U.S. STAY RATES OF FOREIGN-BORN DOCTORAL STUDENTS FROM SENSITIVE COUNTRIES

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EXECUTIVE SUMMARY

Institutions of higher learning in the United States always have attracted students from foreign countries. Most of these students obtain graduate degrees in engineering or physical science disciplines and then remain in the United States for several years or indefinitely after completing their education. In the most common terminology, "foreign students" include only those students who have temporary visas.

This study focuses on the rate (hereinafter referred to as "stay rate") at which foreign doctoral students in engineering and the physical sciences stay in the United States after graduation and the extent to which they find employment at or around our national laboratories. The estimates are based on income tax data and Social Security Administration tax records for groups of doctoral recipients constructed in such a way as to preserve the confidentiality of individuals. The purpose of this study is to follow the stay rate of foreign students who attend U.S. universities and then remain in the United States after graduation. The objective of the study is to ascertain the number of these students remaining in the United States and the possibility of them becoming employed in our Department of Energy (DOE) national laboratories or other governmental agencies.

The stay rates of doctoral students from the People's Republic of China (hereafter referred to as China), India, and Iran are significantly higher than the stay rates of students in the same disciplines from other countries. While the number of foreign students increased during the 1990s, this fact could reflect nothing more than a better quality of life but is, however, a factor that could have significant security implications. Specifically, the subfields within the general categories of engineering and physical sciences are heavily relied upon by the defense industry. These subfields are listed in Appendix A of this document. The data indicate that many doctorates from sensitive countries as defined by the Department of State often have degrees in these subfields. The list of sensitive

countries identified by both the DOE and the Department of State is listed in Appendix B of this document.

The question arises as to whether the education, subsequent work experience, and exposure these students receive might ultimately compromise national security. The DOE and its national laboratories, as well as other governmental research institutions and defense contractors, must balance their educational requirements for employees and availability of employees having those educational qualifications with national security requirements.

The highlights of this study include the following:

- Half (51 percent) of temporary residents who received science and engineering doctorates from U.S. universities in 1994-95 were living in the United States in 1999.
- Nearly two-thirds (63 percent) of temporary residents who received science and engineering doctorates from U.S. universities in 1997 were in the United States in 1999.
- The 63 percent stay rate for the Class of 1997 in 1999 is a record high. An analysis of the reasons why this is so much higher than the 51 percent stay rate recorded in 1999 for the classes of 1994 and 1995 indicates:
  - Nearly half of the difference is due to a shift in the proportion of temporary resident students coming from different countries. A temporary law caused many of the doctoral recipients from China to become permanent residents prior to graduation. This depressed the overall stay rate for temporary residents from the 1994 and 1995 classes because Chinese students have the highest stay rate.
  - Slightly more than half of the difference is due to increased stay rates for temporary resident students from the various individual countries of origin.

- The stay rate for all foreign doctoral recipients two years after graduation (i.e., including those on permanent visas at graduation) increased from 49 percent in 1989 to 69 percent in 1999.
- Among discipline groups the highest stay rates were recorded for computer and electrical/electronic engineering, computer science, and the physical sciences. The stay rate in the social sciences was the lowest.
- Most foreign doctoral recipients come from the four largest source countries. The stay rates vary dramatically for temporary residents from these four countries: China (91 percent) and India (87 percent) are very high while Taiwan (42 percent) and Korea (15 percent) are much lower.
- Stay rates estimated for the Class of 1989 revealed approximately 50 percent of the students remained in the United States in 1999. A larger proportion (about 63 percent) paid taxes on U.S. earnings during at least one of the 10 years following graduation, indicating that for every four graduates who were here in 1999, there was a fifth graduate who remained in the United States to work after graduation but did so for less than two years and, therefore, was not here in 1999.

INTRODUCTION

This study presents an updated analysis of the rate at which students from foreign countries have remained in the United States after completing their education and the extent to which these individuals have obtained an education in the fields of expertise most frequently related to our national security.

The starting point for this analysis is the Survey of Earned Doctorates conducted by the National Science Foundation (NSF). This survey is conducted at the time of graduation at which time the graduating student's Social Security Number (SSN) and general information about employment is requested. Based on the SSN information, the Social Security Administration compiles statistics on the number of persons earning at least $5,000 per year broken down by the individual's country of origin. Along with the information from the NSF, these statistics become the basis for our analysis. The most useful stay-rate figures are for students who have graduated four or five years earlier. In the first few years after graduation, students often return to their native countries on a temporary basis. Additionally, during that period some doctoral recipients serve in postdoctoral appointments and do not pay Social Security taxes. After four to five years, however, these factors are significantly less relevant.

Both Social Security and income tax records are used in this study to minimize errors. Another measure taken to minimize errors is to exclude a small proportion of doctoral recipients for whom the birth year reported to the Social Security Administration differed from the birth year reported to the Survey of Earned Doctorates, the original source for the Social Security numbers of earned doctorates. In addition, minor adjustments were made to account for (1) expected mortality between graduation date and date of stay-rate calculations, (2) missing Social Security numbers (individuals without a Social Security number were assumed to stay at half the rate of others from the same country), and (3) a small proportion who stay in the United States and do not work or who

earn less than $5,000. The net effect of all these adjustments was very small because the adjusted stay rates in most cases do not differ by more than one or two percentage points from what would have been obtained from the raw data provided by the tax authorities. Sampling was used for the largest countries, but sampling error is small because the sample size was never less than 500. The overall sampling rate for DOE sensitive countries was 33 percent.

In summary, there is reason to believe that the stay-rate estimates reported in this document are accurate. The only source of error that has been ignored is the possibility that persons working in the United States do so without paying either Social Security or income taxes, and these are thought to be few.

DISCUSSION

The stay rate of all foreign doctoral recipients from U.S. universities has increased during the 1990s with a sharp increase from 1995 to 1997. Prior to 1995 about half of all foreign doctoral recipients stayed in the United States after graduation, but in 1999 the proportion was about two of three. These estimates are based on stay rates of all foreign doctoral recipients conducted two years after graduation, with the most recent (and highest) estimate made in 1999 for 1997 doctoral recipients. The overall stay rate for 1997 graduates still in the United States in 1999 was 63 percent. Computer and electrical/electronic engineering, physical science, and computer science have rates that are about twice as high as the rates in economics and social sciences. The latest report published in April 2002 by the National Science Foundation, however, indicates a decrease in 1999 graduates from U.S. universities and provides some insight as to why.[1]

There are some special circumstances affecting doctoral recipients in the first few years after students receive their doctorates, and these could possibly cause longer-term stay rates to differ from the stay rates observed only two years after graduation. For example, some students have visas that require them to leave the United States within two years of graduation. Many other graduates take temporary postdoctoral appointments immediately after graduation and may leave the United States after completing those assignments. Also, some recent doctoral graduates take temporary jobs while their spouses finish their education and make more permanent decisions at a later date. For these reasons one might wish to observe stay rates several years after graduation to avoid drawing conclusions from temporary actions. Such stay rates for citizens of the DOE Counterintelligence Programs Sensitive Countries List[2] are shown in Table 1.

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[1] National Science Board, *Science and Engineering Indicators – 2002*, Arlington, VA: National Science Foundation, 2002 (NSB 02-01).

[2] *The DOE Counterintelligence Program Sensitive Countries List*, Security Refresher Briefing, ORAU/ORISE, 2001.

Table 1. Stay Rate Percentages in 1996-99 for Foreign National 1994-95 Science and Engineering Doctoral Recipients on Temporary Visas[3]

	Doctoral Recipients	Percentages			
		1996	1997	1998	1999
China	1,649	88	89	91	91
India	1,995	88	89	89	88
Iran	198	60	61	62	61
Israel	121	42	39	34	31
Taiwan	2,268	44	41	39	42
All other sensitive countries	406	46	48	49	50
Total, sensitive countries	6,637	69	68	68	69
Total, non-sensitive countries	7,552	39	37	37	35
Total, all countries	14,189	53	51	51	51

Source: Oak Ridge Associated Universities

Table 1 shows stay rates for students in all science and engineering disciplines combined. The stay rate for students from sensitive countries is 69 percent, nearly twice the stay rate for students from all other countries. For this cohort the vast majority of the students from sensitive countries come from a few countries with large populations. The percentage fluctuations from year to year are the result of cyclical movements that occur following graduation. Some students return to their homeland for a period of time and for unknown reasons return to the United States to seek employment. While data do not exist to trace the history of stay rates for all sensitive countries, Table 2 provides such data for sensitive countries that collectively account for the vast majority of doctoral recipients.

[3] Information compiled by Michael G. Finn, Oak Ridge Associated Universities, 2001.

Table 2. Stay Rate Percentages of 1992-99 Science and Engineering Doctoral Recipients on Temporary Visas

	Doctoral Recipients			
	1992* (1987-1988)ℜ	1995* (1990-1991)ℜ	1997* (1992-1993)ℜ	1999* (1994-1995)ℜ
China	65	88	92	91
India	72	79	83	88
Taiwan	47	42	36	42
Combined Total	59	72	75	71

*Year of survey
ℜSchool year doctorate was granted
Source: Oak Ridge Associated Universities

Three sensitive countries (China, India, and Taiwan) account for 89 percent of doctoral recipients having temporary visas as shown in Table 2. The stay rate for China is very high and has been near 90 percent since 1995. Table 2 shows an increase in the stay rate for students from China since the 1987 and 1988 surveys. A steady trend toward increasing stay rates throughout the 1990s has occurred for students from India who received doctorates in the United States. A modest decline over this period has occurred for students from Taiwan.

Table 2 shows the trend in the stay rate for students from China, India, and Taiwan combined. The stay rate for students from these three major countries increased sharply at first and has since remained in the 71 to 75 percent range. However, what would otherwise have been a clear upward trend in the stay rate for students from these three countries combined reversed from 75 to 71 percent in the 1999 survey. It is difficult to say why individual country stay rates change. However, the decline shown in Table 2 for China, India, and Taiwan combined is quite clear.

Table 2 describes the stay rate of temporary visa doctoral recipients only. However, some foreign citizens have permanent resident visas by the time they receive their doctorates. This often means that the student immigrated to the United States at an early age, not merely to attend graduate school. Students

can get permanent resident status quite quickly if they are in a special category designated by Congress. In the early 1990s Congress temporarily created a large special category when it passed the Chinese Student Protection Act. This law permitted a large number of Chinese nationals who were students in the United States to apply for and receive permanent resident visa status. This might have had relatively little effect on the overall stay rate of Chinese students because even those on temporary visas stay at a rate above 90 percent. However, for the large subset of students on temporary visas, this reduced the overall stay rate for students who were temporary residents at the time of graduation. It did this by reducing the proportion of the total number of Chinese residents, not by lowering the stay rate for any country.

Table 3 shows that total doctoral awards to non-U.S. citizens were near an all-time high in 1994, 1995, and 1996. However, during those years awards to temporary visa holders decreased sharply while awards to permanent visa holders increased by a similar number. This was almost completely due to students from China. As can be seen in Table 3, the total number of doctorates awarded to permanent residents was unusually high for several years starting in 1994.

Table 3. Science and Engineering Doctorates Awarded to Foreign Nationals by U.S. Universities (1989 to 1999)[4]

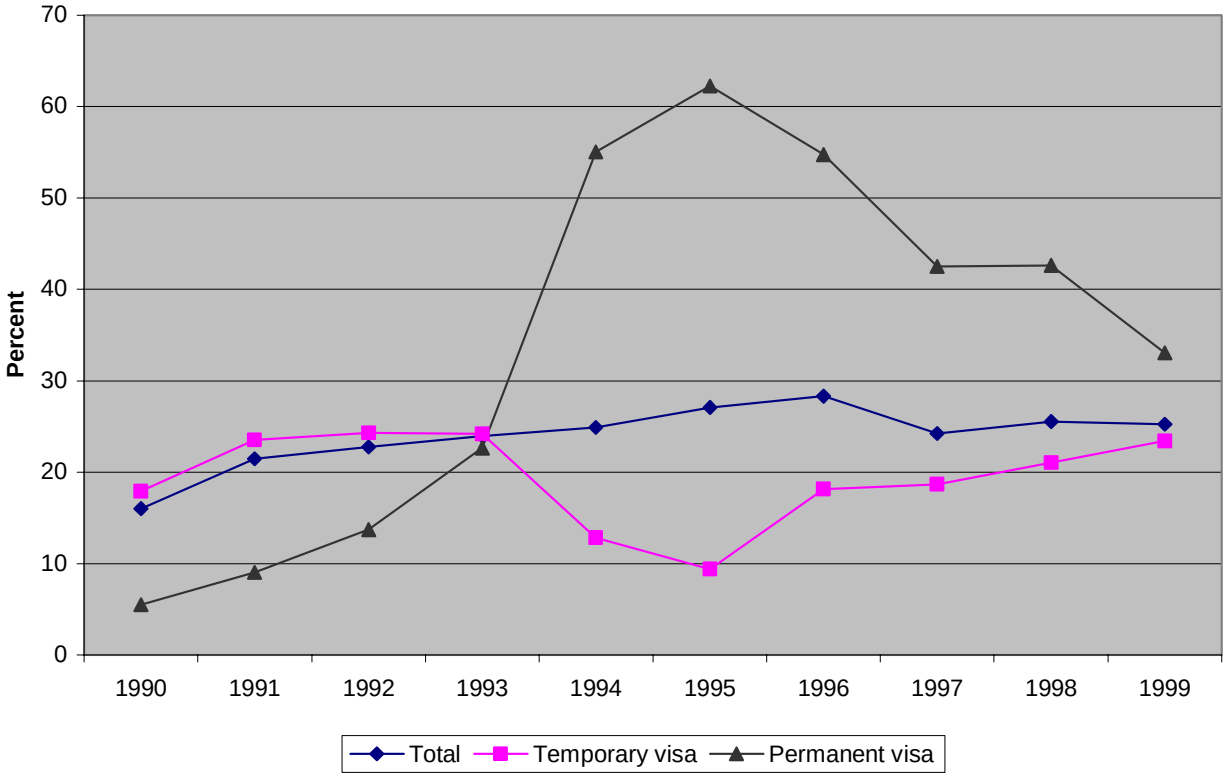
Year Degree Granted	Citizenship					
	Total S/E Degrees	Total Non-U.S.	Temporary Visas*	Permanent Visas*	Total U.S.	Unknown
1989	21,732	6,515	5,391	1,124	13,468	1,749
1990	22,868	7,768	6,571	1,197	14,167	933
1991	24,023	8,926	7,641	1,285	14,629	468
1992	24,675	9,475	8,092	1,383	14,559	641
1993	25,443	9,754	8,113	1,641	14,932	757
1994	26,205	10,542	7,521	3,021	15,166	497
1995	26,535	10,503	6,994	3,509	15,487	545
1996	27,229	10,809	7,806	3,009	15,630	790
1997	27,245	9,240	7,498	2,280	16,122	1,883
1998	27,309	9,159	7,779	2,022	16,246	1,904
1999	25,953	8,886	7,241	1,645	15,783	1,284

*Part of "Total Non-U.S."

Figure 1 shows the temporary decrease in doctoral recipients from China with temporary visas and the corresponding increase in the number of permanent visa doctoral recipients from China. Because the law providing permanent visas was in effect only temporarily in 1993 and 1994, the proportion of Chinese doctoral recipients with temporary visas has slowly returned to a level that is about the same as it was just prior to the special category designation.

[4] Source: National Science Foundation, Division of Science Resource Studies, *Science and Engineering Doctorate Awards: 1999*, NSF 01-314, Author, Susan T. Hill (Arlington, Virginia, 2001).

Figure 1.
Percentage of Doctorates Awarded to Chinese Citizens of All Science and Engineering Doctorates Awarded by U.S. Universities to Foreign Students, by Visa Type, 1990 to 1999



Source: Oak Ridge Associated Universities

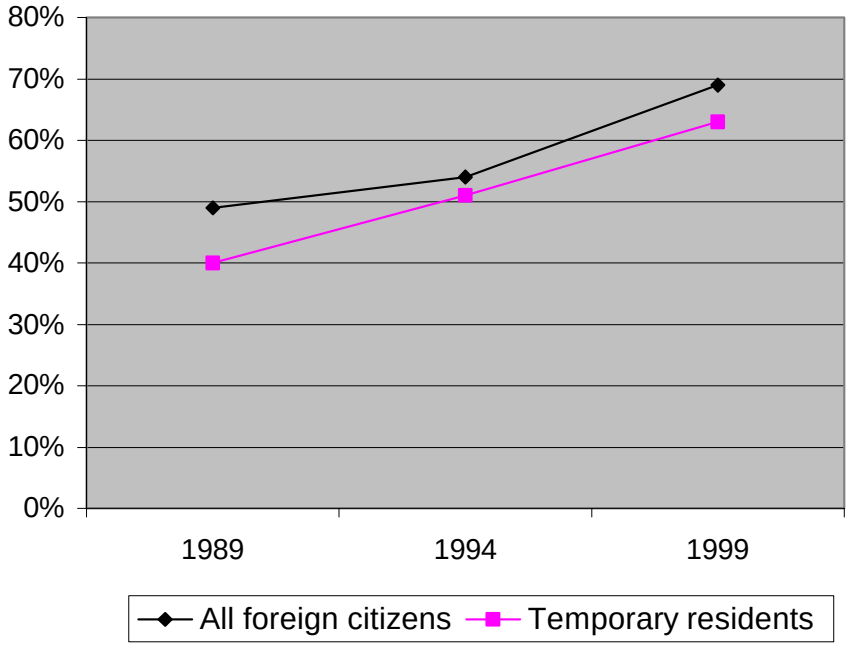
Clearly, the 1999 stay rate for doctoral recipients with temporary U.S. visas from sensitive countries in Tables 1 and 2 was depressed because it focused on the 1994 and 1995 cohorts. Giving permanent resident visas to a large number of Chinese nationals temporarily lowered the weight given to their high stay rate.

The lower stay rates for temporary residents for 1999 reported in Tables 1 and 2 are the correct stay rates for temporary residents receiving doctorates in 1993 and 1994. However, the total stay rate including graduates with temporary and permanent visas certainly increased. We did not estimate separately the permanent resident stay rate for citizens from sensitive countries, so we cannot estimate a total (permanent and temporary resident) stay rate for these countries. However, we can say that the only reason the temporary resident stay rate did

not continue to rise through 1999 in Table 2 was because many Chinese national students converted to permanent resident status. This was a classification change and not a change in stay-rate behavior.

Figure 2 shows stay rates for all foreign students (i.e., temporary and permanent residents). It does not show as many data points as Table 2 because estimates for permanent residents are not available for every year. If one considers only the stay rate for temporary residents, the increase after 1994 appears to be a continuation of an earlier trend. However, the stay rate for students who were on temporary or permanent visas at graduation shows a substantially larger increase after 1994.

Figure 2.
Foreign Students Receiving Science and Engineering Degrees from U.S. Universities Who Were in the United States Two Years After Graduation, 1989 to 1999



Source: Oak Ridge Associated Universities

In the past it was often said that roughly half of the foreign students stay in the United States after receiving doctorates in science and engineering fields. Figure 2 suggests that this was true but that now it is appropriate to say that roughly two out of three stay.

All the stay rates reported above are tabulated about two years after graduation. Our previous report[5] emphasized the stay rate four to five years after graduation. Table 4 shows similar data for the doctoral recipients of 1994 and 1995.

[5] *Stay Rates of Foreign Doctorate Recipients*, Center for Human Reliability Studies, August 2000 (ORISE 00-0889).

Table 4. Stay Rate Percentages in 1996-99 of Temporary Residents Receiving Ph.D.s in 1994-95

Degree Field	Foreign-born Doctoral Recipients	Percent in the United States			
		1996	1997	1998	1999
Physical science	2,347	64	59	59	58
Mathematics	817	50	50	47	46
Computer science	699	62	63	63	63
Agricultural science	813	38	36	36	35
Life science	2,091	56	53	52	52
Computer and electrical/electronic engineering	1,365	63	63	63	62
Other engineering	3,666	55	54	54	56
Economics	975	27	27	27	26
Other social science	1,219	32	31	30	29
Total, all science and engineering fields	13,992	53	51	51	51

Source: Oak Ridge Associated Universities

The stay rate observed in 1999 for the 1994 and 1995 classes is significantly lower than the 1999 stay rate reported earlier (Table 1) for the 1997 doctoral recipients. There seems to be two plausible explanations for this. One is that the stay rate increased sharply sometime after 1995. To the extent that this was caused by increased demand for foreign science and engineering doctorates in the United States, the increased demand must have had little impact on doctorates who had not graduated very recently. Data support this interpretation. For example, the immigration law was changed, and there was a sharp increase in visas granted to temporary workers. In particular, H1B visas were expanded with the express aim of helping high-tech industries in the United States. This particular visa is issued for work purposes to college graduates with special technical skills, most often computer specialists. Graduates with doctorates in

science and engineering often work in the United States on an H1B visa before obtaining a Green Card (permanent resident visa). The ready availability of these visas may facilitate the doctoral graduates who want to stay in the United States to work. Awarded H1B visas increased from 117,574 and 144,458 in 1995 and 1996, respectively, to 240,947 in 1998.[6]

A second possible explanation for at least part of the lower stay rate of the 1994-95 cohort is the reduced proportion of students from China. To explore that possibility one first needs to review how the stay rate varies by country. Table 5 indicates that stay rates continue to vary more by country than by discipline. China, India, and Nigeria have the highest stay rates, and these rates are about four to five times higher than the countries with the lowest stay rates (South Korea, Indonesia, and Brazil).

These country contrasts have been quite stable during the 1990s. Several prior reports placed China and India with the highest stay rates and South Korea and Brazil with the lowest stay rates. Also showing stability are the stay rates for Japan (still quite low) and the United Kingdom (still above average). If one were to look for individual countries changing rates during the 1990s, perhaps the most notable would be China, India, Germany, and Canada, which all showed increases in rates. Among these both Germany and Canada previously had below average rates but now all four countries show above average rates in Table 5.[7]

Table 5 shows stay rates for several countries and country groups for which estimates were not previously available. The grouping "Other Europe, East" includes countries making up the former USSR and its satellites. The stay rate

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[6] U.S. Immigration and Naturalization Service, *Statistical Yearbook of the Immigration and Naturalization Service, 1998*, Table 39, U.S. Government Printing Office: Washington, D.C., 2000.

[7] Finn, Michael G., *Stay Rates of Foreign Doctorate Recipients from U.S. Universities, 1997*, Oak Ridge, TN: Oak Ridge Institute for Science and Education, 2000.

for “Other Europe, East” (69 percent) is well above the average for all countries. Columbia (29 percent), and Chile (26 percent) join Mexico and Brazil as Latin American countries with stay rates well below the average.

Table 5. Temporary Residents Receiving Science and Engineering Doctorates from U.S. Universities in 1994-1995 Who Were Living in the United States from 1996 to 1997

Country of Origin	Doctorate Recipients	1996	1997	1998	1999
China	1,649	89	90	92	91
Taiwan	2,268	45	42	41	42
Japan	233	30	29	27	27
South Korea	1,943	23	18	17	15
Other East Asia	391	27	26	27	27
India	1,995	88	88	88	87
Iran	198	60	61	62	61
Israel	121	42	39	34	31
Turkey	252	46	47	43	44
Other West Asia	981	44	44	43	44
Australia	85	43	40	39	34
Indonesia	119	13	12	15	16
New Zealand	29	51	63	67	63
Other Pacific/Australia	103	68	63	64	66
Egypt	157	38	40	39	37
Nigeria	50	86	87	87	85
South Africa	50	35	39	40	40
Other Africa	542	47	45	45	42
Greece	276	51	51	50	49
United Kingdom	140	61	63	61	60
Germany	262	47	49	50	53
Italy	106	34	39	40	37
France	142	49	47	49	47
Spain	87	33	29	35	34
Other Europe, East	283	72	70	70	69
Other Europe, West	338	42	41	41	39
Canada	430	55	54	55	55
Mexico	223	27	29	29	31
Argentina	67	49	48	46	45
Brazil	255	22	21	21	21
Chile	57	26	24	24	26
Colombia	66	27	28	27	29
Peru	37	74	71	71	66
Other Central South America	254	48	46	44	49
Total, all countries	14,189	53	51	51	51

Source: Oak Ridge Associated Universities

This report includes all the data available on the stay rates of foreign national students from sensitive countries. However, there is one more table of interest. Table 6 shows a trend in stay rates for persons who graduated just two years prior to the date of the stay-rate calculation. Table 6 shows a record high stay rate for all countries (including countries that are not sensitive) in the last column, which records the stay rate of 1997 doctoral recipients in 1999.

Table 6. Temporary Resident Science and Engineering Doctoral Recipients Residing in the United States Two Years After Graduation

	Percent in the United States					
	1986	1989	1992	1995	1997	1999
Physical sciences	46	38	52	59	52	72
Life sciences	24	22	38	57	43	64
Social sciences	26	28	27	26	27	35
Engineering	52	44	52	51	57	66
Total, science and engineering fields	40	36	45	51	47	63

Note: Estimates for 1989 and 1992 describe persons graduating one to two years prior to those years; for all others it is two years prior. In this table, the physical sciences category includes mathematics and computer science, life sciences includes agricultural science, and social science includes psychology.

Source: ORAU Data from 1986 and 1989 are from Finn, Pennington, and Anderson, 1995[8]; data for 1992 and 1995 are from Finn, 1998[9]; data from 1997 from Finn, 2000.[10]

[8] Finn, Michael G., Leigh Ann Pennington, and Kathryn Hart Anderson, *Foreign Nationals Who Receive Science or Engineering Ph.D.s from U.S. Universities: Stay Rates and Characteristics of Stayers*, Oak Ridge, TN: Oak Ridge Institute for Science and Education, April 1995.

[9] Finn, Michael G., *Stay Rates of Foreign Doctorate Recipients from U.S. Universities, 1995*, Oak Ridge, TN: Oak Ridge Institute for Science and Education, 1998.

[10] Finn, Michael G., *Stay Rates of Foreign Doctorate Recipients from U.S. Universities, 1997*, Oak Ridge, TN: Oak Ridge Institute for Science and Education, 2000.

We do not know what has happened to the stay rates of foreign national students from sensitive countries since the 1994 and 1995 cohorts shown in Tables 1 and 2. However, Table 6 shows that stay rates for the most recent cohorts have increased overall, and the increase is quite substantial. The subset of countries that are sensitive accounted for 47 percent of all science and engineering doctoral awards in 1997. With the total stay rate of foreign national students up so much in the 1997 study, it is very likely that the stay rate of students from sensitive countries increased as well.

The National Science Foundation (NSF) study, *Science and Engineering Indicators – 2002*, reports that the federal government attracted only 4-5 percent of graduates with bachelor's and master's degrees, with engineering graduates more likely than science graduates to find federal employment. [11] This new study indicates that the percentage of foreign-born individuals among U.S. scientists and engineers is growing at all degree levels, in all sectors, and in most fields. By the end of the decade, one in four science and engineering doctorate holders had been born abroad.[12] In 1999 in the federal government, 16 percent of Ph.D. holders were born abroad; the share of those in state and local government employment was 19 percent.[13]

The NSF report also reveals that the United States is losing some of the Ph.D. students to other countries that are upgrading their curricula to appeal to foreign students. The number of graduating doctoral students in science and engineering has declined every year since 1996.[14] With seemingly declining stay rates corroborated in the 2002 National Science Foundation report, coupled with the fact that the U.S. government needs science and engineering graduates, this trend must be recognized and evaluated. Hiring competition from other countries

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[11] National Science Board, *Science and Engineering Indicators – 2002*, Arlington, VA: National Science Foundation, 2002 (NSB 02-01), p. 2-4.
[12] Id., p. 0-6.
[13] Id., p. 0-7.
[14] Id., p. 0-7.

for science and engineering graduates may have a negative impact on U.S. technology.

CONCLUSION

Perhaps the most important information learned for the long term is the tremendous growth during the 20th century in the number of foreign citizen doctoral recipients from U.S. universities. While this may have eased the recruiting burden on our educational institutions in the short term, it may be problematic for the country in the long run. In fact the study performed by the National Science Foundation in 2002 indicates the demand for science and engineering doctoral graduates has outgrown the supply, even though 50 percent of graduates had firm offers to remain in the United States. For the United States to remain competitive in the world arena, it is imperative that our national laboratories, other governmental research institutions, and defense contractors have a qualified pool of applicants to fill their positions. The issue becomes one of employing the best and brightest versus the possible security implications of employing individuals from sensitive or non-sensitive foreign countries. The transfer of both classified and industrial information and/or materials is a matter of utmost importance to our national and economic security. A significant foreign presence at and around our national laboratories and the DOE complex is a factor that cannot be overlooked by those with security responsibilities.

The intellectual security of the technology developed at our national laboratories and other governmental facilities and the extent to which foreign students are coming to the United States, obtaining an education, and subsequently working at or around DOE laboratories or other governmental facilities should be monitored closely. This will become even more noteworthy if the stay rates from any of the sensitive countries go down substantially. Such an event might signal an "exporting" of knowledge gained in the United States.

Note: According to the most recent National Science Foundation report titled *Science and Engineering Indicators – 2002*, the growing capacity of some developing Asian countries and economies to provide advanced science and engineering education has reduced the proportion of doctoral degrees earned by their citizens in the United States. For example, in the past five years, Chinese and South Korean students earned more science and engineering doctoral degrees in their respective countries than in the United States. In 1999 Taiwanese students for the first time earned more science and engineering doctoral degrees at Taiwanese universities than at U.S. universities.

APPENDIX A

DOCTORAL SPECIALITIES

The following list contains the doctoral specialties that comprise a significantly larger portion of the employment pool at DOE weapons laboratories compared with total United States employment. To obtain this list of 26 specialties, all 82 specialties in the broad areas of computer and information sciences, mathematics, physical sciences, and engineering were screened. The DOE weapons laboratories share of total employment is higher in these 26 specialties and lower in the remaining specialties.

The procedure used to obtain this data is judged adequate for this purpose but is imperfect in two noteworthy respects. First, doctorates who reported their work to be supported by U.S. DOE funds were counted as employees of weapons laboratories if they reported a work address with the same zip code as one of the zip codes used for any of the following three DOE laboratories: Los Alamos (87544), Sandia (87101, 87199), or Lawrence Livermore (94550, 94551). There could be, however, some doctorates working for DOE contractors outside the laboratory but located in the same zip code that includes laboratory employees. Second, the survey data used for this purpose are based on a sample of only about eight percent of the total. This means that there is sampling error involved and that the list of weapons laboratory intensive specialties given below may differ slightly from the list that would result were a larger sample or a complete enumeration taken.

- Astrophysics
- Meteorology
- Chemistry
  - Analytical
  - Nuclear
  - Physical
  - Theoretical
  - General
- Geological Sciences
  - Geochemistry
  - Geophysics and Seismology
  - Mineralogy and Petrology

- Geological and Related Sciences, General

- Physics
  - Chemical and Atomic/Molecular
  - High-Energy/Elementary Particle
  - Fluids
  - Nuclear
  - Plasma and High-Temperature
  - Physics, General

- Engineering
  - Aerospace, Aeronautical and Astronautical
  - Chemical
  - Engineering Physics
  - Engineering Science
  - Materials Science
  - Mechanical
  - Mining and Mineral

APPENDIX B

DOE SENSITIVE COUNTRIES LIST[15]

Afghanistan*
Algeria
Armenia
Azerbaija
Belarus
China, People's Republic of
Cuba*
Georgia
India
Iran*
Iraq*
Israel
Kazakhstan
Korea*, Democratic Peoples
Kyrgyzstan
Libya*
Moldova
North Korea, Republic of
Pakistan
Russia
Sudan*
Syria*
Taiwan
Tajikistan
Turkmenistan
Ukraine
Uzbekistan

*Identified as terrorist nations by the State Department. (All visits and assignments from terrorist nations must be approved by the Secretary of Energy).

[15] Source: 20001 ORAU/ORISE, Security Refresher Briefing: The DOE Counterintelligence Program