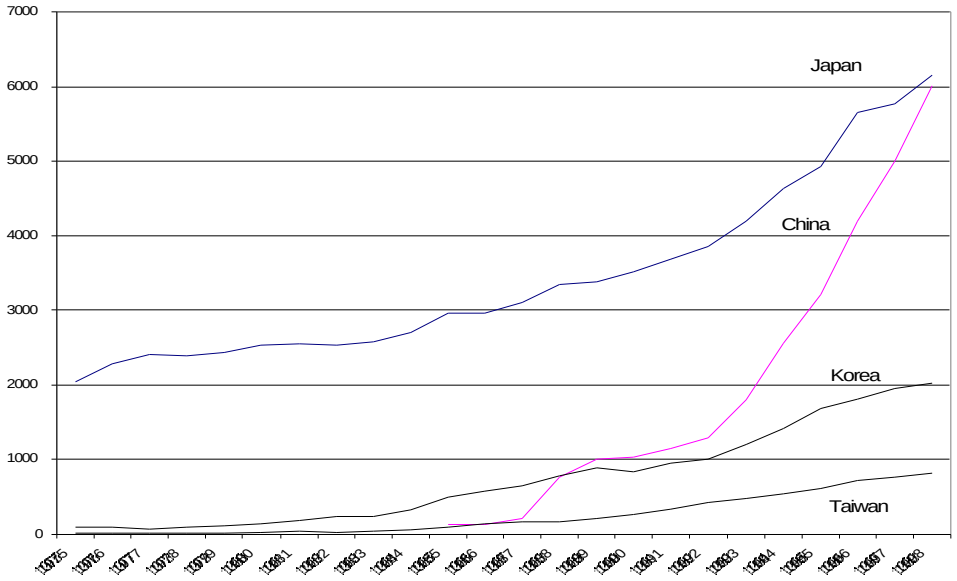
Doctoral degrees in science & engineering in selected European countries



Sources: France--Ministere de l'Edulation Nationale, de la Recherche et de la Technologie, Rapport sur les Etudes Doctorales (Paris: 2000); Germany--Stististisches Bundesamt, Profungen an Hochschuler (Wiesbaden: 1998) and OECD, Education at a Glance, OECD Database 2000; United Kingdom--Higher Education Statistical Agency, Students in Higher Education Institutions, 97/98 (Cheltenham:1999).

Asian developing countries, starting from a very low base in the 1970's and 1980's, have increased their doctoral science and engineering education by several orders of magnitude. Japan has doubled its doctoral S&E degree production within the last decade.

Doctoral degrees in science & engineering in selected Asian countries

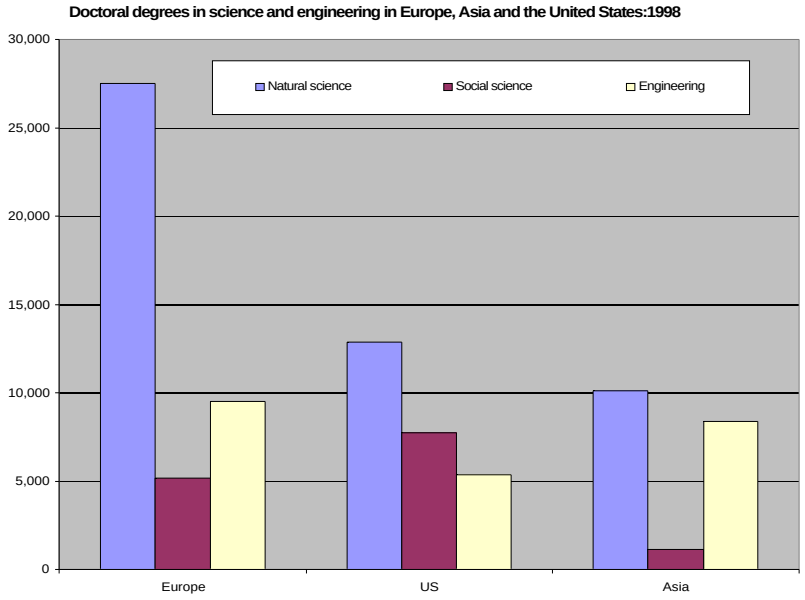


SOURCES: China--National Research Center for Science and Technology for Development, unpublished tabulations; Japan--Ministry of Education, Science, and Culture (Monbusho) ***Monbusho Survey of Education (*** Tokyo: annual series); Korea--Ministry of Education, ***Statistical Yearbook of Education*** (Seoul:1998); Taiwan--Ministry of Education, ***Educational Statistics of the Republic of China: 1998*** (Teipei: 1998).

China, Japan, Korea and Taiwan have established new institutions for graduate education in science and engineering and expanded their S&E graduate programs in existing national universities. 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 5 years, Chinese and Korean students earned more doctoral S&E degrees in their respective countries than in U.S. universities. And in 1999, Taiwanese students, for the first time, earned more doctoral S&E degrees within Taiwanese universities than from U.S. universities.

Figure: Doctoral S&E degrees earned by Asian students within their respective countries and within U.S. institutions.

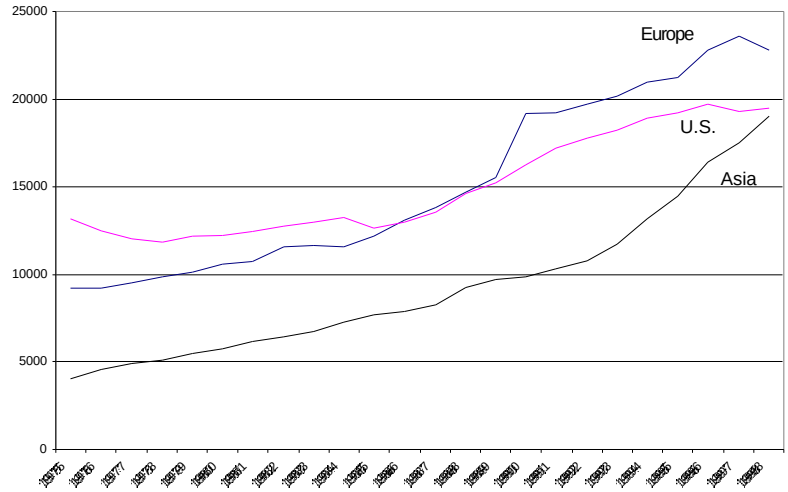
By broad world region, in 1998, Europe produced more doctoral S&E degrees than Asia or the United States. Considering broad fields of science, the largest number of natural science doctorates are earned within European universities, while the largest number of social science doctorates are earned within universities in the United States. In contrast, production in engineering doctoral degrees is more evenly spread across all three regions.



NOTE: See appendix table 1 for countries inclluded within each region.
SOURCE: National Science Board, Science and Engineering Indicators--2000. Arlington, VA, National Science Foundation, and national sources for updates.

Asian universities educate a similar number of students at the doctoral level in natural science and engineering as the United States. In 1998, Asian universities produced more engineering doctoral degrees than the United States, but fewer natural science degrees.

Doctoral degrees in natural science & engineering in the US and selected countries of Europe and Asia



NOTES: Europe includes Germany, France and the United Kingdom; Asia includes China, India, Japan, Korea and Taiwan.
SOURCES: National Science Board, Science and Engineering Indicators--2000, NSB 00-1. Arlington, VA, National Science Foundation; and national sources for updates.

The increasing global capacity for doctoral S&E education implies a share shift in the U.S. percentage of the world's total doctoral S&E degrees. In 1998-99, among the 32 countries for which doctoral degree data were collected, the number of U.S. doctoral degrees in engineering represents less than a quarter of reported degrees. Time series data are not available on all reported countries to determine the U.S. percentage 10 or 20 years ago, but as doctoral education increases in other countries, the U.S. share decreases.

US percentage of world's doctoral science & engineering degrees

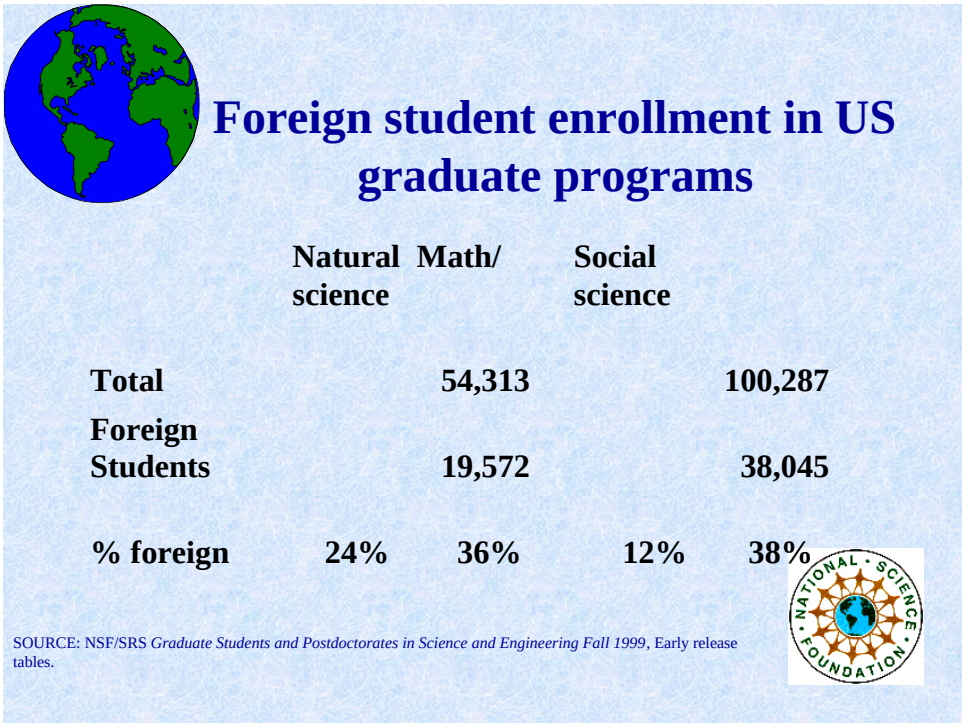
	Natural sciences	Social sciences	Engineering
	55,312	15,378	25,078
U.S. total	13,622	7,731	5,919
U.S. % of total	25%	50%	24%

See appendix table 1..

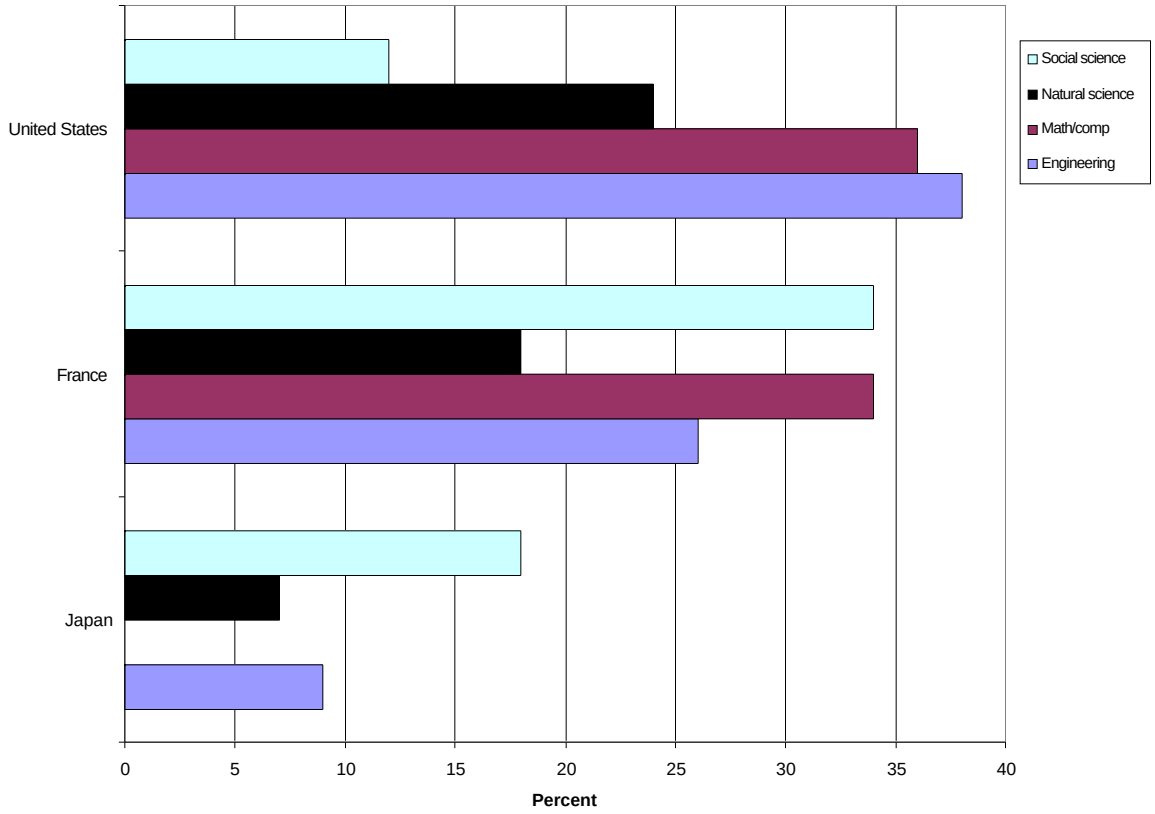
Flows of Students

The second global trend that provides context for the mobility of foreign students in the Survey of Earned Doctorates is the increasing flow of students and postdocs among an increasing number of countries. The traditional host countries for large numbers of foreign students (United States, France and the United Kingdom) are expanding to Japan, Germany, Canada, and Australia.

The NSF 1999 Survey of Graduate Students and Postdoctorates in Science and Engineering shows that over 100,000 foreign students are enrolled in U.S. S&E graduate programs. They represent a significant portion of engineering and math and computer science students.



Foreign students are also very attracted to France and the United Kingdom for graduate programs in science and engineering. The French universities have a particularly long tradition of educating foreign students, and they may have the broadest base of countries of origin of foreign doctoral students, over 150 countries. The vast majority of the top countries of origin are developing countries from Africa, Latin America and Asia. About 15 percent of the foreign students in French doctoral programs are from neighboring European countries. In 1998, the majority of the 17,000 foreign doctoral students who entered French universities enrolled in fields of science and engineering. Foreign students in France represent about 26 percent of doctoral science and engineering enrollment, similar to the proportion in U.S. graduate enrollment. (We are awaiting trend data from the UK.)

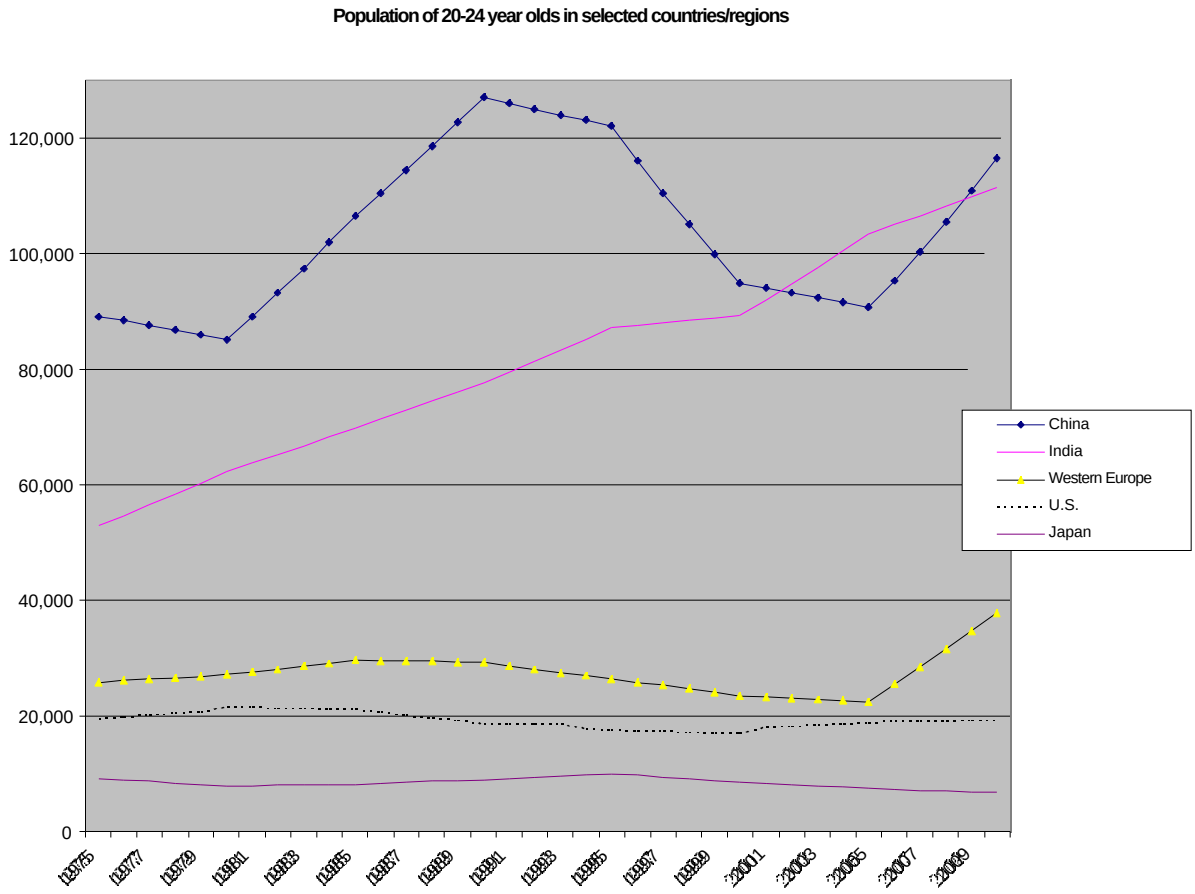


SOURCES: United States--NSF/SRS Graduate Students and Postdoctorates in Science and Engineering Fall 1999, Early release tables; France--Documentation Center, Education Statistics, Vanves, France; Japan--Monbusho Survey of Education.

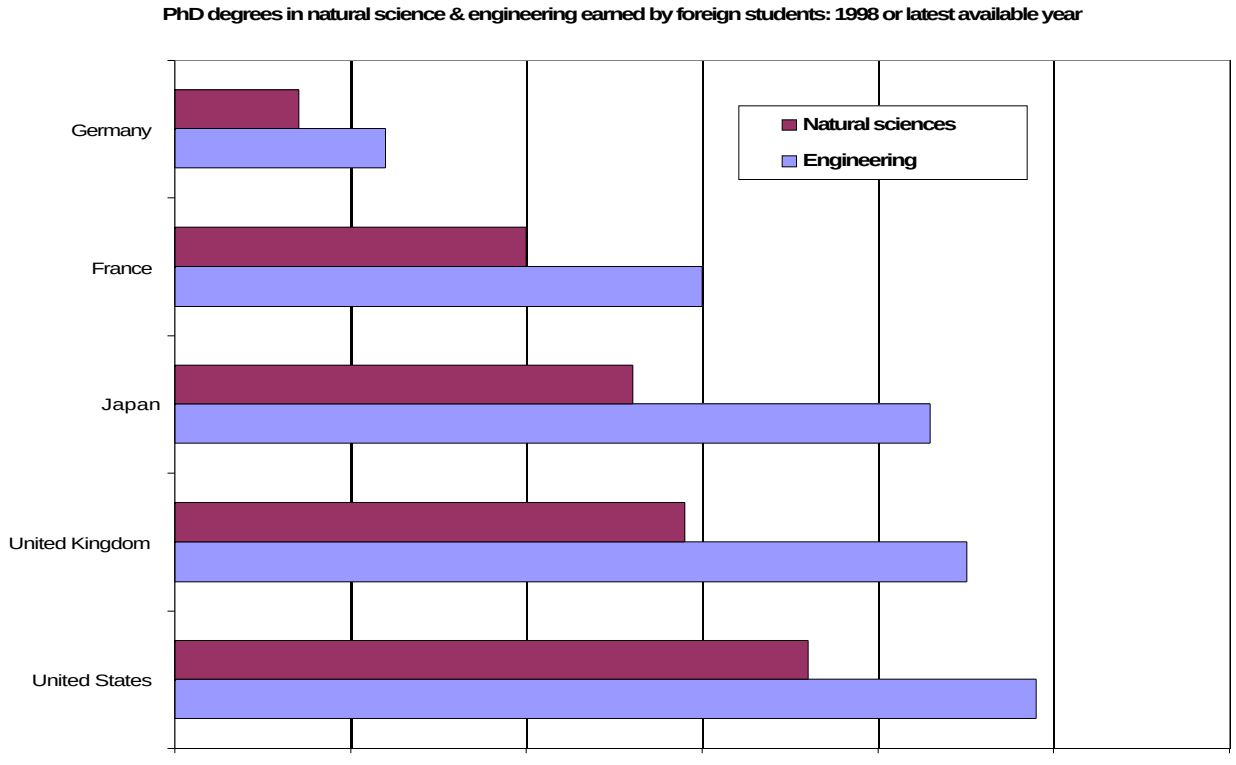
Japan is attempting to bolster its enrollment of foreign students in science and engineering. Japan's goal of 100,000 foreign students, promulgated in the 1980's, has never been met, but is once again being discussed as a serious target. In 1998, 55,000 foreign students enrolled in Japanese universities, mainly at the undergraduate level. In that year, about 12,000 foreign students enrolled in graduate S&E programs in Japan, representing 10 percent of the graduate students in science and engineering. Germany is also recruiting foreign students to fill their graduate programs, particularly in engineering.

Demographics

Part of the reason for the increasing flow of foreign students in science and engineering is the declining college-age population in the major industrial countries, and the ability to recruit graduate students from countries with far larger student populations. While China and India each have almost a 100 million young people in their college-age cohort, the United States and Western Europe each have around 20 million. The U.S. college-age population decreased from 22 million in 1980 to 17 million in the year 2000, a reduction of 23 percent. Europe is having an even steeper decline in its college-age population, from 30 million in 1985 to 22 million in the year 2005, a reduction of 27 percent. Japan's 10-million college-age population, which began to decline in 1995, will reach a low of 7 million in 2015, representing a loss of 30 percent of its college-age cohort.



The increasing amount of academic research and the demographics of declining college-age populations in industrialized countries are among some of the factors that have fostered the flow of science and engineering students to advanced countries. The United States, the United Kingdom, Japan and France are among the leading countries in the



education of foreign students at the doctoral level.

The third global trend is the increasing international circulation of scientists and engineers and S&E information. The circulation refers not only to those who return to their home countries for employment, but also to short visits for conferences and seminars and other mechanisms for exchanging information. The international networking of expatriate scientists and engineers with their home countries and new international cooperative arrangements for university programs in science and engineering are part of this trend. While there is anecdotal information every day on this trend in the *Chronicle of Higher Education* and in science journals, it lacks quantification. We know, for example, that Ireland, Korea and Taiwan have been particularly successful in attracting back their scientists and engineers after advanced training and research experience abroad. Their dynamic economies can utilize highly trained scientists and engineers. Quantification is lacking, however, of those who return to their home countries and how they contribute to S&T infrastructure.

These trends indicate that 1) the institutional capacity for doctoral S&E education is becoming more dispersed, even to developing countries, 2) increasing numbers of foreign graduate students are flowing to a greater number of countries, and 3) reverse flow increases as countries can absorb high-level talent.

International mobility of foreign doctoral recipients in the United States

Within this background of global trends, we will now examine the international mobility of foreign S&E doctoral recipients as shown in the Survey of Earned Doctorates. The

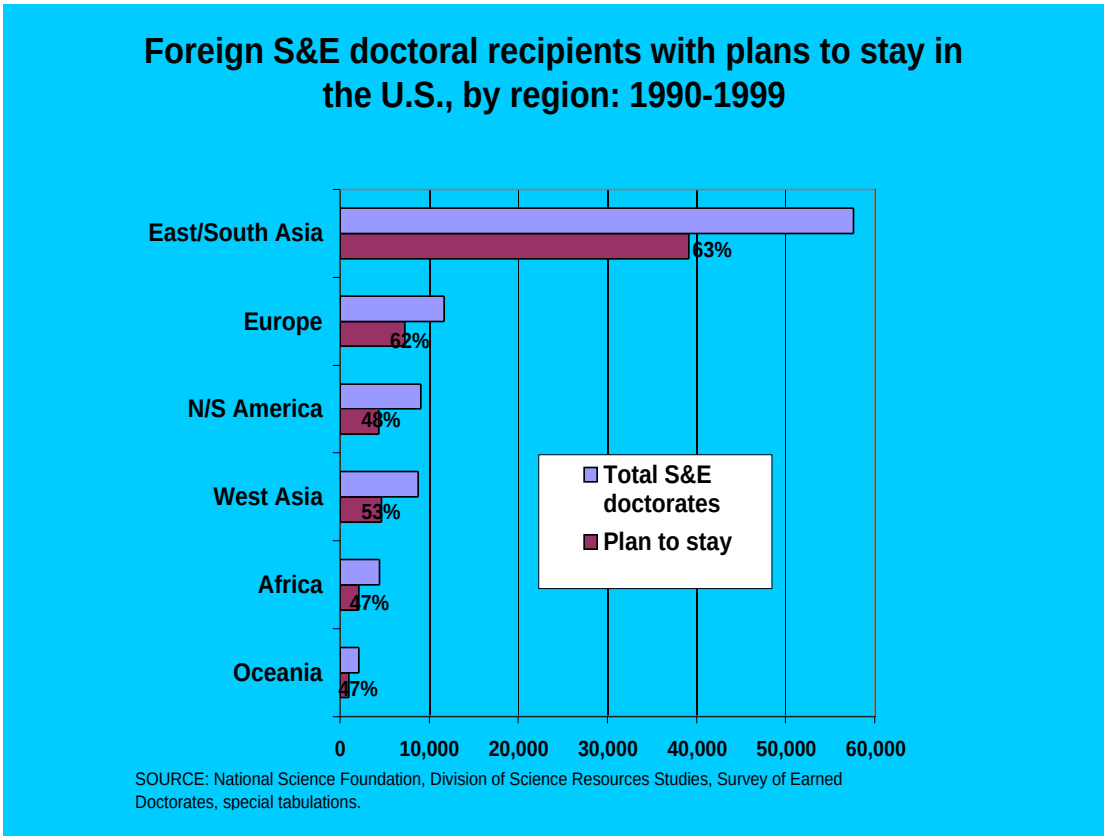
Foreign S&E doctoral recipients with plans to stay in the United States

SOURCES: National Science Foundation, Division of Science Resources Studies, ***Science and***

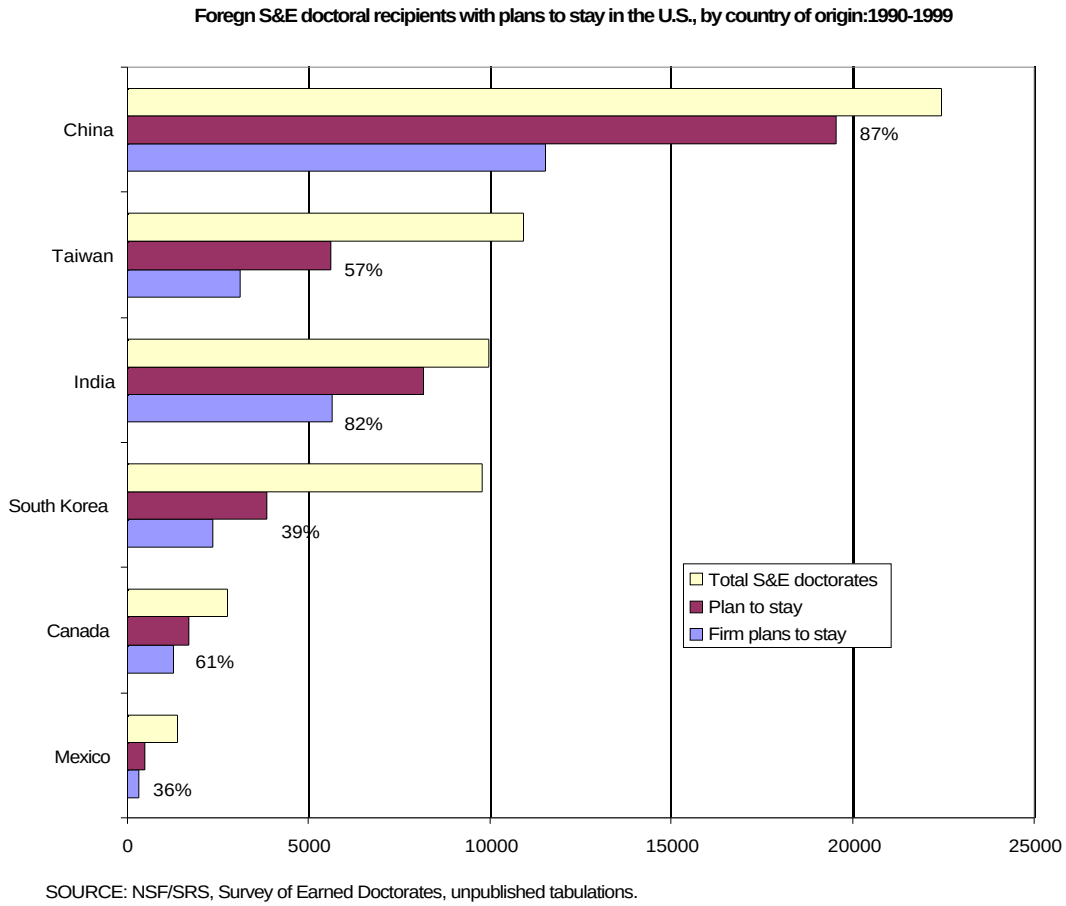
number of doctoral S&E degrees earned by foreign students has declined somewhat from the peak year of 1996.

However, the number with firm plans to stay has remained at the peak level of 1996. From 1996 to 1999, over 4,000 foreign doctoral recipients had firm offers to remain in the United States at the time of degree conferral. Until 1992, about 50 percent of those who received an S&E degree from the United States planned to stay (not firm plans). Since 1992, however, the early 1990, however, the percentage has continued to increase.

Plans of foreign doctoral students to stay in the United States differ by their region of origin. Those fromEast and South Asia and Europe have the highest percentage who plan to stay in the United States.

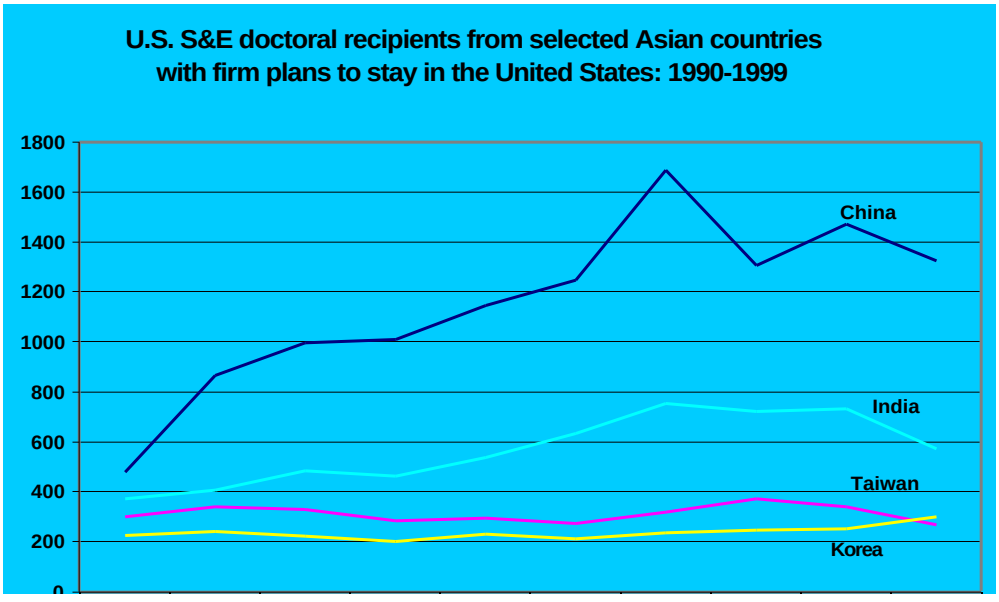


Individual countries within regions also differ significantly. Within Asia, China and India have higher than average stay rates in the United States, Korea and Taiwan lower. In North America, Mexico has a relatively low stay rate.



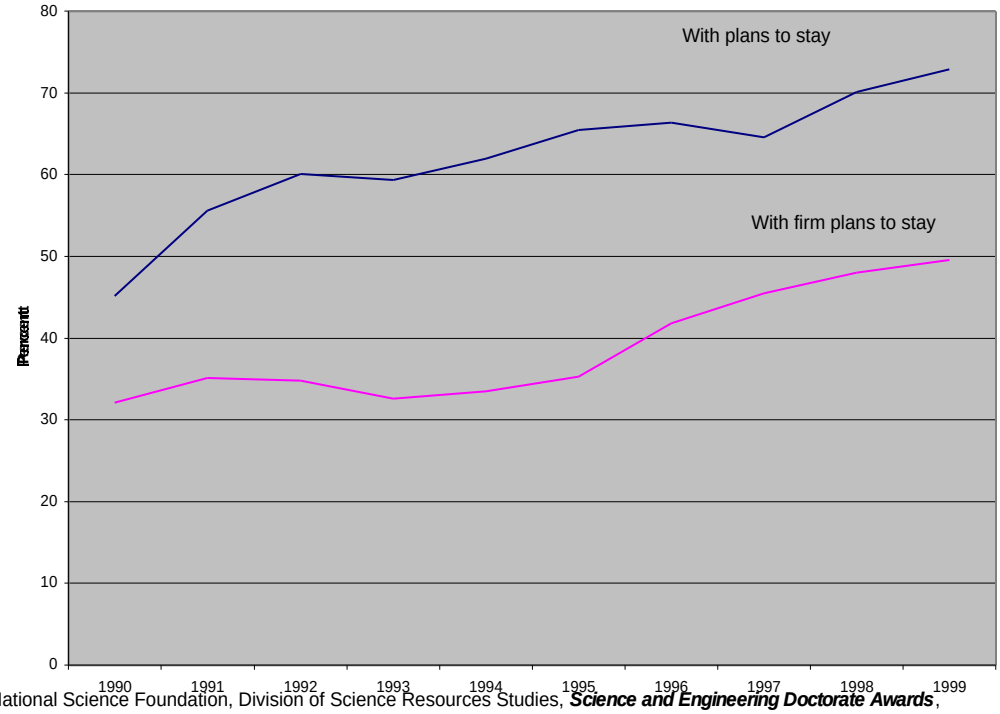
SOURCE: NSF/SRS, Survey of Earned Doctorates, unpublished tabulations.

If we examine firm plans to stay year by year for Asian countries, we see slight shifts in the last few years. Fewer doctoral recipients from China, Taiwan and India have firm plans to stay in the United States, and an increasing number of Koreans do.



In 1999 in the Survey of Earned Doctorates, over 70 percent of foreign doctoral recipients planned to stay in the United States and half of them had firm offers to do so, that is mainly for post-doctoral appointments and employment in industry.

Percent of foreign S&E doctoral recipients with plans to stay in the United States



Source: National Science Foundation, Division of Science Resources Studies, ***Science and Engineering Doctorate Awards***, Detailed Statistical Tables, and Unpublished tabulations of the Survey of Earned Doctorates (SED).

Conclusions

International mobility of foreign doctoral recipients is dynamic, and patterns change quickly. In the future, foreign students may not come in such great numbers from the major sending countries: China, India, Korea and Taiwan. For example, the number of foreign graduate students from Taiwan has decreased by 40 percent in the last five years, from 25,000 in 1993/94 to 15,000 in 1999/2000. A greater number of foreign graduate students from other developing countries may enter U.S. graduate programs. For example, foreign graduate students from Mexico grew from 2,900 in 1993/94 to 4,000 in 1999/2000.

Foreign students may not come in such great numbers to U.S. graduate programs due to access to advanced education in their own countries, or other countries. For example, there have been a declining number of foreign graduate students entering U.S. programs from Thailand, Malaysia and Indonesia. Possibly graduate programs in other Asian countries are attracting more of these students.

The percentage of foreign doctoral recipients planning to stay in the United States may return to the lower 50 percent level that existed until 1992. The 60-70 percent stay rates of the 1993-99 period may have been driven by the expanding U.S. economy and employment opportunities.