

CHAPTER 2 – INTERNATIONAL LABOR FORCE MIGRATION

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The big picture is the international migration of high-skilled workers and scientists and engineers to the United States. To some extent, this also gives us an insight into some of the flows that we are beginning to see indications of occurring around the world.

Data Sources for High-Skilled Migration to the United States

- Decennial census PUMS
- NSF/SRS SESTAT
- NSF/SRS national survey of college graduates
- NSF/SRS survey of earned doctorate
- NSF/SRS graduate student and postdoc survey
- Current population survey
- State department visa application data
- USCIS admissions data
- OIS administrative record studies

In the previous presentation, Rolf Lehming discussed a number of the data sources that NSF is using here. This is a similar and overlapping list that can be used to look at issues of high-skilled migration.

One of them is the decennial Census public use micro-samples (PUMS), which is 5 percent of the population. The strength of it is large sample sizes and, since 1990, the ability to distinguish degrees. The weakness is that it only has what level of degree a person has and their occupation. It does not have their field of degree, and it does not give you very good information

about where the person might have gone to school. That, in studying some of the international flows, can be a very important issue.

The NSF/SRS SESTAT database gives much more detail on where people went to school, on their educational histories, on what fields they studied, etc. That is a smaller sample, limited to people with science and engineering degrees, and it has one particular problem for this particular study in that only once a decade are we able to refresh the sample with people who have degrees from foreign institutions. So, toward the end of the decade, its reliability is best for those who graduated from U.S. schools, and becomes a little bit worse for those who graduated from foreign institutions.

One of the components of SESTAT is the *National Survey of College Graduates*. The first run of that at the beginning of the decade becomes a valid sample for anyone who was on the Census with a bachelor's degree above, with an over-sampling of the foreign. And it is from that we are able to pick up a lot of information on foreign degrees. On the first run in the decade, besides being closest to where we are picking up people with foreign degrees, we are also able to have a comparison sample of people with non-science and engineering degrees so you can look at the English majors, the business majors, etc.

The *Survey of Earned Doctorates* was mentioned in the previous presentation. That survey provides information on people at the time they receive U.S. doctorates.

NSF's *Survey of Graduate Students and Postdoctorates in Science and Engineering* gets counts of postdocs, including how many are here on temporary visas. It also counts the foreign students in graduate departments at U.S. universities.

The *Current Population Survey*, which is the American labor force survey conducted by the Bureau of Census for the Bureau of Labor Statistics, actually has better information than the Census on the foreign-born because of some of its modules, but the sample size is much more limited. It covers about 60,000 households in a given month. You can still do some inferences.

After that, you can try to make inferences from various sources of administrative records. The State Department has some data on visa applications and visas being granted. The U.S. Citizenship and Information Service (formerly the INS) also has admissions data, and the Office of Immigration Statistics has various studies of administrative records from various sources within the government. Both of these are within the Department of Homeland Security.

Before going into the migration statistics in general, let's take a look at what has been happening in the labor market for U.S. scientists and engineers in the last couple decades.

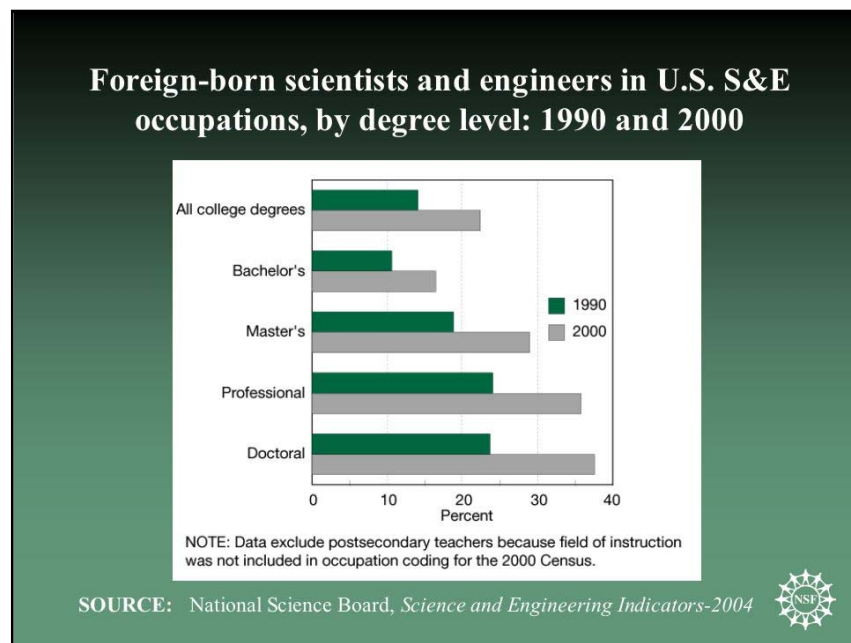
The story is that there has been very rapid growth. As seen in the accompanying slide, there has been an average annual rate of 4.9 percent growth in employment in science and engineering occupations between the 1980 and 2000 decennial censuses.

Average Annual Growth Rates: 1980-2000	
• Employment in S&E occupations	4.9%
• -- excluding math/computer	3.3%
• S&E bachelor's degree production	1.4%
• S&E master's degree production	2.0%
• S&E doctoral degree production	1.9%
• Total civilian labor force	1.1%

Source: NSF/SRS tabulation of U.S. Census 1980-2000 PUMS

A lot of that, to be sure, is the growth of information technology (IT) employment, but even if you take out all of the computer-related occupations from the list, you still have a very rapid 3.3 percent average annual growth rate. If you look at U.S. degree production, it has been growing faster than the labor force, but the growth in bachelor's, master's, and even doctorate production degree production is much slower than the growth in actual employment in S&E.

How have we been growing the labor force faster than the growth in new degree production? Well, part of the story which I am not going to talk about today is that we have relatively few people retiring. That part of it may change with time. The other part is that we have had very large flows of foreign-born scientists and engineers, as seen in the graph below.



The graph shows how the percentage representation of foreign-born scientists and engineers has grown by degree level between the 1990 and 2000 censuses.

The Census provides data on occupations, so it is in a way the least controversial measure of who is actually doing science and engineering. This is using a definition of science and engineering that includes a computer scientist but not a computer programmer.

**Census estimates of the percent foreign-born in science and engineering occupations:
2000**

	All S&E Occupations	Engineering	Life Sciences	Math / Computer Sciences	Physical Sciences	Social Sciences
All college educated	22.4	20.8	25.6	24.7	26.8	11.3
Bachelor's	16.5	15.2	8.3	19.0	14.6	10.4
Master's	29.0	29.4	18.5	37.0	24.7	10.7
Professional degree	35.8	32.7	58.8	31.5	46.5	12.7
Doctorate	37.6	51.3	44.9	44.6	44.7	12.8

Note: Includes all S&E occupations other than postsecondary teachers since field of instruction was not included in occupation coding for the 2000 Census.
Sources: U.S. Census 2000 5-percent PUMS

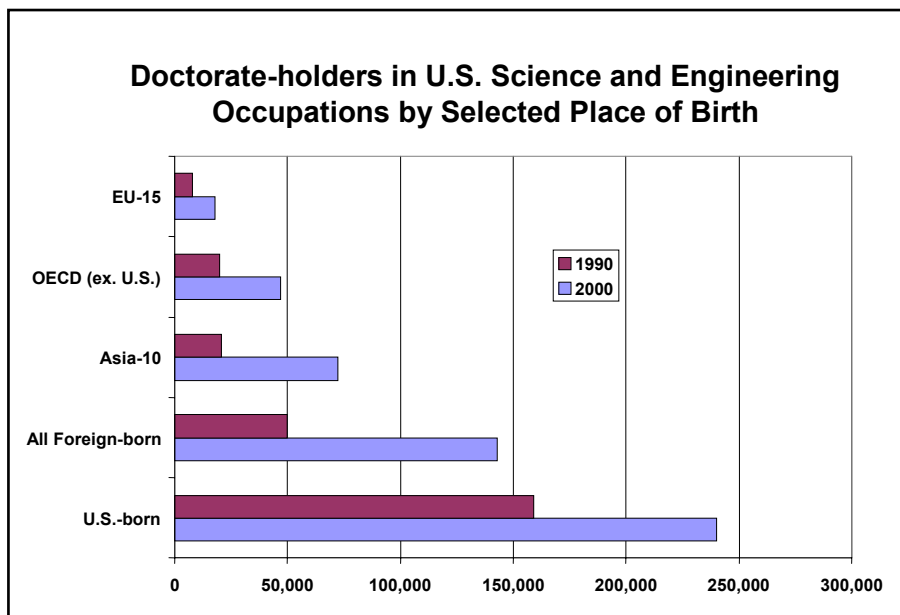
In 2000, 37.6 percent of the people with doctoral degrees working in science and engineering occupations were foreign-born. Across all degree levels, over one-fifth (22.4 percent) of the people employed in science and engineering occupations were foreign-born.

By field, you can see that the social sciences, while still having a good number of foreign born, are actually bringing down the numbers. In the life sciences, math and computer sciences and physical sciences, about 45 percent of people with Ph.D.s employed in science and engineering occupations are foreign. In engineering, it topped 50 percent.

This large expansion of foreign-born scientists and engineers occurred amidst very rapid growth in science and engineering employment. If you break it out by place of birth, you also see large growth for the native-born.

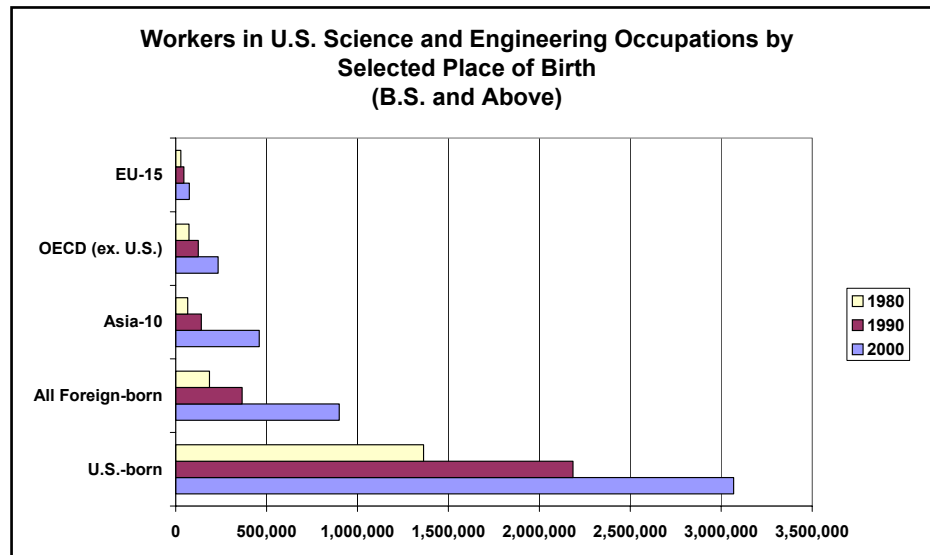
The graph to the right shows it for doctorate-holders in U.S. S&E occupations. Native-born employment in science and engineering occupations at the doctoral level grew by an average annual rate of 4.2 percent between

1990 and 2000. The foreign-born grew by an average annual rate of 11 percent. And while a lot of the growth came from Asia, other sources contributed as well to the growth of foreign scientists.



Source: U.S. Census 5-percent PUMS

The slide to the right is the same as the previous one, but it looks at bachelor's degrees and above. Here, the extra line is 1980, so you can see the trend from 1980, 1990, and the 2000 censuses. There is very rapid growth in employment of natives in S&E occupations but even more rapid growth of the foreign-born.



Source: U.S. Census 5-percent PUMS

As previously mentioned, NSF's SESTAT measures people with U.S. degrees in S&E and tries to include people with foreign degrees in S&E to the extent that we are able to find them from the Census once a decade. So we knew that by 1999, our estimate of the percent foreign-born was going to be an underestimate.

Comparison between NSF and Census estimates of the percent foreign-born in a comparable list of S&E occupations: 1999 and 2000

	1999 NSF/SRS SESTAT Estimates	2000 Census 5-Percent PUMS Estimates
All college educated	15.0	22.4
Bachelor's	11.3	16.5
Master's	19.4	29.0
Professional degree	10.0	35.8
Doctorate	28.7	37.6

Note: Includes all S&E occupations other than postsecondary teachers since field of instruction was not included in occupation coding for the 2000 Census.
Sources: U.S. Census 2000 5-percent PUMS and National Science Foundation, Division of Science Resources Statistics, SESTAT 1999

When we tried to do a direct comparison – and there are a few things done here to try to make the NSF list of occupations the same as the Census list – and looked at the percent foreign-born, we found an even bigger gap than expected. We were off by about 9 points at the doctorate level, off by about 7 points overall, and off by about 5 points at the bachelor's level.

There are a number of reasons why this could be, but the most likely one – and hopefully we will find out in another year or so when we have data from the 2003 *National Survey of College Graduates* – is we have had a large influx of people with foreign science and engineering degrees.

I want to stress that this is nothing new. When we looked at 1993, our closest data to where we were able to pick up people from the 1990 Census with S&E degrees, about half of the foreign-born with science and engineering bachelor's degrees had their bachelor's degree from abroad, along with about one-third of those with a Ph.D. This particular chart is across all fields of degree, so it includes humanities and business majors coming from abroad.

Share of college-educated foreign-born individuals in the United States who hold foreign degrees: 1993
(Percentages)

	Highest degree from foreign school	Any foreign degree	Foreign secondary school
Bachelor's	49.1	51.1	67.4
Master's	24.1	57.2	76.4
Professional	60	69.3	74.3
Doctoral	31.2	73.3	86.7
All degree levels	40.2	54.7	71

Source: NSF/SRS 1993 National Survey of College Graduates.

The chart to the below shows just the scientists and engineers. Note that the scientists and engineers are actually slightly more likely to be here with a foreign degree than the overall foreign-born population with bachelor's and above.

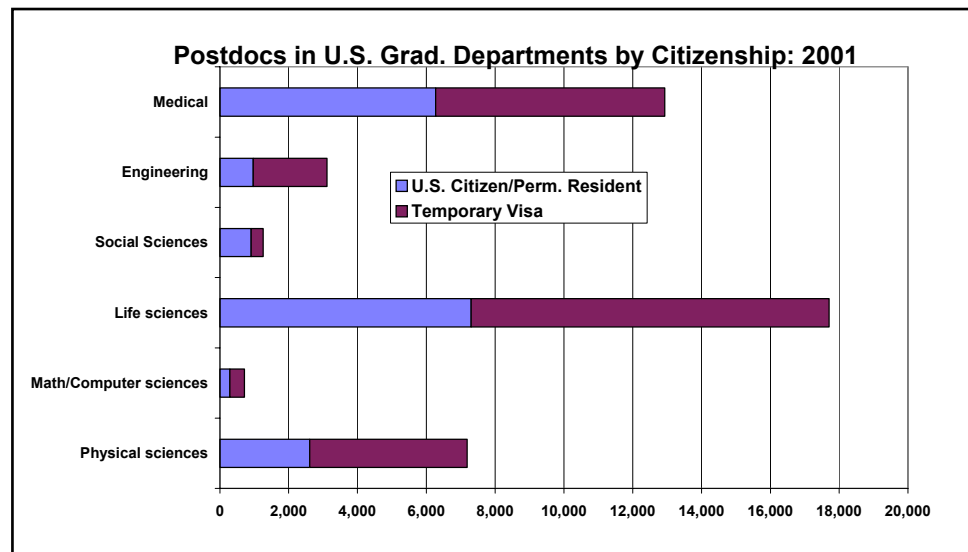
Place of education for U.S. foreign-born residents with science and engineering degrees (1993)

	All foreign secondary and post-secondary degrees	Foreign secondary school and BS; U.S. highest degree	Foreign secondary school; U.S. BS and highest degree	All U.S. secondary and post-secondary Degrees
	Percent			
All foreign-born with some S&E degree	33.0	17.7	16.5	30.3
Highest degree (regardless of field):				
Bachelor's	39.4	2.3	19.3	38.5
Master's	23.3	36.5	15.4	21.2
Professional degree	27.9	5.1	10.9	52.1
Doctorate	32.7	40.1	9.8	9.3

NOTES: The data do not include immigrants to the United States after the 1990 Census who received their higher education in another country. The total of all regions does not add to total foreign-born because of suppressed cells in the individual country data.
SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1993.

At the doctoral level, we clearly have entry of foreign scientists through a number of mechanisms. One of them I want to highlight is the postdoc mechanism, because I find a lot of people do not think of it as an avenue into the United States.

We actually have relatively poor mechanisms for measuring people who come in with foreign degrees for postdocs. We do, however, have a survey of graduate departments where we ask people about the number of postdocs in the department, how many are here on temporary visas,



etc. For 2001, this provides the counts for U.S. citizens and permanent residents combined versus those on temporary visas by field. This is just for those who are in U.S. graduate departments. It probably misses people in some of the research institutions that are on some university campuses. It certainly misses the Howard Hughes Institute and places like that, which have postdocs.

If you were to look at the number of foreign people with U.S. degrees who go to postdocs and compare it with the above, this is about double the number of foreign postdocs you would get. So, a lot of the people coming to postdocs in the U.S., perhaps particularly in the life sciences, have foreign doctorates.

The other mechanism, of course, is the more familiar one of foreign students who come to the U.S., sometimes with a bachelor's from their home country, sometimes entering college in the U.S. for the first time. A little over half of the people on temporary visas earning a U.S. Ph.D. stay in the U.S. longer-term.

Shown below is a measure done by Mike Finn of the Oak Ridge Institute for Science and Education on the percentage of people in the United States from the 1996 graduation cohort measured at various

Degree Field	Percent in the United States				
	1997	1998	1999	2000	2001
Physical science	67	65	63	63	64
Mathematics	59	59	57	57	57
Computer science	67	66	65	65	64
Agricultural science	40	39	37	38	38
Life science	63	61	59	61	62
Computer/EE engineering	73	72	71	71	70
Other engineering	62	60	59	58	58
Economics	27	27	27	27	26
Other social science	37	35	36	35	33

Source: Finn (2003) and Science and Engineering Indicators 2004

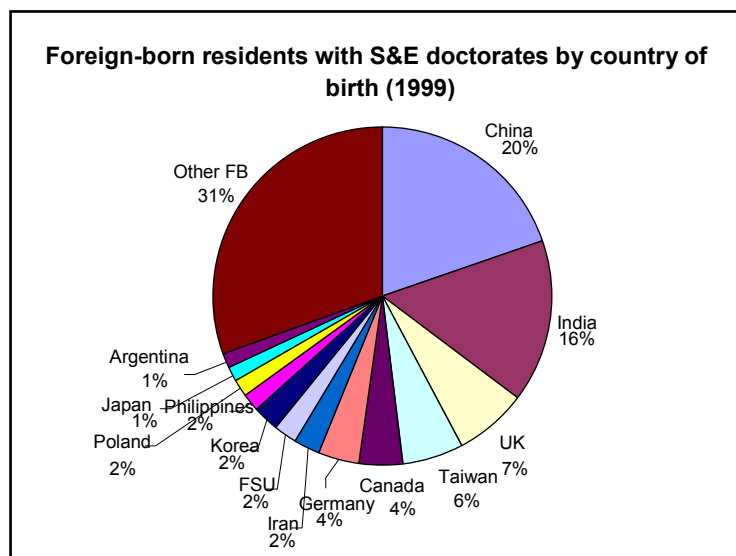
points in time. Besides the fact that it differs by field, it is interesting to note how stable these percentages are. The methodology that Mike Finn is able to use for confidentiality purposes does not allow him to tell if these are the same people in each of these years who are actually there. These are just members of the graduating class who were found in the U.S. working at the particular point in time. But we do know (both anecdotally and from some glimpses of data) that people are mobile, that they leave and come back in some cases.

In 1995, there was a particularly diligent attempt to try to find out where the people on the survey of doctoral recipients actually were if we could find them. This is called a lower-bound estimate, since we never found some of the people. From that, we could do some statistics on people who had left the U.S. Now, to be in the survey of doctoral recipients, you had to have plans to remain in the U.S. to begin with, so these are people who for the most part did initially stay in the U.S.

We are able to see for the different graduating cohorts percentages that were identified as working outside the U.S. We see just in the two-year period between 1993 and 1995 certain percentages leaving.

Decade of Ph.D.	Those residing outside the United States in 1995	Those who had left the United States between 1993 and 1995
	1955–64	13.7
1965–74	22.7	1.3
1975–84	22.2	2.3
1985–94	19.4	4.1

Note: Data include foreign-born U.S. citizens, permanent residents, and those who expressed definite plans to stay at time of receipt of their degree.
Source: NSF/SRS 1993, 1995 Survey of Doctorate Recipients.



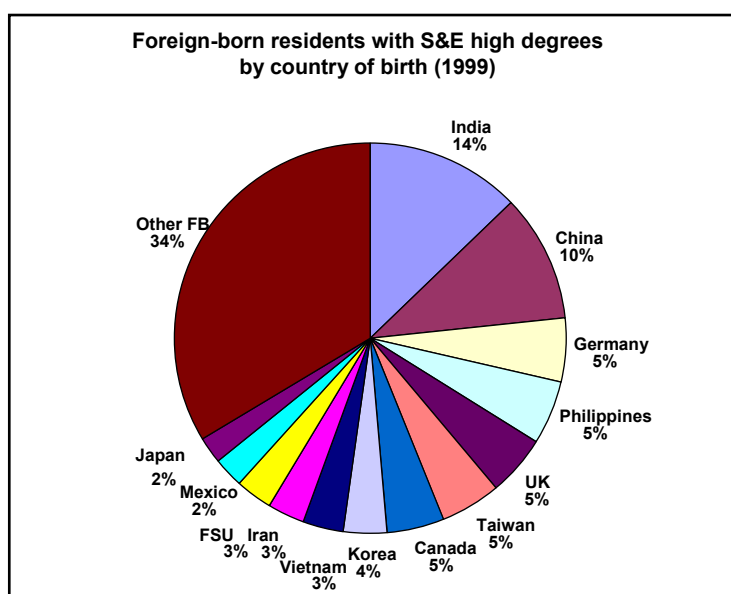
NSF receives a lot of data requests about foreign scientists from China and India, and China and India are a prominent part of the picture to be sure, but in terms of foreign-born residents with S&E doctorates, they make up just over one-third – not that much more than China and India are as their share of the world population. After that come UK, Taiwan, Canada and Germany. Even with a fairly large list, getting down to Argentina at one percent, there is still another third just for the rest of the world. We have a very diverse mix of scientists and engineers.

Looking again at foreign-born residents with any S&E degree as their highest degree, as opposed to a doctorate, you end up with even more diversity, with the China-India combination being under one-quarter as shown to the right.

This is a topic for research, where a lot of people have a lot of opinion, but not a lot has been done to rigorously look at some of the issues. But what is the effect on the U.S. of getting all of this good talent?

We think it may improve productivity, but one concern people have raised is that it might discourage U.S. students. The slide below takes the graduate student survey and estimates a fixed effects regression model, using the graduate department as the unit of observation to see what happens to enrollment when you add additional foreign students.

We really do not see any evidence, at least in this very aggregate level, of displacement of U.S. students by foreign students in graduate school. Actually, for underrepresented minorities, they tend to increase a very trivial amount when foreign students increase, but that amount is actually statistically significant. We see a bit of an increase for white U.S. citizen permanent residents and a very small negative for Asian, although it has been pointed out that this was a period of time



Fixed-effects model estimates of the change in U.S. native S&E graduate enrollment associated with changes in graduate temporary-visa foreign student enrollment

An increase of one fulltime foreign student in a S&E graduate department is associated with:

- + 0.02 fulltime U.S. citizen/perm. minority
- + 0.33 fulltime U.S. citizen/perm. white
- 0.07 full time U.S. citizen/perm. Asian

Model: Departmental level fixed effects controlling for department size in the previous period, dummy variables for year, and changes in the enrollment of other groups.

Data: NSF Graduate Student Survey, 1982-1995

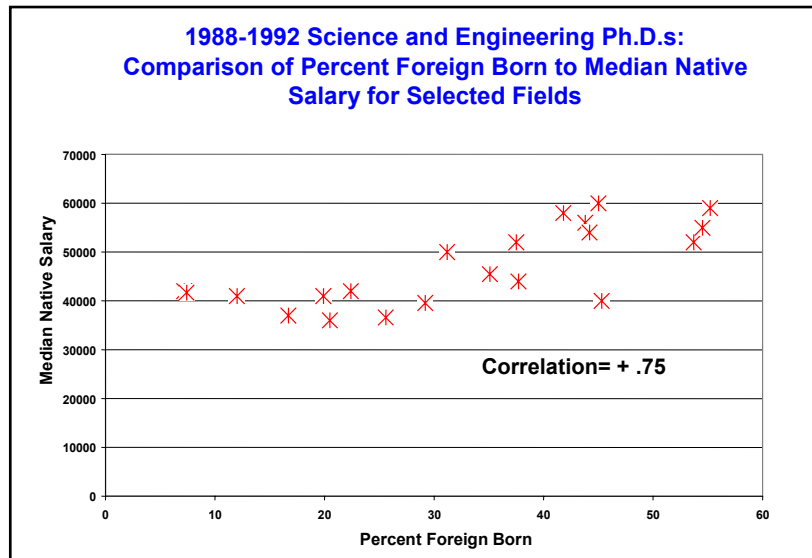
when, because of the Tiananmen Square law, a number of Chinese students had switched to permanent resident status. So that could be a data artifact.

The other thing argued but not well-studied is that it might affect natives by reducing the salaries. Again, you cannot just look at the percent foreign-born in salaries as seen here and call it a reasonable study, but the foreign scientists and engineers tend to be in more highly-paid fields. And it is not just engineering versus social sciences. Within the social sciences, economics, which has a high percentage of foreign

citizens, tends to have higher salaries than sociology, which has a low percentage of foreign citizens. Similar scenarios exist within engineering (electrical engineering vs. civil engineering) and in physical sciences (physics vs. geology). Across all the broader categories, you still tend to see higher percentages of foreign-born within the higher-paid specialties. This can partially be because they are more attractive to bring people into the U.S., but it does mean that the empirical work to try to show wage effects of this type of flow becomes challenging.

We might be moving toward what I call a multi-node knowledge network. Instead of thinking of the world as people coming to the U.S. and staying, or even the U.S. being the all-powerful central node of transmission of world knowledge, with people in knowledge coming here and occasionally going back, I think we are seeing both increased and more complex flows of students, workers, and finances. We are certainly seeing increased international collaborations, and we are definitely seeing global and regional labor markets for some types of skills. That can be very high-level skills, simply because they are very rare, but at the same time, there are skill sets that might be very easily moved across borders because they are very interchangeable, and that might be some of what we see in IT movement around the world.

Part of why this is happening, of course, is that the U.S. is not the only game in the world anymore. While we are still definitely number one, and we are still a place that attracts people because we are a very good place to do research, the rest of the world is catching up in R&D spending, degree production, education of foreign students themselves, authorship of scientific articles, etc. And the hardest-to-measure part of that is there is also increasing competition for international talent.



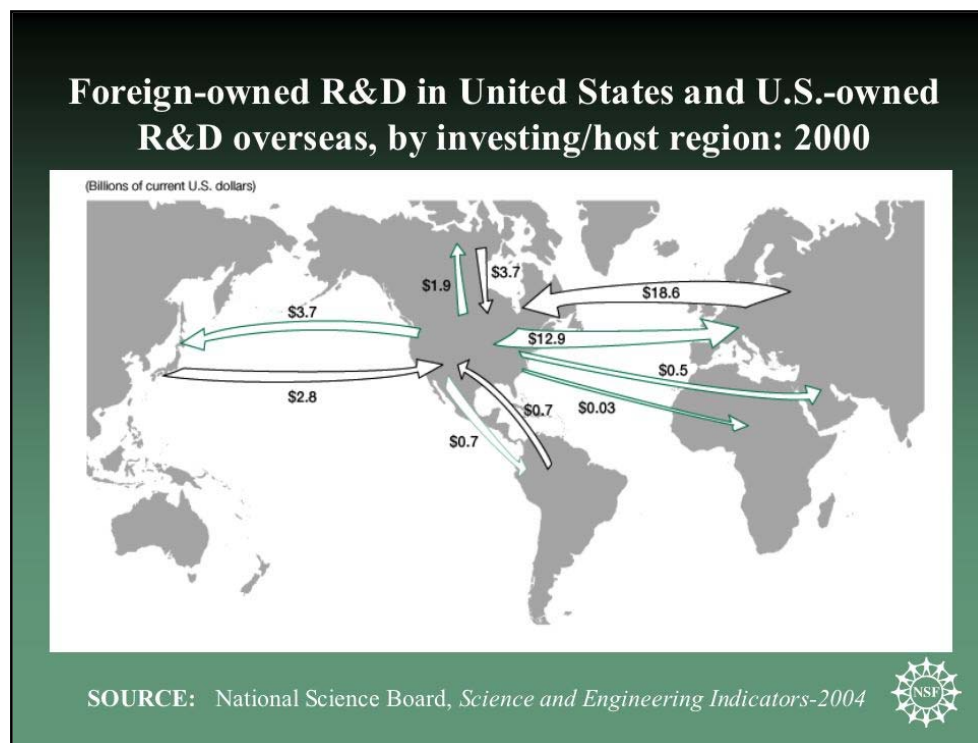
Multiple Node Knowledge Network

- **Increased and more complex flows of students, workers, and finances**
- **Increased international collaborations**
- **Global and regional labor markets for some skills.**

U.S. is #1 but declining in share of:

- **Global R&D Spending**
- **Natural Science & Engineering Degree Production**
- **Authorship of scientific journal articles**
- **Education of foreign students**
- **Competition for international talent**

In addition to people crossing borders to find research opportunities, you have money crossing borders, at least in part to find places where there are people doing the research. Shown here is a slide showing foreign-owned R&D in the U.S. and U.S.-owned R&D overseas. If you add up all those things, the U.S. actually ends up with a slight surplus. There are large flows of money for R&D, and one of the things determining the flows is people.



So if we have people crossing borders and money crossing borders, it is not that there is a single researcher wage that is common across the globe, but it is true that whatever happens in one market for S&E talent affects other markets now. In that sense, we do have a global labor market.

One indication of some of the complexities of the flows comes from people who are being educated in countries other than where they were born or where they end up working. Looking again at the 1993 SESTAT data, we find a surprising number of people who were working in the U.S. who had their degrees not from where they were born and not from the U.S. At the doctorate level, over one-fifth of foreign-born individuals with Ph.D.s had their Ph.D.s from some third country.

U.S. Resident Foreign-Born Individuals With Degrees From Third Countries: 1993 (Other than U.S. or Country of Birth)

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

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

**European Union Born Recipients of U.S. Doctorates (1987-2002):
Place of Immediate Postdoc Plans (Percent)**

	Other Country	Country of Birth	United States	Unknown
Austria	21.9	15.2	54.5	8.4
Belgium	20.9	14.6	56.1	8.4
Britain	11.7	11.1	71.3	6.0
Denmark	19.2	22.8	51.8	6.2
Finland	12.8	39.9	48.2	3.1
France	15.6	24.1	50.9	9.5
Germany	14.0	20.2	59.5	6.3
Greece	9.6	20.1	58.7	11.6
Ireland	13.0	11.1	68.5	7.5
Italy	16.1	25.8	51.0	7.2
Netherlands	16.2	16.9	61.6	5.3
Portugal	11.5	51.2	33.8	3.5
Spain	15.2	29.9	48.3	6.6
Sweden	11.2	20.3	61.5	7.1

Source: NSF/SRS Survey of Earned Doctorates, 1987-2002
 Note: Proportion remaining in the United States does not reflect longterm stay rates because of postdocs and other short-term post-degree activities

The accompanying slide shows the European Union (EU) countries, and for many EU countries, those that do leave the U.S. go to somewhere other than their country of birth. If you were to do this for students from Latin America and students from Africa, the percentages are not that much lower than you find looking at EU citizens, so it is not just a phenomenon of the increased movement within the EU.

As seen in the next slide, in 1995, a little over 3 percent of the U.S. native-born are abroad, and maybe the real number is a little bit higher.

From the immediate plans after degree, about 2 percent of the U.S.-born have immediate plans outside the country, so as a longer-term figure, this might be credible.

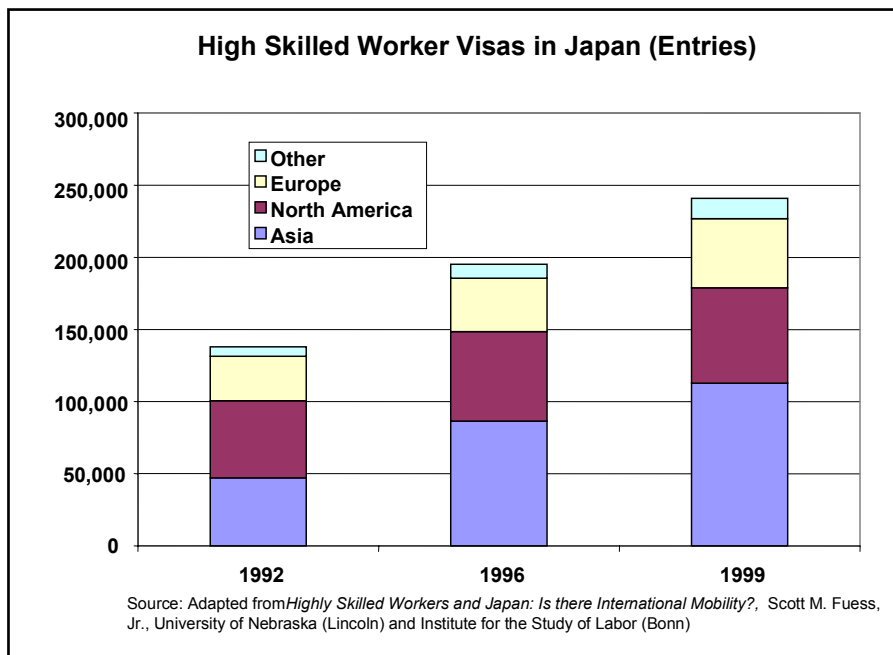
Lower Bound Estimates of U.S. Citizens and Permanent Resident Ph.D. Graduates residing outside the U.S.: 1995

	Native Born		Foreign-born with citizenship at time of Ph.D.		Permanent resident at time of Ph.D.		Total citizen or permanent resident at time of Ph.D.	
	Number Abroad	Percent of Total Abroad	Number Abroad	Percent of Total Abroad	Number Abroad	Percent of Total Abroad	Number Abroad	Percent of Total Abroad
All S&E	13,900	3.3	1,400	7.4	4,300	13.6	19,600	4.1
Life Sciences	3,400	2.7	200	5.0	900	12.0	4,500	3.3
Math and Comp. Sci.	1,000	4.2	100	4.2	200	10.2	1,200	4.6
Physical Sciences	2,200	2.5	300	8.7	800	12.6	3,200	3.3
Social Sciences	5,900	4.2	300	7.5	1,200	18.0	7,400	4.9
Engineering	1,500	3.0	500	9.1	1,300	13.1	3,300	5.0

What is interesting is the way this propensity to be abroad increases. If you take the foreign-born who actually have U.S. citizenship at time of degree, it is more than double the propensity to be abroad. These are

often people who came to the U.S. when they were young or had been in the U.S. for a very long time, so they could get citizenship by the time they got their Ph.D. If you take the people who have permanent residence in the U.S. (those who already have their green card) again it is a doubling of the propensity to be abroad. And as in the previous slide broken out by different years, among the temporary residents who tell us that they are going to stay in the U.S., we found about 20 percent abroad.

Japan is often discussed as a nation not of immigration, and it is very true that in Japan it is almost impossible to receive Japanese citizenship. However, in the early nineties, they did introduce a series of temporary high-skilled work visas that can be indefinitely renewed. Here you see the trend in those high-skilled temporary admissions in Japan, with continent of origin, the red bar being North America.



Germany had a "green card" program which is actually more equivalent to the U.S. H-1B visa, to attempt to bring in high-skilled workers, particularly in the IT area. That was suspended after the dot-com crash, but even as it was suspended, other things were going on just to increase the openness to foreign workers.

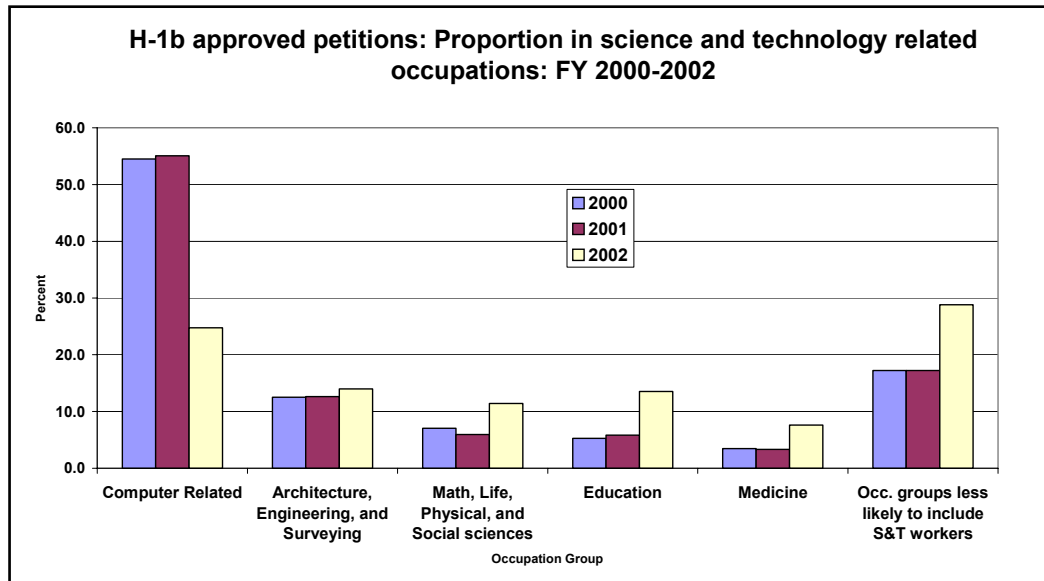
Many European research ministries are making special efforts, not so much through universities but through research centers, to recruit the best of foreign talent wherever they can find it.

Temporary visas issued in categories likely to include scientists and engineers: FY 2002

Visa type	Category	Number of visas
Work		
H-1b	Specialty occupations requiring bachelor's equivalent	118,351
L-1	Intracompany transfers	57,721
O-1	People of extraordinary ability	6,026
O-2	Workers assisting O-1	1,972
Student/exchange		
F-1	Students	234,322
J-1	Exchange visitors	253,841

SOURCE: U.S. Department of State, Immigrant Visa Control and Reporting Division, administrative data.

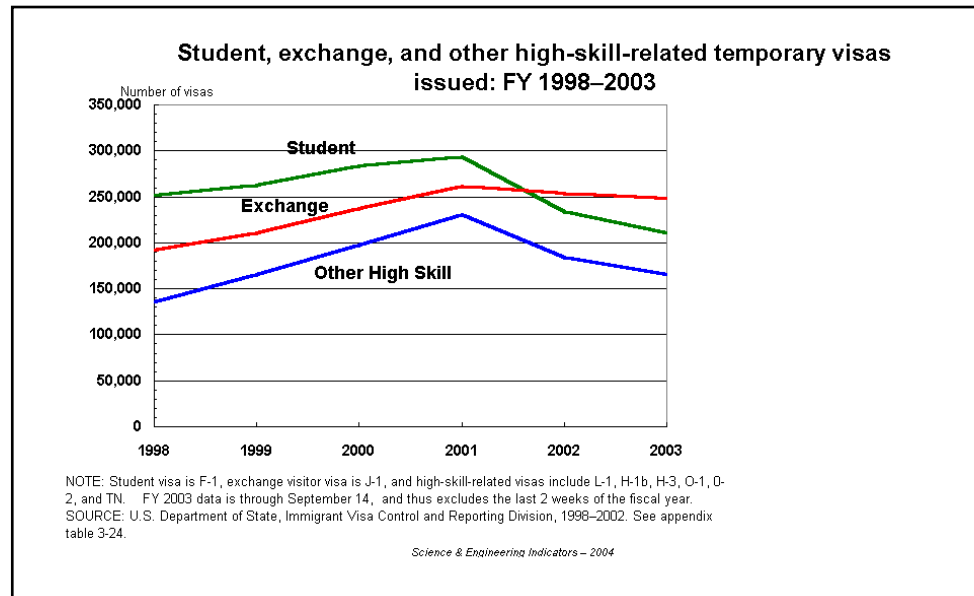
Back to the U.S., certainly important modes of entry into the U.S. of high-skilled workers are various classes of temporary work visas. Shown here is the H-1B, which is formally defined as "specialty occupations requiring a bachelor's or equivalent," although it also includes fashion models. Also shown is the L-1, which covers intra-company transfers. And there are actually a number of other temporary programs, but listed here are just the O-1, "persons of extraordinary ability," and the O-2, "workers assisting O-1." Also shown are student visas and exchange visitor visas.



Source: U.S. Department of Homeland Security, Bureau of Citizenship & Immigration Services

We have some information on the occupational breakdown from the H-1B visas. Before the dot.com crash, a little over half of the H-1Bs were computer-related. After the dot.com crash, about one-quarter of them are computer-

related. The rest are divided among a lot of fields that might contain a lot of scientists and engineers, such as architecture, engineering, and surveying; math, life, physical, and social sciences. Note that if a physics professor gets recruited under the H-1B, he/she ends up under the education category rather than under the math, life, physical and social sciences.



Another question NSF often gets is how is this changing given the environment after September 11th? There is really very little in the way of hard data in most of the sources to look at this. One thing we do have are reports on temporary visas issued by the U.S. State Department. The graph here shows the trend over time. Student visas are down 26

percent. There has been a smaller decline in the exchange visitor visas (the J visas) which are often used for visiting faculty and postdocs. The "other high skill" noted on the graph is the H-1B and the other categories mentioned before. There, of course, a lot of the decline could be due to the collapse in demand in the IT industry.

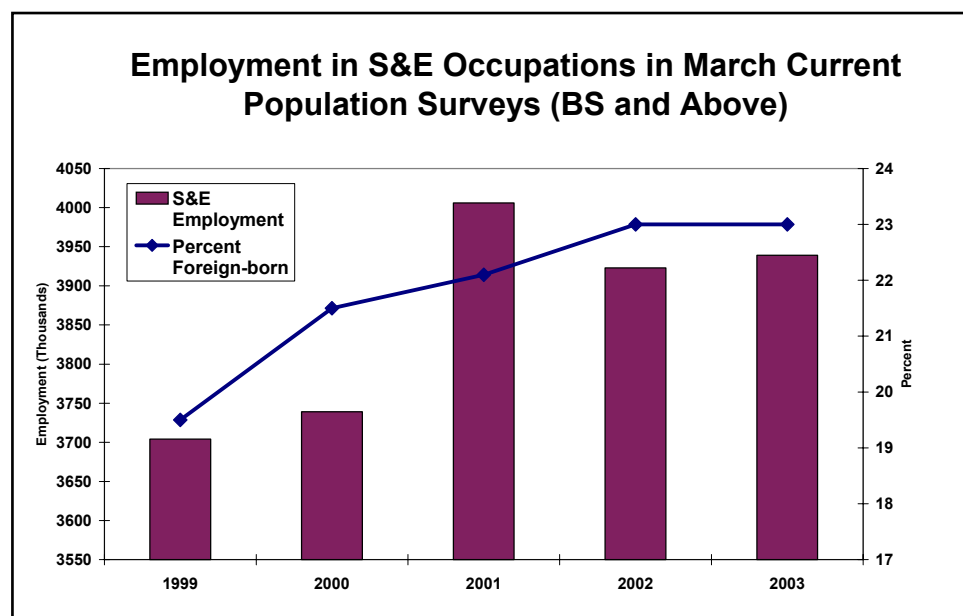
Looking at visa applications, we can break it down in terms of the applications that were made and the percentage of the applications that were refused. Since fiscal year 2001, which ended on September 30, 2001, there is a decrease from almost 400,000 to 325,000 in people applying for U.S. student visas. But at the same time, the refusal rate edged up from 27.6 to 35.2 percent.

	Student (F-1)		Exchange visitor (J-1)		Other high-skill related visas	
	Applications	Percent Refused	Applications	Percent Refused	Applications	Percent Refused
FY 2001	399,988	27.6	279,524	7.8	248,421	9.6
FY 2002	346,419	33.3	278,598	10.5	203,551	11.9
FY 2003	325,844	35.2	295,624	15.9	200,233	17.8

Note: Data for each fiscal year is through September 14 and excludes last 2 weeks of reporting. Other high-skilled-related visas include L-1, H-1b, H-3, O-1, O-2, and TN visas.
Source: U.S. Department of State, Immigrant Visa Control and Reporting Division, 1998-2003.

There has actually been a slight increase in the number of applications for exchange visitor visas for people wanting to come in for postdocs, visiting faculty, and things of that nature. There, the refusal rate, while only moving up about the same amount in absolute percentage points, amounts to a doubling because it starts from a lower base. For the other high-skilled visas, again, there is a decrease in applications but also a big increase in rejections.

It appears to be true, at least going by Department of Homeland Security Secretary Tom Ridge's Congressional testimony, that relatively few of these refusals are actually for direct security reasons, but it appears there is a lot more scrutiny regardless.



The chart here shows information from the March Current Population Survey, the easiest one to work with. Please note that the table does not start from zero. The chart shows S&E employment increasing before the crash, with the percentage foreign-born a little bit below in 2001. This is essentially equivalent to what we find in the 2000 Census. Then, after

the drop in employment in 2002, the percent foreign-born are still increasing, then remaining flat for the last year.

The United States is both much more dependent on the flow of high-skilled labor, and is generally becoming a more important phenomenon in the world.

Audience Questions/Comments:

- Richard Ellis, Ellis Research Services – You indicated that using monthly data from the Current Population Survey does not really yield a lot of helpful information, but how much does that problem ease if you go to the merge group and work on an annualized basis with CPS data?

Response: You essentially triple the sample size. If you want to get technical, I like taking a year's worth of the monthly outgoing rotation groups, essentially one-quarter of the sample from each CPS, but then aggregate it over the year, not repeating any individuals over the year. It helps to the point where you might be able to say something about foreign-born Ph.D.s in the aggregate. You at least get numbers very similar to the Census numbers when you aggregate over a year.

- Howard Garrison, FASEB – You noted that the *Survey of Graduate Students and Postdoctorates in Science and Engineering* does not cover a lot of freestanding research institutes. Have you looked at another source for data on graduate students who might be working in those institutes and total number of people coming in to be postdocs and compared the two different data sources so that you might estimate the under-coverage in the graduate student and postdoc survey?

Response – It is one of the things that we want to look at more, and we have been discussing ways of trying to survey those institutions, maybe in a postdoc survey, but that is a longer-term plan. The issue is not as bad for the graduate students as postdocs, because graduate students tend to be affiliated with a graduate department even if they are doing their work somewhere else.

- Lynda Carlson, National Science Foundation – We are doing research right now for a feasibility study for postdocs, and we are looking broadly at all of the areas that might be involved, so that would include trying to get more institutions into the sample that you are discussing. In addition, we are doing a major evaluation and redesign of the existing survey of graduate student support and postdocs, looking at the data itself and issues of interpretation by the respondents to do some clarification. We know that there is substantial under-representing of postdocs on that survey right now.
- Rachel Ivie, American Institute of Physics – When you look at foreign-born scientists, do you ever take into consideration the age at which they became citizens? Some people do become citizens when they are children and would still be counted as non-native.

Response – Certainly a lot of foreign talent comes in at an early age. The bottom line is at the Ph.D. level, that would not change the numbers very much; it would at the bachelor's level.