

**Mark Regets**  
**National Science Foundation**  
**Division of Science Resources Statistics<sup>1</sup>**  
**mregets@nsf.gov**  
**703-292-7813**

## **An Overview of Foreign-born S&E workers in the United States and their measurement**

**Prepared for 11/7/2007 NBER Conference on  
career patterns of foreign-born scientists and engineers,  
trained and/or working in the U.S.**

In a country whose scientific heroes in the last century included Einstein and von Braun, the importance of foreign talent for American science and technology is not a new phenomenon. However, changes in both the global economy, and the way science and technical knowledge is created and used, have made foreign-born science and engineering (S&E) talent even more central to the United States' economic health and its importance in the world. There have been four major trends over the last few decades that combine to increase the importance and the nature of foreign scientists to the United States.. These are the growth in the importance of S&E skills in the labor force; the increase in the proportion of scientists and engineers in the United States that are foreign born; the spread of the capacity for all forms of science and technology activity to many more places in the world; and the increasing performance of both academic and commercial S&T activity by networks that cross national borders.

The growth in the importance of S&T knowledge in the labor force is shown only in part by the growth in narrowly defined science and engineering occupations from about 2 million in 1980 (2% of total employment) to 5 million (4% of total employment) in 2005. A much larger number, 13 million individuals, reported in 2003 on NSF's SESTAT surveys that at least a bachelor's degree level of knowledge in science and engineering was needed in order to do their

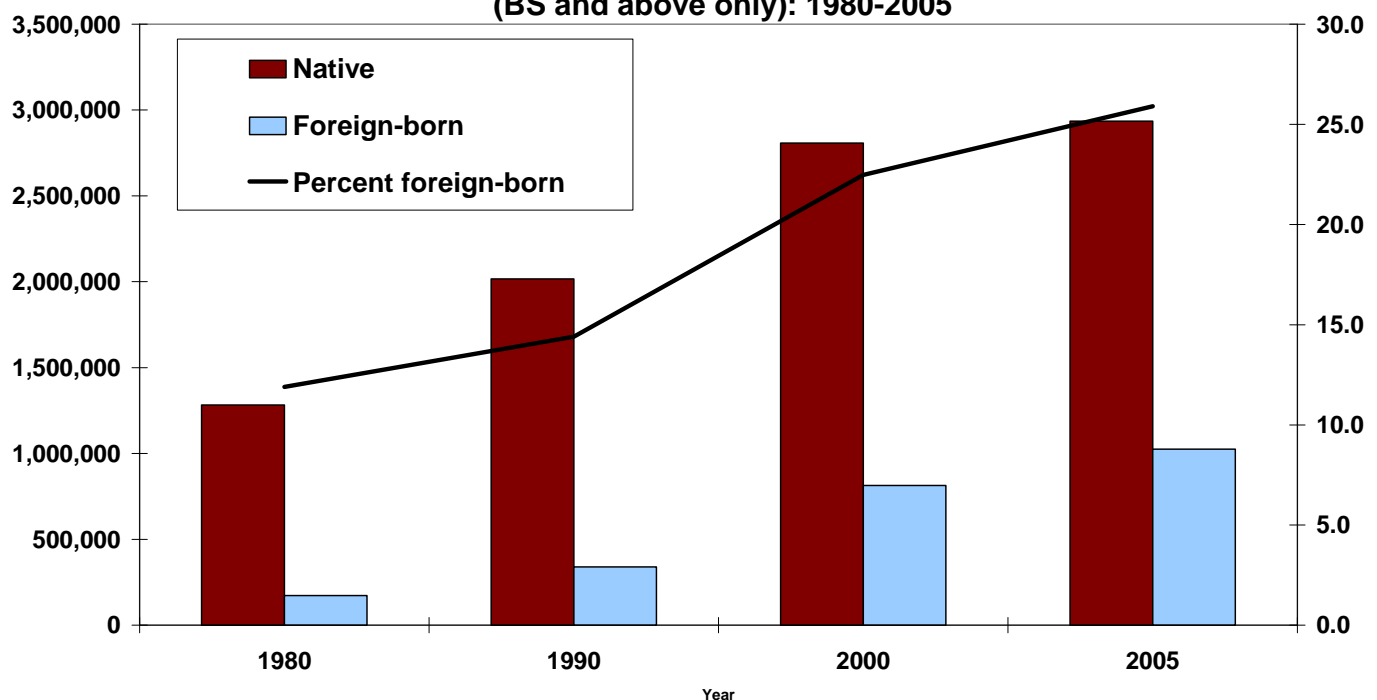
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<sup>1</sup> This paper does not, of course, necessarily reflect the views of the National Science Foundation, Georgetown University, the Institute for the Study of Labor (IZA), or any other organization with which I have a professional affiliation.

jobs<sup>2</sup>. In addition, measurements of S&E occupation from the Census, CPS, and American Community Survey exclude large numbers of unarguably S&E workers such as university professors in S&E fields. For both reasons, measurements of the characteristics foreign scientists and engineers need to go beyond narrow occupational definitions.

In absolute numbers, natives have been responsible for most of the increase in the number of S&E educated workers and most of the increase in employment in S&E occupations (see figure 1, which looks at employment in S&E occupations by those with a B.S. or higher level of education). Over this 25 years, employment in S&E occupations has grown about 3 times faster than the labor force as a whole, and about 2½ times faster than S&E degree production. Some of this growth was possible due to relatively low proportions of S&E-trained individuals near traditional retirement ages, but it was also possible due to more rapid increases in the numbers of foreign-born scientists and engineers. The proportion foreign-born among those in S&E occupations measured on the decennial census and the American Community Survey has increased from around 10% in 1980 to slightly over 25% in 2005.

**Figure 1: Growth of employment in science and engineering occupations (BS and above only): 1980-2005**



SOURCES: Tabulations of Census Bureau PUMS (1980, 1990, 2000); and American Community Survey (2005).

<sup>2</sup> In many occupations that required scientific training as a prerequisite for additional professional training, such as physicians with M.D.s, a majority nevertheless reported not needing S&E training in their jobs.

The proportion foreign-born among scientists and engineers increases with level of education among both those in S&E occupations (see table 1) and among a larger group whose highest degree is in an S&E field (see table 2). Among those in S&E occupations on the 2005 American Community Survey, the proportion foreign-born increases from 19% at the bachelor's degree level to 41 percent at the doctorate level. On the 2003 National Survey of College Graduates, the proportion of those with S&E degrees who were foreign-born ranged from 15 percent at the bachelor's degree level to 35% at the doctorate level. Substantial growth occurred in the foreign-born proportion at all degree levels, using either the occupation or degree based measure.

**Table 1: Census estimates of foreign-born individuals in S&E occupations, by education level, 1990, 2000, and 2005**

(Percent)			
Education	1990 Census	2000 Census	2005 Census ACS
All college educated	14.1	22.4	25.7
Bachelor's	10.6	16.5	19.1
Master's	18.9	29.0	32.7
Doctorate	23.7	37.6	41.1

NOTE: Includes all S&E occupations other than postsecondary teachers because field of instruction was not included in occupation coding for 2000 Census or the American Community Survey.

SOURCES: Tabulations of U.S. Census Bureau, PUMS (1990, 2000) and American Community Survey (2005).

**Table 2: NSF National Survey of College Graduates estimates of percent foreign-born among those with S&E highest degrees: 1993 and 2003**

	1993 NSCG	2003 NSCG
All college educated	13.4	18.9
Bachelor's	9.8	15.2
Master's	18.0	27.2
Doctorate	23.0	34.6

SOURCES: NSF/SRS National Survey of College Graduates (1993, 2003)

## Problems identifying foreign-born scientists and engineers

*"There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know."*

Former Secretary of Defense Donald Rumsfeld

It is important to note that looking at National Survey of College Graduates estimates of the proportion of S&E degree holders that are foreign-born degrees are lower than the proportions estimated based upon occupation from Census Bureau sources. This is not, however, because the foreign-born with S&E degrees being more likely to be in S&E occupations--this is only a minor factor. The proportion foreign-born in S&E occupations, as measured on the 2003 NSCG is nearly identical to that found for S&E degree holders (see table 3). The difference between the NSCG estimate of the proportion of foreign-born scientists and engineers is likely due to an undercount.

**Table 3: NSF versus Census Bureau estimates of foreign-born individuals in S&E occupations, by education level: 1999, 2000, and 2003**

(Percent)

Education	1999 NSF/SRS SESTAT	2000 Census 5% PUMS	2003	
			NSF/SRS SESTAT	Census Bureau American Community Survey
All college educated	15.0	22.4	22.5	25.0
Bachelor's	11.3	16.5	16.3	18.8
Master's	19.4	29.0	29.0	32.0
Doctoral	28.7	37.6	35.6	39.5

NSF/SRS = National Science Foundation, Division of Science Resources Statistics; SESTAT = Scientists and Engineers Statistical Data System; PUMS = Public-Use Microdata Sample

NOTES: Includes all S&E occupations other than postsecondary teachers because field of instruction not included in occupation coding for 2000 Census or American Community Survey. All college educated includes those with professional degrees.

SOURCES: NSF/SRS, SESTAT (1999) and preliminary estimates (2003), <http://sestat.nsf.gov>; U.S. Census Bureau, PUMS (2000); and American Community Survey (2003).

On the 2003 NSF SESTAT surveys, 40% of the foreign-born whose highest degree was in a S&E field had their degree from outside of the United States. This was also true for 36% of the foreign-born with S&E doctorates. However the 2003 SESTAT only had the potential of including a foreign degreed individual in its sample only if the individuals: a) was in the United States in April 2000; b) understood that the 2000 Census applied to non-citizens and participated; and c) was in the United States during the SESTAT/NSCG reference date of October 2003<sup>3</sup>. Thus counts of foreign-born scientists from the 2003 SESTAT will miss those with foreign education who entered the United States after April 2000--a 3½ years gap. In addition, No foreign-educated scientists and engineers who entered the United States after April 1990, and who left the United States anytime before October 2003, would ever be covered by any NSF survey.

The increasingly global nature of many high-skilled careers, science and engineering being just one prominent example, is likely to make these data gaps worse. A single movement from one country to another would eventually be captured by most data systems. Migrations that last only a few years would not be. In addition, with the United States providing a shrinking proportion of global education in S&E,

**Some other partially known unknowns:** There are several types of movements of highly skilled individuals across borders that are known to occur, based upon anecdote or upon nonrepresentative survey results, which are likely to complicate attempts to understand foreign-born S&E:

- U.S. educated S&E degree holders who leave the country after their degrees and reenter at a later point in their careers are excluded from NSF's data system. (Anecdote: The German labor economics research institute IZA list four non-U.S. citizen, but U.S.-educated alumni of its research program that are now employed at U.S. universities.)
- A transition to a "permanent" visa is sometimes associated with a person leaving the United States. Foreign-born scientists and engineers employed inside the United States are often valued as people willing and able to take foreign assignment--in their country of origin or elsewhere. (Interviewers in the New Immigrant Survey-Pilot found examples of this behavior).

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<sup>3</sup> In practice, there is likely to also be an undercount resulting from individuals who leave the country after the SESTAT reference date, but before NSF's combined mail and telephone survey activity is able to contact them.

- Postdocs and other apprenticeship-like short-term research positions employ large numbers of foreign-trained doctorate-level scientists and engineers. Decentralized hiring and entry via several different visa classes makes it impossible to know the total number of postdocs in the United States, let alone their nativity and other characteristics. (Anecdote: Senior officials at a major U.S. research university expressed confidence that they knew of all temporary visa postdocs at their institution, since only J-visas were used. However, Labor Condition Applications, the first step to a H-1B visa, were filed by the university for several hundred "postdoctoral appointments".)
- Many measurements become more difficult when individuals engage in multiple migrations over the course of their careers. One sign of this appears in NSF SESTAT data that shows many individuals working inside the U.S. with degrees from some third country: a country other than the United States or their place of citizenship. In 1993, this was true of 22% of foreign-born S&E doctorate holders in NSF's SESTAT data. NSF's Survey of Earned Doctorates, a survey of recipients of U.S. Ph.D.s, also finds many who have immediate employment plans in third countries.

**Table 4: U.S. Resident Foreign-Born Individuals With Degrees From Third Countries: 1993**

	<b>Number in U.S.</b>	<b>Percent of Foreign-Born with Same Education Level</b>
<b>All Degree Levels</b>	311,700	8.7
<b>Bachelor's Degree</b>	135,100	5.8
<b>Master's Degree</b>	96,200	11.7
<b>Professional Degrees</b>	34,900	15.0
<b>Doctorate</b>	45,600	22.2

Source: NSF/Science Resources Statistics 1993 SESTAT data and 1993 National Survey of College Graduates

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