What Does Global Expansion of Higher Education Mean for the US?

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University education, once the privilege of a modest number of well-to-do persons in higher income countries, spread massively throughout the world in the latter part of the 20th century and beginning of the 21st century (Shofer and Meyer, 2005). Between 1970 and 2006 the number of students enrolled in institutions of higher education increased from 29 million to over 141 million. The numbers studying science and engineering, where the content of courses is relatively similar around the world, increased commensurately. The global expansion of higher education eroded the US position as the country with the most highly educated work force and potentially endangers the US lead in science and technology. In the 2000s diverse business and academic groups issued reports about the risk to national competitiveness and national security due in part to the slower growth in the supply of science and engineering students in the US than overseas (National Academy of Science, 2006; Council of Competitiveness, 2007).

In which countries has university education spread so rapidly? Why have so many more students gone on to higher education and countries expanded their higher education system so much in the past 30 or so years? What are the implications for the US? How might the country best respond to the rest of the world closing what had been a huge higher education gap with the US?

This study examines these questions in two stages.

Part I documents the global expansion in university training in terms of the increased *proportion* of young persons enrolled in university in advanced countries, many of whom now surpass the US in the proportion going to college; the increased *absolute number* of young persons obtaining university training in developing countries, particularly China, which dwarf

US numbers; the influx of women into higher education, particularly in advanced countries where women now constitute over half of university students; and the growing number of international students, particularly from developing countries. The main message is that with just 5% of the world's population, the US will continue to lose its quantitative edge in higher education, including science and engineering, in the foreseeable future.

Part II examines the implications of this change on the US labor market, university system, and economy writ large. I link the influx of highly educated immigrants to the expansion of higher education overseas and to international students in the US. My analysis suggests that the globalization of higher education should benefit the US and the rest of the world by accelerating the rate of technological advance associated with science and engineering and by speeding the adoption of best practices around the world, which will lower the costs of production and prices of goods. But the increased number of graduates in other countries threatens US comparative advantage in graduate-intensive sectors, most notably if the graduates cost much less than comparable US workers. I conclude by considering whether it is better for the US to import talent through immigration or to offshore work to highly educated workers overseas and what government and university policies that might enhance the net benefits to the US from the global expansion of higher education.

1. Expansion of Higher Education

Exhibit 1 presents estimates of the number of persons enrolled in higher education and the US proportion of enrollees in selected years from 1970 to 2006. The data are from the UNESCO Institute for Statistics, which reports enrollments in "tertiary "education for most countries over this period[1]. The estimates are best viewed as giving orders of magnitudes rather than precise statistics. One reason they give only orders of magnitude is that definitions of tertiary education and counts of students vary across countries. Another reason is that UNESCO does not report statistics annually for every country, so that to get numbers for a given year I had to fill in missing observations for some countries by taking data from the nearest surrounding year. Even though I used a large window (going back to 2000 in a few cases to obtain estimates for 2006), data for some countries was still missing, including Sri Lanka, Syria, and Serbia, among others. Another reason is that the UNESCO database lacks information for the ex-Soviet Union, ex-Yugoslavia, and the two Germanys from 1970 to 1997.[2] To deal with this problem, I used enrollment figures from the Banks Cross National Time Series Archives[3]. Although data from national sources are presumptively more accurate than UNESCO figures, I use the UNESCO data for all countries, including the US.

The exhibit shows that in 1970 approximately 29% of the world's college students were in the US.4 Thereafter, the US share of world college enrollments dropped rapidly so that by 2005-2006 the US share was 12% -- 41% of its 1970 share. During this period enrollments in other advanced countries went from barely half of US enrollments to 23% greater than in the US.

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1 http://stats.uis.unesco.org/TableViewer/tableView.aspx?ReportId=47

2 http://www.uis.unesco.org/en/stats/centre.htm; http://www.uis.unesco.org/pagesen/DBGTerIsced.asp

3 Cross National Time Series Data Archive, 2004 Arthur S. Banks, ttp://www.databanks.sitehosting.net/www/faq.htm

4 State-developed land grant colleges and universities led to the first mass higher education system in the world. The GI Bill helped increase enrollments in colleges and universities. Refugees from Europe contributed to building first-rate science and engineering research programs. Sputnik led to large investments in R&D and university education.

The developing countries, most spectacularly China, increased enrollments by such large absolute numbers that in 2006 nearly three quarters of the world's tertiary level enrollments were in developing countries. Chinese government statistics, which differ somewhat from those in the UNICEF data show an increase in full time enrollment from 924,000 in 1993 to 5.4 million million students in 2006 and increase in total enrollment from 5 million or 5% of the age cohort to 25 million or 22% of the age cohort over the same period. (*www.alberta**china**.com/upload/IB_BEJING-_123071-v1-**China**_Higher_education)*

Exhibit 2 turns to first university degrees. Columns 1 and 2 give the number of bachelors' degrees in total, the number in the natural sciences and engineering; the number of 20-24 year olds, and the numbers of degrees relative to the number of 20-24 year olds for the US and the world, respectively. Column 3 shows the ratio of the US numbers to the world numbers. The US had about 4.9% of the world's 24 year olds, 14.4% of all bachelor's degrees, and 9.1% of science and engineering degrees. Column 4 estimates the changes in the US relative to the areas of the world for which the NSF data goes back to 1995 -- Europe, Asia, and North America. The 1995-2004 trend shows that the US share of bachelor's degrees fell 5.5 points over the decade while the US share of natural science and engineering degrees fell by 1.3 points. Measured as percentages of 1995 levels the decline in US shares was still greater for bachelor's degrees overall than for science and engineering degrees. If we had data on degrees for the entire world the US share presumably have fallen by larger amounts than in column 4 since enrollments grew rapidly in the areas with missing degree data -- South America, Africa, and Oceana.

Given that the US has 5% of world population and that most of the rest of the world is in catch-up mode in mass higher education, the decline in the US advantage is likely to continue for some time.

PhD graduates in science and engineering

The PhD is the critical degree for advanced research and thus for increasing the stock of knowledge on which economic growth ultimately depends. Exhibit 3 records the ratios of PhDs earned in science and engineering in major PhD producing countries relative to the numbers in the US from 1975 to 2004. PhDs in science and engineering outside the US increased sharply over this period while the number granted in the U.S. stabilized at about 26,000 per year, then increased to 29,000 by 2006. In 2004 the EU granted 78% more S&E PhDs than the U.S.

The greatest growth in PhDs granted is in China. In 1975 China produced almost no science and engineering doctorates. In 2004, according to the NSF figures, the country graduated 23,000 PhDs, approximately 63% in science and engineering. Between 1995 and 2003, first year entrants in PhD programs in China increased six-fold, from 8,139 to 48,740. At this rate China will produce more science and engineering doctorates than the U.S. by 2010. The quality of doctorate education surely suffers from such rapid expansion, so the numbers should be discounted to some extent, but as the new Chinese doctorate programs develop, quality will undoubtedly improve.

Within the US, moreover, international students earn an increasing proportion of S&E PhDs. In 1966, the foreign-born obtained 23% of science and engineering PhDs; 71% were awarded to US-born males and 6% to US-born females. In 2006, the foreign-born obtained 48.2% of science and engineering PhDs; 26.3% were awarded to US-born males and 25.5% to

US-born females.5 Looking among fields, the foreign-born received 23.2% of all doctorates awarded in the social and behavioral sciences, 32.3% in the life sciences, 50.6% in the physical sciences, and 63.6% in engineering. Since few US students earn S&E PhDs overseas, the ratio of S&E PhDs earned by US citizens or residents to those earned by citizens of other countries fell more rapidly than the ratio of degrees granted by US universities to degrees granted by foreign universities. For instance, if we add the number of S&E PhDs granted to Chinese students in the US and other countries to the numbers granted in China, the ratio of Chinese degrees to US PhDs granted less those given to the Chinese rose to 0.71 in 2001. But since many Chinese who gain PhDs in the US remain in the US, it is more appropriate to count them as part of the US supply.

Propensity to enroll and graduate: advanced countries

The OECD and NSF provide data on the proportions of young persons enrolling and graduating university. Exhibit 4 displays the rank of the US in "entry rates" into tertiary education and in first time graduation relative to the relevant age group in 1992 and 2005 from the OECD data.[6] In 1992 the US was 2nd (to Canada) in entry rates and 3rd in graduation rates among the 20 or so OECD countries that reported data. In 2004 the US was 7th and 13th, respectively. The lower ranking of the US in graduation rates than in entry rates reflects what the OECD calls the low "survival rate" of students in the US where a smaller proportion of entrants to higher education graduate with four year degrees than in other advanced countries. The exhibit also displays the rank of the US in numbers of bachelor's graduates and graduates in the

5 The 1966 figures are from Freeman, Jin, and Shen (2004); the 2006 from NSF 2008.

6 These are cumulated entry rates for countries so that if 20% of 20 year olds enter tertiary education and 21% of 21 years olds enter, the rate is 41%

natural sciences and engineering relative to the age group in 1992 and 2004 reported by the NSF. These data show a lower rank for the US in natural science and engineering degrees per 24 year old than for all bachelor's degrees per 24 year old because Americans are less likely to major in science and engineering than students in other countries.

Another way to illustrate the declining relative position of the US in higher education is to compare the proportion of workers with college degrees across cohorts/age groups. Since most graduates obtain their degree in their twenties, the share of persons with degrees in different age groups reflects the share of young persons earning degrees when the age group was in their twenties and thus at different time periods. OECD data on higher educational attainment by age group show that in all of the advanced countries save the US the proportion with university education is much higher in younger than older age groups. In the US there is little difference in the graduate shares by age. The implication is that the college share of young persons stabilized in the US while growing among other advanced countries over this period.[7]

It is natural, at least for labor economists, to wonder if the differences in the shares or changes in the shares of young persons investing in higher education across countries are related to cross-country differences in the economic payoff to higher education. Within countries, college going appears to respond to differences in returns, measured in various ways (Freeman; Edin and Topel). Exhibit 5 examines the relation between the proportions of young persons graduating university and OECD estimates of the ln wage differential between university

7 See, OECD, Education at a Glance, 2005, Table A1.3a. Regressions of the ln of the college share of each age group and a trend indicator for when the group was in the age group of the youngest cohort, 25-34 years old (4 for age 25-34; 3 for age 35-44, 2 for age 45-54 and 1 for age 55-64) give a 0.028 coefficient on time in the US with a standard error nearly as large. By contrast, the coefficient on the time indicator for the other countries was 0.19 with a standard error 1/4th the size.

graduates and secondary school graduates and estimates of internal rates of return to investing in higher education that take account of costs of tuition, among other factors (Baorini and Strauss, 2007. Consistent with its high level of earnings inequality the US has the largest coefficient on higher education in a ln earnings equation. But, as noted, the US has only a moderate rate of college going. Figure 5A graphs the regression based estimates of the ln earnings differential for university graduates and the proportion of young persons obtaining university degrees for the advanced OECD countries. There is a modest positive correlation (r = 0.19) but what is most striking is that countries with narrow distributions of earnings and low college/high school wage differentials such as Sweden have higher enrollment ratios than the US. Sweden graduates approximately three times as many PhDs in science and engineering relative to the age group as does the US despite having a lower return to post-bachelor's education!

What might explain the weak correlation between the coefficients on college education and the proportions going to university in these data? One possible factor is that the earnings regressions do not take account for the direct costs of college-going, which differs greatly between the US with its high tuition and European countries. To deal with this and differential taxes and other factors that may influence the return, the OECD calculated internal rates of return using comparable cross-country earnings data for individuals. Figure 5B shows that the relation between the OECD estimated internal rate of return and the proportions earning degrees a is stronger than is the relation between the earnings differentials themselves and the proportion graduating university (r = 0.29). But again there is a lot of variation. Four of the countries with higher rates of college graduation than the US have lower estimated internal rates of return, while three of countries with higher rates of return. Perhaps in countries with narrow earnings distributions such as Sweden, Netherlands, and Finland, people judge the smaller returns as less risky than in the US where the dispersion of wages is so great that the average returns are less meaningful. From these calculations I conclude that high returns have driven at least some of the growth of university training but that there is sufficient country variation for other factors, including educational policies, to also affect enrollment and graduation rates.

China and India

Increases in the number of university graduates in China and India have attracted attention as part of the discussion of the off shoring of computer programming and increased multinational investments in research in those countries. There are also national security concerns about China's growing numbers of scientists and engineers and R&D. In 2005 the top executives from high tech firms cited reports that China graduated as many as ten times the number of engineers as the US and that India also graduated more engineers than the US to call for policies to increase the supply of science and engineering graduates in the US. More detailed investigation, however, found that part of the China/India to US gap in engineering degrees was due to comparisons of numbers with different definitions of degrees (Wadwha, et al). The Chinese and Indian data included graduates from short courses comparable to US two- year degree programs while the US data excluded computer science degrees that the other countries counted with engineering. Adjusting the numbers of graduates for comparability brings the US, China, and India numbers closer but does not overturn the trend growth of degrees in China and India compared to the US. It simply displaces the increase in four year comparable degree production 2-3 years behind the publicized figures.

What about the quality of the education? In an effort to determine the qualifications of new graduates in developing countries, the McKinsey Global Institute (2005) asked recruiters for multinational firms to estimate the proportion of graduates from different countries that might be suitable candidates for their firm in terms of language, skills, and potential mobility. The recruiters estimated that in engineering 10% of graduates from China and 25% of graduates from India were so qualified (McKinsey Global Institute, 2005, exhibit 2, p 8). But the survey did not ask whether these graduates could perform successfully for Chinese or Indian subcontractor firms in their local area nor explored at what point firms would prefer to subcontract work to firms with less qualified graduates at the lower pay in those countries. Finally, the study never asked for the proportion of graduates from US engineering schools that recruiters viewed as qualified.

Surge of Women into Higher Education

Underlying the increase in university enrollments and degrees has been a huge movement of women into higher education. Exhibit 6 shows the ratio of the number of females to males enrolled in tertiary education from 1990 to 2006 in the world, in advanced countries, in the US, India, China, and the rest of the developing world. When the ratio is 1.0 the number of women and men among enrollees is the same, when it is below 1.0 there are more men than women and conversely when the ratio is above 1.0. Worldwide, the proportion of female to male enrollees increased by over 20 points. In the advanced countries and in the US, it went from below 1.0 to considerably above 1.0, with little indication that the rise has peaked. With women making up more than half of new university students and graduates in the advanced countries, companies and countries whose institutions and policies allow them to make most effective use of this "new" source of highly skilled workers will have an edge in global competition. In China and India, the ratios remain below 1.0 while in many countries in Africa, Latin America, and in the

Arab world, the ratios are far below one.

The surge of women into higher education in the US has greatly increased the proportion of advanced academic and professional degrees going to women. Exhibit 7 shows that in 2006 the ratios of female to male enrollments were above 1.0 at the bachelors, master's level (which includes many school teachers) and just a bit below 1.0 for law, PhDs and MDs. If we limit doctorates to the US born, the ratio of female to male PhDs rises to 1.03. In 2004 22% more women than men were granted Graduate Research Fellowships by the National Science Foundation, which suggests that the female to male ratio among PhDs in science and engineering will continue to rise.

International Students

The proportion of students who study in countries other than their own has been increasing rapidly since at least the mid 1970s. Column 1 of Exhibit 8 shows that the number of international students grew nearly fivefold from 1975 to 2005. Column 2 shows that even with the rapidly increasing enrollments in foreign countries the international student share of world enrollments rose. Because the number of international students to the US (column 3) grew more slowly than the total number of international students, the US share of international students fell (column 4) even though the international share of US university students increased (column 5).

Countries differ in the extent to which they recruit and/or attract international students at the undergraduate or graduate level. Some countries like Australia and to a lesser extent the UK specialize in undergraduate education for international students. The US's intake of international students consists disproportionately of graduate students, many in PhD programs. There are also many international post-doctorate students/workers. Most of US international students are from

Asia, with India and China being the largest source countries (exhibit 9). Exhibit 10 shows that the foreign-born share of enrollments and degrees is particularly high in graduate science and engineering and increased greatly in those areas from 1985 to 2005.

Although the international student share of graduate degrees far exceeds the international student share of bachelor's degrees, foreign-born undergraduates are important in the supply of foreign-born graduate students and in the number with post-bachelor's science and engineering degrees working in the country. The reason is that the likelihood that a foreign-born undergraduate does graduate work in the US is higher for those with US undergraduate degrees than for those with undergraduate degrees outside the country. In 1993, 36.6% of foreign-born residents who obtained a master's degree in science and engineering had a US bachelor's degree (and over half of them also had a US secondary school degree). Multiplying this by the 24.7% of S&E master's degrees going to the foreign-born in that year, approximately 9.7 % of all S&E master's degrees were awarded to foreign born persons with US bachelor's degrees. This is 2.5 times the foreign-born share of US bachelor's degrees in science and engineering. At the doctorate level 19.1% of foreign-born residents with a science/engineering PhD had a US bachelor's degree (with nearly half also having graduated from a US secondary school). Given that the foreign-born had 40.6% of S&E PhDs in that year, about 10% of all S&E PhDs were awarded to foreign born persons with US bachelor's degrees. This is 2.8 times the foreign-born share of US bachelor's degrees in science and engineering. 8

While these statistics are consistent with the notion that attracting international students at the bachelor's level (and the high school level) raises the probability that those students

8 The 1993 estimates are from Mark Regets, "Foreign Students in the US" power point presentation, June 27, 2005 Brussels Dialogue Meeting on Migration Governance, OECD

continue their studies at US institutions and eventually remain in the country to work, they do not establish causality nor estimate the impact of policies toward international students on immigrant flows. Analyses of the impact of study in a foreign country on working in a foreign country for Europe based pm reasonably good pseudo-experiments establish such causal connections and estimate magnitudes of impacts. I discuss these analyses in section II.

In the aftermath of 9/11 the academic and research communities feared that tightened visa requirements would reduce the number of international students coming to the country. The State Department rejected more students applying for visas than in the past, particularly from China, and made it more difficult for international students to travel outside the US. The number international students applying to and enrolling in US universities fell from 2002/03 through 2005/06, breaking an upward trend that stretched back at least from 1959/60. But the State Department responded to complaints about the difficulties faced by international students and remedied many of the problems (National Academy of Sciences, 2005). Even with the post 9/11 drop the US attracted 560,000 or so international students in 2003-2005, and the number increased from 2005/06 to 2006/07.

What factors lie behind the huge increase in international students in recent years and in their choice of countries? Examining the number of student visas to the US in the early 2000s from different countries Rosenzweig (2006) found some evidence that the number choosing to go the US was higher for "gravity model" type reasons in the form of population and distance from the US and to the number of universities in the students home country, to level of GDP per capita, but *inversely* related to the return to skills in the home country. The implication is that many come to the US with the intention of remaining to work in the US, which fits well with my estimates in the next section that at least in science and engineering a huge proportion of those who study in the US immigrate to the country.

PART II—Implications

The globalization of higher education has implications for supply and demand in the labor market, for the US university system, and for the economy writ large.

Immigration and labor force

Increased numbers of foreign-born university graduates trained outside the US and increased numbers obtaining degrees as international students in the US provide new and growing sources of highly educated workers for US firms. By coming to the US these immigrants strengthen the country's comparative advantage in high tech and university workforce intensive sectors. At the same time, however, the increased number of university graduates overseas and international students who return to their homeland improves the ability of those countries to compete with the US in high tech and other sectors that use highly educated workers. By augmenting the supply of highly educated workers in the US and worldwide, moreover, the greater number of highly educated foreign-born persons reduce the payoff to investing in higher education in the US unless the increased supply generates increases in demand (Acemoglu). This is clearly not the case in some areas. The supply of highly able programmers from India and other developing countries willing to work at lower pay than Americans has dampened the growth of the supply of programmers in the US.

The 1990s economic boom provides striking evidence of the extent to which immigrant university graduates can increase labor supply in the US in times of great demand. The boom attracted huge numbers of university educated foreign-born workers whose numbers remained high through the mid-2000s, particularly in science and engineering. Data from the Current Population Survey show that in 2005, the foreign-born made up 18% of bachelor's S&E workers, 32% of master's S&E workers, and 40% of the PhD S&E workforce – far greater than the comparable proportions from the 1990 Census of 11% for bachelor's, 19% for master's and 24% for PhDs. In 2000 and 2005 the foreign-born made up over half of doctorate scientists and engineers under the age of 45. Nearly 60% of the *growth* in the number of PhD scientists and engineers in the country in the 1990s came from the foreign born. Looking more broadly, in 2007 the foreign born constituted 18% of all college graduates working in the US and 28% of the growth of college graduates from 2000 to 2007.[9]

As intimated in the earlier discussion of international students, a huge proportion of immigrant scientists and engineers come to the US first as students.10 Exhibit 11 shows that nearly 60% of all foreign-born scientists and engineers obtained their degrees in the US. The foreign-born proportion of degree recipients was higher at the PhD and master's level than at the bachelor's level, though even among bachelor's graduates half of foreign-born S&E workers in the US were US university- educated. Data by country show large differences in the proportions obtaining degrees in the US versus other countries. Many S&E workers from India, the Philippines, the former Soviet Union, and the United Kingdom were educated outside the US whereas the majority of foreign-born S&E workers from China, Taiwan, South Korea, Mexico,

9 The 2007 data are from the Bureau of Labor Statistics, Foreign Born Workers: labor force characteristics in 2007 .(http://www.bls.gov/news.release/pdf/forbrn.pdf). The 2000 data are from the Migration Policy Institute http://www.migrationinformation.org/Feature/feb05_spotlight_table1.cfm

10 Neither the CPS nor the Census ask where someone earned their degree, so they do not distinguish between international students who stay in the US and immigrants who come with foreign degrees. The 2000 Census reported a much higher number of foreign-born S&E workers than did the NSF's SESTAT data system, because the latter counts foreign-born recipients of US degrees but not immigrants with overseas degrees between Census years. The Community survey asks about

and Germany were educated in the US. Since the US accounts for about 10% of S&E degrees granted in the world (from 8.5% of Bachelor's to 17.6% of PhDs), if foreign-born persons were equally likely to work in the US regardless of where they obtained their degree, 10% of the foreign born scientists and engineers working in the US would have been US-educated compared to the 60% who in fact were US-educated.

To estimate the probability that US educated foreign-born scientists and engineers end up working in the US, I compare NSF estimates of the stock of foreign-born S&E workers with highest degrees in the US in the country to the cumulated number of the foreign-born who obtained a US degree in the preceding 30 or so years for doctorates, master's and bachelor's graduates. The NSF (2008, appendix table 3-8) reports that in 2003 the US had 1.34 million foreign-born S&E workers with a highest degree in the US: 176,000 of these workers had a PhD from the US, 438,000 had a US master's as their highest degree, and 723,000 had a US bachelor's degree as their highest degree. For doctorates, I estimate that on the order of 250,000 persons who were not US-born or permanent residents obtained PhDs in science and engineering between 1970 and 2003[11]. Dividing the 176,000 estimated stock in 2003 by 250,000 suggests that about 70% of the PhDs in the thirty-three year period were in the US in 2003. This statistic is of the same order of magnitude as Survey of Earned Doctorates data that shows that 70% to 75% of foreign doctoral recipients plan to stay in the US after they graduate (NSF, Indicators, table 2-33) and with Michael Finn's (2007) estimates that in the 2001 PhD graduates cohort, 66% of foreign-born doctorates were working in the United States for at least 2 years and that 62% of the

11 There is a problem with using temporary residents since the US gave permanent resident status to Chinese students following Tiananmen Square incident, and those students would be counted with US citizens/permanent residents.

1995 graduates were still working in the US ten years later. For masters' graduates, I estimate that about 600,000 non-citizens, non-permanent residents obtained a degree between 1965 and 2003, a slightly longer period due to their presumed younger age. [12]. Dividing the 438,000 estimated stock in 2003 by this number suggests that around 2/3rds stayed to work in the country. For bachelor's graduates, I estimate that on the order of 550,000 non-citizens and non-permanent residents obtained S&E degrees in the US from 1960 to 2003 (again a bit longer to allow for the younger age of these graduates). In this case the 2003 stock of 723,000 exceeds my estimate of the number of foreign born persons with a US S&E bachelors highest degree. While this makes clear that the comparisons are crude, it does not gainsay the conclusion that I draw from these data: that a huge proportion of international students who obtain US degrees end up working in the country years later.

Turning to foreign-born S&E graduates who obtain degrees overseas, the NSF estimates that in 2003 there were 0.9 million foreign born S&E workers with their highest degree outside the country. On the basis of estimates of the number of bachelor's or higher graduates outside the US and the proportion of those who studied science or engineering, there were about 31 million university-educated S&E workers outside the country.13 Dividing the 0.9 million foreign-educated S&E workers in the US by the 31 million degree recipients, I estimate that approximately 3% of foreign-born S&E workers with highest degrees outside the country

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12 There is a problem with using temporary residents since the US gave permanent resident status to Chinese students following Tiananmen Square incident, and those students would be counted with US citizens/permanent residents.

13 My estimate is based on NSF estimates that 26% of the stock of university graduates in the world was in the US in 2000 "or most recent year" (Science and Engineering Indicators 2008, figure 3-52). In 2003 50 million persons aged 25 and over had 4 or more years of higher education in the US (Statistical Abstract, 2003, table 214). The supply of university graduates outside the US was thus on the order of 150 million persons. From the statistics in exhibit 2 of this study, I estimate that 27% of bachelor's graduates outside the US are in science and engineering. This gives an estimate of 31 million science and engineering graduates outside the US.

immigrated to the country.

The massive difference between the estimated probability that most foreign-born S&E graduates with US highest degrees end up working in the US and the estimated probability that a S&E graduate outside the country migrates to the US surely overstates the causal impact of being an international student immigration. Students who choose to study in the US are presumably more interested in US residence than students who study elsewhere. The best estimates of the causal impact of being an international student on a graduate's future location of work relate to the European Union's Erasmus program (http://en.wikipedia.org/wiki/ERASMUS_programme). This program provides financial incentives to encourage students to study outside their country for one or two terms. Comparing groups before and after introduction of the program and groups eligible and ineligible due to the timing of their university's involvement with the program, Parey and Waldinger estimated causal impacts on location decisions on the order of 20 percentage points. Other studies of student migration and employment in the EU (Oosterbeck and Dinand, 2006; De Grip, Fourage and Sauerman, 2008; Dreher, Axel and Poutvaara, 2008) find similar orders of magnitude for the impact of being an international student and future work in a foreign country. As to the mechanism by which study abroad causally affects working abroad, Parey and Waldinger (2008, table 11) find that social factors in the form of a partner are important in leading former international students to work outside their home country and that assessments of career prospects also influence the decision to work overseas, presumably by linking the students to potential future employers.

The estimated impacts of study abroad on the job location of Europeans fall far below the huge difference in the proportion of international students who immigrate to the US and the proportion of non-US trained graduates who migrate to the US for three reasons. First, because they correct for the presumably huge selectivity bias in who becomes an international student. Second because the Erasmus program is a much smaller treatment than 4-6 or so years of study for a degree in the US. since those educated in the US are in the country for longer periods than the Erasmus and related semesters overseas programs, they could very well build up job and social connections that could make the decision to return home closer to an immigration decision than the decision to remain and work in the US. Third and possibly most important, the bulk of US international students are from developing countries such as China and India rather than from comparable advanced countries. The rates of staying for PhD graduates are much higher for persons from lower income countries than for those from higher income countries.

Barring supply creating its own demand for science and engineering workers, the increased number of foreign-born S&E graduates in the US invariably reduces the employment opportunities and earnings of US-born S&E graduates (Borjas, 2009). Similarly, the increased number of foreign-born S&E graduates outside the US is likely to induce US multinationals to locate research and development work overseas. Consistent with this between 1994 and 2004 R&D employment increased by 94% in the majority owned foreign affiliates of US multinationals while employment in the parent firm increased by 39%.14 Since a large and growing proportion of the R&D workforce in the US is likely to consist of the foreign-born, the overall trend is for a sizable shift of the work force of these firms from native-born R&D workers to foreign-born R&D workers, as we would expect given the rising foreign-born share of S&E

14 In 1994 RD employment was: 92,400 in majority-owned foreign affiliates of US MNCs and 591,200 in US parent firm http://www.bea.gov/scb/account_articles/international/1296iid/table17.htm. In 2004 it was 179,300 in majority-owned foreign affiliates and 818,7000 in parent firm (Yorgason, 2007, tables 1 and 3).

graduates from domestic and foreign universities.

The University System

The supply of university students and graduates and their choice of work location is only part of the story of the growth of higher education around the world. The other part relates to the increased number or scale of the institutions of higher education that employ faculty and other staff to "produce" graduates. In many countries the central government determines the number of places in various departments to which students apply, so that the distribution of graduates among fields depends on government policies. In the US state governments have been the major force in expanding the number of institutions of higher education, though in recent years and student choices determine the distribution of graduates. In yet others – Korea, Philippines – much of the expansion of higher education has come through the private sector. Australian universities actively recruit for international students, largely because the national government has reduced public funding (Marginson, Welch).

The huge expansion of higher education in the US between 1960 and 2005 first took the form of large increases of enrollments in existing institutions and then of large increases in the number of institutions. Between 1960 and 1980 enrollments in institutions of higher education in the US nearly tripled, from 3.3 million students to 12.1 million students. The number of institutions increased more modestly, from 2,008 to 3,231 (including 2 year institutions), so that approximately 2/3rds of the 1960 to1980 expansion took the form of increased enrollments at existing institutions.15 Between 1980 and 2005 enrollments increased from 12.1 to 17.5 million – a 45% increase; while the number of institutions increased to from 3231 to 4276, by 32%. In

15 Calculated using ln metric, the growth of enrollments was 1.30 ln points while the growth of the number of institutions was 0.48 ln points.

this period, 86% of the expansion took the form of increased numbers of institutions[16] -- a lagged response to the huge growth of enrollments in the 1960s and 1970s.

What about the expansion of higher education worldwide? The International Association of Universities provides information on over 16,000 institutions of higher education around the world (IAU, 2003, 2008). In addition, several Internet sites provide data on universities outside the US during the 1990s period of rapid enrollment growth (http://univ.cc/; www.braintrack.com/about.htm). These data provide a potentially extraordinary source of information on the development of mass higher education around the world that goes beyond this study.[17] The published data and Internet files give some insight into the incredible expansion of the university sector worldwide. Exhibit 12 records the names and years of founding (or of changes in the nature of an institution into a university) in two developing countries: Bangladesh and Chile. Many of the institutions in both countries were developed in the 1990s. In Bangladesh the new institutions were public sector, but in Chile there was an expansion of private sector colleges and universities. Bangladesh has an Open University. The universities in both countries report connections with universities in advanced countries.

International ratings of universities place US institutions at the top of the world tables. The Institute of Higher Education, Shanghai Jiao Tong University rates eight of the top ten universities as American, nine of the next ten, and 37 of the top 50 (http://ed.sjtu.edu.cn/rank/2005/ARWU2005_Top100.htm). In its league tables, the Times of

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16 Calculated using ln metric, the growth of enrollments was 0.37 ln points while the growth of the number of institutions was 0.32 ln points.

17 The IAU data are in computer form but not publicly available as of 2008 but earlier data may exist only in paper form. I am currently trying to get all of these data organized in research-friendly forms.

London places more UK universities among the top but the UK numbers still fall far short of those for the US (http://www.timesonline.co.uk/tol/life_and_style/education/article502890.ece). Associated with the dominance of the US university system is its ability to attract outstanding foreign-born scientists and engineers, many of whom first came to the country as international students, as noted. In 2003 a large proportion of full-time doctoral instructional faculty in research institutions in the physical sciences/math/ computer sciences/engineering were foreign-born -- 47% of compared to 38% in 1992 (NSF, 2008, appendix table 5-21).

The growing number of students and universities in other countries impacts the US university system in several ways. Increased numbers of bachelor's graduates from other countries raises demand for places in US graduate and professional schools. If US universities treat foreign and domestic applications equally, the increased share of bachelor's degrees outside the US will reduce the proportion of US graduates admitted to particular programs. In 2008 the bright US graduate from, say, Haverford must compete for admission to Berkeley, Harvard, Michigan, or MIT with students from China, Brazil, India, France, Germany and so on as well as with top graduates from Texas, Syracuse, Dartmouth etc. In July 2008 the Chronicle of Higher Education reported that the three leading major undergraduate institutions for US PhD programs were Tsinghua, Beijing, and Seoul National University.18 Given that the top US graduate and professional schools have not increased the number of graduate slots much (Freeman, Jin, Chen) the chances of graduates of US institutions gaining admission to these programs has been and is likely to continue to fall.

But this does not mean that overseas applicants push students from US bachelor's

18 http://chronicle.com/news/article/4822/graduates-of-chinese-universities-take-the-lead-in-earning-american-phds

programs out of post-graduate education. The US has a large number of universities that have expanded graduate enrollments. The expansion of US-born women into graduate programs occurred more or less simultaneously with increased foreign student enrollments. Many foreign-born graduate students enrolled at less prestigious universities, which enabled those institutions to improve their graduate programs (Freeman, Jin, Chen). To the extent that the supply of US students to graduate programs diminishes due to the increased attraction of MBA or law programs, bachelor's graduates from overseas will keep some graduate programs in business.

Over time foreign universities will improve their quality, so that the expansion of higher education outside the US will create greater competition for American universities in attracting international students. For American students and faculty, the benefit will be a greater number of quality universities at which to obtain an education or a job. The challenge to US universities will be to remain world centers of excellence in spite of increased overseas competition. This presumably requires that they innovate in various ways, taking advantage of their "brand names", culture of openness, ties with business, and so on. Some US institutions have developed overseas branch campuses to increase enrollments in particular countries (for instance, Carnegie Mellon in the Qatar). This may work in some countries but not in others. In the early 1990s about 40 US universities had branches in Japan, but the Japanese educational authorities did not accredit them and all but 3 have shut down.

Foreign universities, particularly from Australia and the UK, have been more active than US universities in seeking international students as undergraduates. Some Australian universities award degrees to students who do part of their education at lower cost universities in their home country. The Australian government gives preference in immigration to graduates from

Australian institutions. British universities have more branches overseas than American universities, particularly in Commonwealth countries. In non-English speaking countries many universities have switched their education into English, which increases their attractiveness for international students. Among the developing countries, China's Project 985 policy for creating a number of first-rate universities of international advanced standing represents perhaps an extraordinary bold effort to leapfrog a low income country to the forefront of higher education. It involved providing sizable financial grants to nine universities -- Beijing Fudan, and Nanjing among traditional universities and to Tsinghua and five other institutions oriented primarily to science and technology. In 2004 the government expanded financial support to an additional 30 institutions. While it will take time, and perhaps increased democratization of China for these universities to challenge the very best American universities, the Chinese university system has greatly improved its attractiveness to faculty and students worldwide. In fall 2008 the Chronicle of Higher Education reported that China had become the fifth top college destination for international students, particularly attracting those from Asia (Hvistendahl, 2008).

In the face of global competition it is difficult to imagine the US maintaining the dominance it has had in the latter part of the 20th century (just as it is difficult to imagine the US maintaining its dominance of the global economy). But barring some horrific policies or events I would expect US universities to continue to among the world's leader in higher education into the foreseeable future and thus to keep attracting high skill immigrants to the country.

Impacts on the economy

The increased number of science and engineering and highly educated workers around the world has two clear positive impacts on the economy. First, it should accelerate the growth of scientific and technological knowledge and the economic progress that flows from this knowledge. One does not have to be a devotee of "the singularity" view of technological progress[19] to believe that having three or so times as many university graduates, particularly in science and engineering, than two or so decades ago, the Internet to spread knowledge, and computers to perform calculations unimaginable two or so decades ago could produce a golden age for humanity. We benefit regardless of whether advances in our understanding in biology or nano-technology or robotics or economics for that matter that improves our longevity or health, provides us with better or lower cost products, or raises productivity come from the US or other places, or from US-born persons or foreign-born persons. To the extent that taxpayers in some other country fund research and education, we win without paying for it. Second, the increased number of highly educated workers overseas should raise productivity in foreign countries, which in turn should reduce the cost of their exports to the US. This will benefit all Americans who do not compete in producing those goods. If Romanian scientists and engineers figure out ways to improve the production of shoes, the price of shoes on the global market will fall, and the US as a major importer of shoes will benefit.

But there is a negative side. The increased supply of university graduates in other countries will enhance their ability in the high tech sectors that employ relatively many college graduates, where the US has comparative advantage. In the context of the North-South model of trade in which the advanced North does the R&D that produces innovative products and the developing South produces products based on low wage labor, this competition will squeeze US

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19 http://en.wikipedia.org/wiki/Technological_singularity

earnings and job opportunities. With more highly educated workers, developing countries should be able to increase their rate of innovation and their rate of imitation. The prices of US exports in high tech and other university graduate intensive sectors should decline, with adverse consequences for the workers in those sectors and for workers with similar skills elsewhere.

In some cases, given the lower cost of labor, the US may lose its position as the major producer of high tech goods or of the research and development on which they are based. NSF (2008) data show that China has in fact increased its share of export markets in high tech goods. The Georgia Tech index of the technical prowess of countries based on a variety of statistics shows a huge rise in the position of China's prowess. The index will surely show increases in the position of other developing countries in the next decade or two.

There are two possible responses to the growth of highly educated workers worldwide. The US can seek to attract international students on the notion that many of them will stay in the country as immigrants and encourage high skilled immigrants to come to the country. Given that the multinational firms in the forefront of technology can locate activities in the US or offshore activities overseas, the policy issue for the US would seem to be whether it is better to attract immigrant specialists, which seems easier if they come first as international students, or to have the multinationals offshore an increasing proportion of their work overseas.

Which is better for the US – off shoring or immigration? Grossman-Rosi-Hansberg (2006) make a case for offshoring. Assuming that wages in the developing countries are lower for similar work than wages in the US offshoring costs less than the same work done by immigrants in the US. Offshoring is equivalent to an improved technology that allows US workers to do their tasks better. Foreign-born workers compete on the offshorable tasks but not other activities with Americans for whom they are substitutes. By contrast, immigrants compete with Americans in all sorts of jobs, including those in non-traded sectors. Taking a broadly similar approach Jones and Ruffin argue that under some conditions it is even desirable to give our best technology to the low wage foreign countries, because we will then get the products back at the lowest cost. In the case of science or engineering, better to have an inventor doing their work overseas at lower cost than than doing it in the US at higher cost.

But can the same person do as good work in a developing country as in the US? There is diverse evidence that the huge pay and productivity difference between workers in the US and in developing countries cannot be explained by human capital or capital/labor ratios or any other observable measure, for that matter. Analyzing research papers, Macgarvie and Khan show that the number of papers written is higher for nominally similar international students in the US than for those whose fellowships make them return to their native countries. The implication of these findings is that the same person working with the same capital produces more in the US than in most other countries. Why? One possible reason is the US's business and work culture, which is difficult to replicate, but whatever the reason, the greater productivity in the US implies that immigration raises output more than offshoring and thus is to be preferred on that criterion.

Does the productivity of US workers benefit more from immigration or offshoring? Working in direct contact with someone would appear to raise productivity more than buying their goods, because of the greater likelihood of learning about work activity from them. Kremer and Maskin's model of the mixing of low and high skilled workers does not deal with immigration and offshoring per se but it gives conditions for the sorting of workers between advanced and developing countries that shows that the answer to the productivity question will depend on relative numbers and productivities of skilled and less skilled workers outside and within the US as well as on the strength of complementarity reflected in the production function.

Conclusion

This paper has documented the spread of higher education around the world. It has shown that the rising proportion of young persons going to college in advanced countries, which have risen above those in the US in some countries, and human resource leapfrogging in the huge populous developing countries has greatly diminished the US's share of the world's university students and graduates. Because international students make up roughly half of university graduate immigrants, the ability of US universities to attract the world's best and brightest international students has important consequences for its success in attracting immigrant talent.

The growing number of foreign-born persons getting PhDs outside the US as well as in US universities will undoubtedly diminish the gap between US universities and those in other countries. The world ranking of top universities in 2020 is likely to include many more from other countries. Increasingly, new knowledge will come from workers outside the country, but there is much the US can gain from this. We do not have firm enough knowledge to know whether the US will do better through immigration or through offshoring of some university graduate-level work overseas. My guess is that by educating some of the best students in the world, attracting some to stay and positioning the US as an open hub of ideas and connections for university graduates worldwide, the country will be able to maintain excellence and leadership in the "empire of the mind" and in the economic world more so than if it views the rapid increase in graduates overseas as a competitive threat. But to turn that guess into something would require some simulation of alternatives with empirically valid parameters that goes far beyond my competence and arguably that of current social science.

Exhibit 1: Millions of Enrollments in Higher Education (including < 4 year) Worldwide and US Share, 1970-2006

	1970	1980	1990	2006
World	29.4	55.3	67.6	141.5
US	8.5	12.1	13.7	17.5
Other advanced	4.9	8.2	12.9	21.5
Developing	16.0	35.0	41.0	102.5
China	<0.1	1.7	3.8	23.4
India	2.5	3.5	5.0	12.9
US share	29%	22%	20%	12%

Source: UNESCO, Institute for Statistics, on line files

Exhibit 2: Millions of First University Degrees, Natural S&E Degrees, 24 year olds, ~2004 and Δ ~1995-2004

	US 2004	World 2004	US/World 2004	Change in % pts, 1995-2004*
First Degree	1.407	10.926	12.9%	-5.5
Nat S&E	0.219	2.395	8.5%	-2.8
24 yr old	3.851	79.363	4.9%	-0.5
First/24 yr old	36.5%	13.8%	2.64	-1.30
Nat S&E /24 yr	6.1%	3.5%	1.74	-0.71

Source: NSF 2008, appendix table 2 -37 and 2006 table 2-37 for 24 year olds; NSF 1998 for 1995; * 1995-2004 for US/(Asia+Europe+ North America)

Exhibit 3: Ratio of S&E PhDs from Foreign Universities to US Universities and US share of World S&E PhDs, 1975-2010

	1975	1989	2001	2004	2010
Asia major nations [a]	0.22	0.48	0.96	1.23	
China	na	0.05	0.32	0.57	1.26
Japan	0.11	0.16	0.29	0.29	
EU major (Fr, Germ, UK)	0.64	0.84	1.07	1.02	
All Advanced EU [b]	0.93	1.22	1.54	1.78	1.92
Chinese 'diaspora'/ US [c]			0.72		
US Share of World S&E PhDs			22.3%	17.6%	

Sources: Science & Engineering Indicators – 2008 , table 2-40; 2002, table 2-36; Weigo & Zhaohui National Research Center for S&T Development (China) – private communication; [a] China, Japan, India, Korea ; [b] Includes Norway, Switzerland, excludes new EU entrants, extrapolation to 2010; [c]'diaspora' includes estimates of Chinese doctoral graduates from UK, Japan, and US (with temporary visas). US natives = citizens and permanent residents

Exhibit 4: US Rank in Propensity for University Training, 1992-2005

Graduation Data from OECD/NSF

	1992	**2005**
"Tertiary A" graduation rates (OECD)	2 of 15	13 of 20
Bachelor's Degrees/24 yr old (NSF)*	2 of 21	14 of 23
Nat Science & Engineering/24 yr old (NSF)	3 of 21	19 of 23
Phd or equivalent graduation rates (OECD)	---	9 of 20
All Science Grads/ 25-34 yr olds (OECD)	---	12 of 20

Enrollment data from OECD

	1995	**2005**
first time entry as % of age group	2 of 15	7 of 20
Enrollment % of 20-29 yr olds	9 of 20	12 of 20

Survival Rates from OECD for advanced countries

Graduation/new entrants for type A 2004 17tie out of 18

OECD, Education at a Glance, NSF, Science and Engineering Indica tors

Exhibit 5A: OECD Estimated Ln Wage Coefficient and Proportion of 24 yr olds Getting Bachelor's Degree (r=0.19)

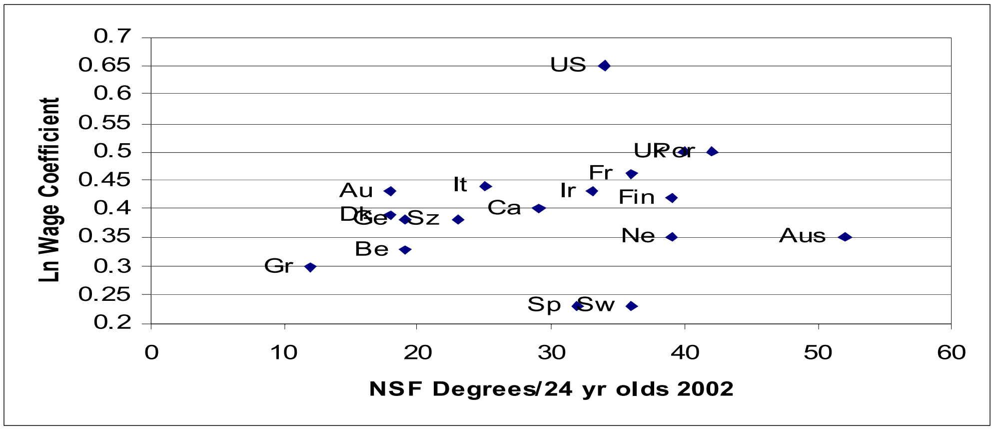

Exhibit 5B OECD Estimated Internal Rate of Return to College Degree and Proportion of 24 yr olds Getting Bachelor's Degree (r=0.39)

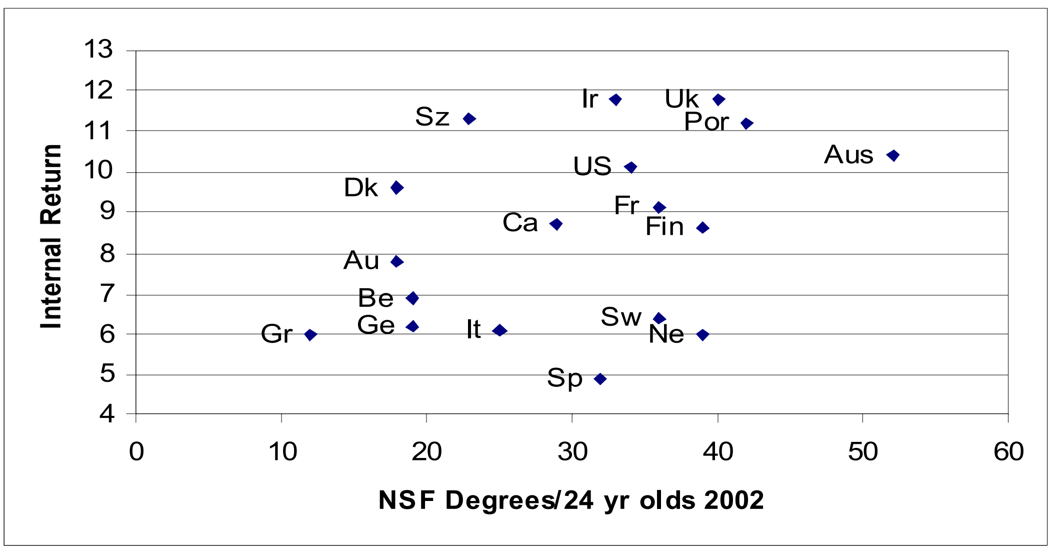

Exhibit 6A: Ratio of Female to Male Tertiary enrollment rates

Group/Country	1988	2005
WORLD	64	105
Advanced	106	121
US	116	140
Netherlands	81	108
All developing (	54	91
Chile	82	96
Malaysia	87	131
Most populous developing countries		
India	47	70
China	55	95
Indonesia	--	79
Brazil	106	132
Pakistan	46	88
Bangladesh	25	53
Nigeria	--	55
Mexico	66	99
Philippines	--	123
Vietnam	--	71

Exhibit 6B: Enrollment Ratios of Women/Men in higher education, by age group, advanced countries, 2004

	OECD	UN		OECD	UN
Norway	1.54	1.38	Belgium	1.21	1.06
Iceland	1.78	1.82	Austria	1.19	1.24
Australia	1.23	1.14	Denmark	1.42	1.58
Ireland	1.28	1.28	France	1.28	1.47*
Sweden	1.55	1.47	Italy	1.34	1.27
Canada	1.36	--	UK	1.37	1.17 *
US	**1.39**	**1.27**	Spain	1.22	1.41
Netherlands	1.08	1.17	NZ	1.41	1.41
Finland	1.20	1.26	Israel	1.33	--
Luxembourg	1.18	--	Greece	1.17	1.23
Portugal	1.32	--			
Germany	..	0.97			
Japan	0.89	0.73			
Switzerland	0.80	0.97			
Korea,	0.61	0.87			

Exhibit 7: Ratio of Females to Males in US higher education, enrollments and by degree, 2006

College Enrolments	1.29
Bachelor’s	1.36
Master’s	1.50
PhD	0.96
MD	0.96
Law	0.92
MBA	0.75

Source: US Statistical Abstract, 2008

Exhibit 8: International Students Worldwide, and in the US and US share, 1975-2005

Year	Millions of International Students Total	US	US Share
1975	0.6	0.15	25%
1980	0.8	0.29	36%
1985	0.9	0.39	38%
1990	1.2	0.45	33%
1995	1.3	0.51	35%
2000	1.9	0.57	26%
2005	2.7	0.58	22%

- Source: OECD, Education at a Glance, 2007, Box c3.1 and IIE, International Students and Mobility http://exchanges.state.gov/universitysummit/mobility_report.pdf
- NB: Project Atlas reports somewhat smaller numbers: “In 2006, UNESCO estimated that over 2.5 million students were being educated at the tertiary level in countries other than their homes, up from an estimated 1.7 million in 2000” (http://www.atlas.iienetwork.org/?p=46572)

Exhibit 9: Share of US degrees to non-citizens/permanent residents, 1985-2005

	ALL		Natural S &E		Engineering	
	1985	2005	1985	2005	1985	2005
Bachelor's	3.0	3.1	5.4	5.2	7.2	8.0
Master's	9.4	12.8	27.2	38.6	26.2	39.7
Doctorate	25.3	39.3	33.1	50.9	59.6	68.8

Source: Degrees, NSF, Science and Engineering Indicators, 2008, chapter 2, Tables 2-28. 2-30, 2-31; Post-docs, Enrolments, grad, table 2-22.

Exhibit 10: Proportion of international students by academic level and major source country, 2006-2007

Total international students to US: 582,984

% by Academic level: Graduate 45.4% ; bachelor's, 29.2%, associates, 11.6%, other, 13.8%

% by top ten source countries: India, 14.4%; China, 11.6%, Korea, 10.7%, Japan, 6.1%, Taiwan, 5.0%, Canada, 4.9%, Mexico, 2.4%; Turkey, 2.0%, Thailand,1.5%, Germany 1.5% (Over 2/3rds from Asia; nearly 85% from developing countries.

Source: International Educational Exchange, Open Doors 2007; Tab le 3 INTERNATIONAL STUDENTS BY ACADEMIC LEVEL, 2005/06 & 2006/07; Figure 2A TOP 20 LEADING PLACES OF ORIGIN OF INTERNATIONAL STUDENTS, 2005/06 & 2006/07; http:// opendoors.iienetwork.org/?p=113136 and ?p = 113121

Exhibit 11: Percentage of Foreign-Born S&E workers whose highest degree was from US, 2003

PhD	64%
Master's	69%
Bachelor's	54%
Total	60%

Source: NSF, 2008. Table 3-8

Exhibit 12: Universities in Bangladesh and Chile, 2004

Bangladesh Universities

Name	Year Founded
Bangabandhu Medical	1965(1998)
Bangabandhu Medical Agric	1983(1998)
Bangladesh Agricultural Univ	1961(1972)
Bangladesh Open Univ	1992
BUET	1947(1992)
Chittagong	1964(1966)
Dhaka	1921
HMDSTU	1976(2002)
Islamic	1979(2000)
Jahangirnagar	1970(1972)
Khulna	1991
National University	1992
Rajshahi	1953
Shahjalal	1987
American International	1994
Ahsanullah	1995
AUB	1996
DIU	1989
Dhaka	1995(2000)
EWU	1996
Gono Bishwabidyalay	1998
IUB	1993
IUBAT	1992
Islamic University of Techl	1981
North South Univ	1992
People's University	1996
Queens	1997
Asia Pacific	1996
Univ Sci & Tech, Chittagnong	1992

Chilean Universitites

Name	Year Founded
arturo prat	1984
metropolitan of education	1986
metropolitan of tech	
antofagasta	1981
atacama	1857
bio bio	1988
chile	1738
magallanes	1961(1981)
santiago chile	1849(1981)
talca	1981
tarapaca	1982
valparaiso	1911(1981)
Adolfo Ibanez	1953(1989)
Alberto Hurtado	1997
Andres Bello	1988
Autonomous Univ Christian	1975(1988)
Autonomous Univ of South	1989
Bernardo O'Higgins	1990
Bolivariana	1988
Catholic-Cardinal Henriquez	1990(1993)
Catholic	1888(1930)
Catholic Univ of Holy Concept	1991
Catholic Univ of Maule	1991
Catholic Univ of North	1956(1969)
Catholic Univ of Temuco	1991
Catholic Univ of Valparaiso	1928(1961)
Central	1982(1993)
Chile Adventist	1965(1990)
Diego Portales	1982(1993)
Federico Santa Maria Tech	1932(1935)
Finis Terrae	1981(1996)
Francisco De Aguirre	1990(2001)
Gabriela Mistral	1981(1992)
Ibero_American Tech	1989
International	1892(1988)
Jose Santos Ossa	1992
Las Condes	1987
Mariano Egana	1988
Maritime	1990
Miguel de Cervantes	1998
Panamerican	1989
El Libertador	1990
San Andres	1994
San Sebastian	1989 (2001)
Santo Tomas	1988
Southern	1955
Aconcagua	1978(1989)
Americas	1988(1997)
Andes	1989(2001)
Arts, Science and Comm	1981(1999)
Arts and Social Sciences	1982
Computer Science	1989
Concepcion	1919(1980)
for Development	1990
Mayor	1988(1996)
of the Pacific	1990
Of theRepublic	1988
of the Sea	1989
VP Rosales Tech	1982(1992)
Vina del Mar	1984(1990)

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