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An analysis of the foreign-educated elite academics in the United States

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ABSTRACT

This study collects the educational backgrounds of 14310 full professors from top 48 universities in the United States. The aim is to analyze the role of foreign education in academics training in the United States. There are two parts of the analysis. In the first part, we find the countries from where the professors get their education. We note that there are some concentrations in provision of undergraduate studies. For example, Greece provides more undergraduate degrees to professors than the whole continents of South America or Africa. Moreover, we show that most of the foreign-educated professors get their undergraduate education from high-income countries. In the second part, we find the ratio of foreign-educated professors by the type of the university and the academic field in which they currently work. We show that the ratio of foreign-educated academics does not vary with public ownership of the university or the ranking of the university. However, the ratio of foreign-educated professors varies significantly among academic fields.

1. Introduction

This study collects the educational backgrounds of a large number of academics to understand the role of foreign education in academics training in the United States. We handpick the data from the top 48 universities in the United States. We get the educational backgrounds of all full professors who work in 16 academic fields related to the natural sciences, the social sciences, engineering and humanities. In all, the education backgrounds of 14310 full professors is obtained.

There are two parts in the analysis. In the first part, we analyze the source countries from where the professors get their education. It is examined whether the students who take their education from certain countries are more likely to become elite academics. Moreover, the paper investigates whether the poorer countries are more likely to provide education to elite academics. It also examines the source geographical regions that provide education to elite academics.

In the second part, we analyze the institutions in which the professors currently work. The paper studies whether the foreign-educated professors more likely to work in public universities. The ratio of foreign-educated professors in higher and lower ranked universities is also analyzed. Moreover, we find the academic fields in which foreign-educated academics are more likely to work.

The brain drain is defined as the loss of skilled labor because of the emigration from the country. Bhagwati and Hamada (1974) show that the brain drain is associated with a significant level of output loss if skilled and unskilled labor are not substitutes.

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It is observed that most of the prestigious universities are concentrated in few countries that can attract highly skilled academics. Therefore, brain drain is an important issue in the academic world. The brain drain of academics has already been analyzed in previous studies. Ioannidis (2004) and Stephan and Levin (2001) are closely related to the present paper because they also analyze the brain drain of academics in a large scale by spanning many academic fields. Ioannidis (2004) collects the birth origins of 1523 highly-cited researchers from all over the world. The author finds that the ratio of foreign-born academics depends on the host country and the academic field. Stephan and Levin (2001) analyze the birth origins and educational backgrounds of 4500 science and engineering researchers from the United States who are National Academy members or have other qualifications such as being authors of highly cited papers. They find that the ratio of foreign-educated elite academics is increasing through time.

Another closely related paper to our study is Wang, Mao, Wang, Peng, and Hou (2013). They also focus on the academics attracted to the top US universities. However they constrain their study only to academics of Chinese origin. They find that the ratio of Chinese academics is highest in the medical field and the number of Chinese academics is highest at Ohio State University.

Hunter, Oswald, and Charlton (2009) analyze the birth and educational backgrounds of 158 the most-cited physicists. They show that the United States has become a very strong magnet for physicists. Although only 29.7 percent of their sample are born in the United States, 67.1 percent currently works in the United States.

Laudel (2003, 2005) follows 131 biomedical researchers who participate on a regular yearly basis in the prestigious Gordon conferences. Elite academics are highly mobile in every stage of their career. Moreover, academics are found to be attracted to the United States at different stages of their career.

An alternative method to measure the extent of brain drain is to use information from publications. Basu (2013) searches the Indian names in the Web of Science and compares the productivities of Indian researchers who work in India to those Indian researchers who work abroad. The Indians abroad are found to be more productive and the gap is increasing through time. Furukawa, Shirakawa, and Okuwada (2013) find the educational backgrounds of more than 7000 scientists from the biographical notes in the journals from the computer vision, robotics and electron devices fields. They find that highly-ranked graduate schools attract students from all around the world. Woolley, Turpin, Marceau, and Hill (2008) make a survey on East Asian scientists by using the e-mails in the contact information in articles taken from SCI. They find that many of the East Asian researchers get their graduate and post graduate training from Europe and North America

The prevalence of foreign-born academics is not surprising because there is a high stay rate of PhD students in the United States. The studies that use the Survey of Earned Doctorates show the extent of the stay rates. Johnson and Regets (1998) state that more than half of the PhD graduates from Science and Engineering programs intend to stay in the United States. Bound Turner, and Walsh (2009) show that there is a steep upward trend of the number of PhD graduates who have foreign undergraduate degrees. Finn (2010) and Kim, Bankart, and Isdell (2011) show that the stay rate of the foreign-origin PhD students increases with time.

The brain drain studies are not confined to academics. Docquier and Marfouk (2006) use OECD and US Census data to find the number of college graduates who migrate to OECD countries. Docquier, Lohest, and Marfouk (2007) use the same data and find that small, poor and politically unstable countries are more likely to lose their educated labor force to OECD countries.

Mullan (2005) studies the source countries of all foreign-educated medical doctors who have emigrated to Australia, Canada, United Kingdom and the United States. India is found to be one of the top providers of medical doctors to all these countries.

Gibson and McKenzie (2011) analyze the brain drain of a thousand people from Tonga, Papua New Guinea and New Zealand who have been successful in high school by participating in scientific olympiads or being top performers in college admissions exams. They find that those who attain PhDs are less likely return to their country.

The treatment of foreign-educated professors in the United States as a brain-drain indicator is limited for two main reasons. First, pre-tertiary backgrounds of the professors are not collected because of data availability issues. Stephan and Levin (2001) and Hunter et al. (2009) show that the ratio of foreign-born academics is significantly different than the ratio of foreign-educated academics. This is not surprising as Marginson and van der Wende (2007) show that more than ten percent of the tertiary students in Australia, Germany and United Kingdom are foreign born. Some students may go to these countries for education and use their education as a stepping stone to become academics in the United States. Paul (2011) shows that the stepping-stone migration is prevalent and has many routes.

Second, this study is confined to universities in the United States for reasons that we describe in the data section. Therefore, we miss the brain gain of the other countries from the United States. The brain gain is the opposite of the brain drain and is defined as the benefit of a country from skilled labor migration. We do not cover any academics who are educated in the United States but become elite academics in other countries. In other words, our measure is unidirectional and only specifies the loss of the foreign countries.

There can be a comparable amount of brain drain and brain gain for a particular country. Then, the term “brain circulation” is used for these countries. For example, Bekhradnia and Sastry (2005) show that there is a comparable number of academics moving in and out of the United Kingdom.

Canibano and Woolley (2015) examine the rich brain drain and brain gain literature that starts around the 1960′s. There are many paths of brain drain and brain gain. The net brain drain depends on the assumptions of the studies. They classify

the literature into the optimistic and pessimistic categories where the former studies find a more equalitarian distribution of benefits of skilled labor mobility.

There are brain gain studies that find that the researchers who return to their source countries gain by their increased productivity partly by sustaining their ties of collaboration in the host countries. Jonkers and Tijssen (2008) and Velema (2012) show this type of brain gain for Chinese-returned and Mexican-returned researchers respectively.

Part of the brain gain is detected in the human capital investment behavior of the agents. Beine, Docquier, and Rapoport (2001) note that there is an additional benefit of going abroad for the countries which send their skilled labor abroad. This additional benefit motivates parents to invest more in their children's education. Therefore, the source countries may end up having a higher stock of high-skilled workers even after sending a considerable amount of their skilled labor abroad.

Although we do not consider the brain gain directly, we think that the number of foreign-educated professors might lead to the potential for reverse brain drain for some countries. Marginson and van der Wende (2007) show that Turkey, Chile and India are among the countries where the ratio of foreign undergraduate students are below one percent. Therefore, most of the students who are educated in these countries are actually born and raised there. Monteleone and Torrisi (2012) find in their survey that one of the major reasons for reverse brain drain is family considerations. Therefore, many professors have the potential to return to the country where they get their undergraduate degrees if their families also reside in that country. We see that this is happening in Turkey. Many professors from top Turkish private universities were previously at elite US institutions. They are mostly Turkish origin and many of them have their undergraduate degrees from Turkey.

Dill and Soo (2005) show that many of the global rankings of universities include the success of the graduates from these universities as one of their criteria. The number of professors who get their tertiary education in one country but work in elite institutions in the United States would partly demonstrate the success of the tertiary institutions in that country. Consequently, the findings of the present study help to evaluate the success of the tertiary institutions in the world.

The analysis of this paper answers a couple of important questions that are unexplored in the literature. For example, we see whether the ratio of foreign-educated professors change as the ranking of the university increases. In other words, we compute the share of professors with foreign undergraduate degrees and see whether the share increases with the prestige of the university.

Borjas (2004) shows that the foreign students crowd out native students in prestigious US graduate programs. We study whether the students who have foreign undergraduate degrees are as succesful as their domestic counterparts who have attended the same US grad school. In other words, we see whether the students who crowd out natives would benefit the United States by becoming academics at the very best US universities.

2. Data

We collect data from 48 US universities that are top 100 in the Shanghai Rankings. The only three US universities that are in top 100 excluded are specialized in life and/or medical sciences.

Our interest is confined to the United States because of data-availability issues. Professors in most other countries are not as willing to expose their background as professors in the United States. We also would have language difficulty for the professors in non-English speaking countries because it is difficult to collect data from non-English sources.

We choose academic fields that exist in the majority of the 48 universities and match departments to the academic fields. For example, there are economics departments in all universities and we assign them to the economics field. In some cases, this matching is not easy. For example, the electrical engineering and computer engineering departments are separate in some universities but merged in other universities. Therefore we lump these departments into one single "Electrical & Computer Engineering and Computer Science" field. We were unable to match departments to the biological sciences fields. For example, a singular biology department could not be found in many of the universities. As a result, we exclude this important academic field. Additionally, we exclude some academic fields such as anthropology because of the high rates of missing data. At the end, we are left with the following 16 academic fields:

- Natural Sciences: Chemistry, Mathematics, Physics
- Engineering: Biological and Biomedical Engineering, Chemical Engineering, Civil and Environmental Engineering, Electrical & Computer Engineering and Computer Science, Industrial Engineering, Material Science and Engineering, Mechanical and Aero Engineering
- Social Sciences: Economics, Psychology, Political Science, Sociology
- Humanities: History, Philosophy

The analysis is confined to full professors. Assistant professors, associate professors, emeritus professors, teaching faculty and professors in practice are excluded. There are two reasons for confining our study to the full professors. First, there is a technical incompatibility issue of junior positions. For example, an assistant professor in mathematics is usually an instructor position whereas the same title is given almost exclusively to tenure-track positions in economics. Second, we focus on a group of researchers who have already settled in the United States. As Bekhradnia and Sastry (2005) show junior faculty is much more mobile than senior faculty.

The main drawback of examining full professors is that we have a cohort of old researchers. For example, we even have professors who were educated in the 1960s. Therefore our analysis does not represent the current trends but historical movements of skilled academics.

The list of professors is taken from departmental web pages in most of the cases. In rare cases, where the departmental stratification is not available (e.g. Caltech), we appoint the professors according to their specialty.

The analysis is restricted to the core faculty to refrain from double counting. That is, this study only considers the first appointment of the professors. For example, a professor is only counted as an economics professor if her first appointment is in economics and her second appointment is in psychology. This way, we refrain from counting the professors twice.

We collect the undergraduate and PhD institutions of the full professors and their graduation dates from these institutions. We rely on many sources when we look up the educational backgrounds of the full professors. The main tools that used are as follows.

- The official web pages of the professors
- Internet search engines such as Google and Yandex
- Undergraduate catalogs
- Commencement leaflets
- PhD data-bases such as Proquest
- PhD thesis of the professors
- Field specific academic trees such as Mathematical Genealogy
- Field specific data-bases for researchers such as Inspire for physics
- Reference books such as *American Men & Women in Science*
- Social network sites such as Linkedin
- Internet encyclopedias such as Wikipedia
- Web pages of the previous workplaces or temporary visits
- Various other sites such as interviews in newspapers, welcome notes in department newsletters, alumni news and seminar announcements

As a last resort, we send e-mails to the professors asking only for their educational background information. We received replies for around 1/3 of these e-mails. This is a similar response rate as Woolley and Turpin (2009) who asked for the CVs of Australian researchers.

The analysis gives the utmost importance to data completeness. Missing data imposes serious bias to the study. For example, it is observed that a professor is more likely to state her undergraduate degree in her web site if she attains her undergraduate degree from a prestigious university. Therefore, our findings would be seriously biased towards professors who have prestigious undergraduate degrees if there is a large amount of missing data.

The paper gathers the undergraduate and graduate institutions of 97.2 percent of the professors. The educational background information including the graduation dates is complete for 95.9 percent of the professors. Most of the missing data is concerning their undergraduate degrees. There is little missing data in regards to their PhD degrees. The data includes the PhD institutions of 99.9 percent of the professors. The PhD information including the graduation date is complete for 99.7 percent of the professors.

There is a large interfield variability in availability of data. For example, we could not find 9.6 percent of the mathematics professors' undergraduate institutions whereas only 0.3 percent of the economics professors' undergraduate institutions could not be found.

There is also variation among universities in data availability. The undergraduate institutions of all professors in eight universities were available whereas the undergraduate institutions of 8.2 percent of the Carnegie Mellon professors were not.

Population of countries are extracted from World Bank data for the year 2014.[1] World Bank also groups countries by per capita income intervals that is used in the analysis.[2]

We use the migration data from the 2000 Census available from US Census Bureau reports.[3] The total number of migrants from each country is given in these reports. Moreover, the number of migrants who are 25 years and older and have college education is also reported.

3. The percentage of foreign-educated professors in the United States

We compute the ratio of foreign-educated professors by dividing the number of foreign-educated professors to the number of all professors. It is found that 34.5 percent of the professors have foreign undergraduate degrees whereas only 12.5 percent of the professors have foreign PhD degrees.

[1] Population data is available from http://data.worldbank.org/indicator/SP.POP.TOTL?view=chart.
[2] Income groups are available from https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
[3] The US Census Bureau reports are available from "https://www2.census.gov/programs-surveys/decennial/tables/2000/stp-159/national/."

The high ratio of foreign undergraduate degree holders show us the importance of foreign education in academics training in the United States. More than 1 in 3 professors get their undergraduate degrees abroad. Therefore, the very best talents who get their undergraduate education abroad are attracted to become academics in the United States.

The relatively lower ratio of the foreign PhD holders implies that many of the academic talent abroad is attracted to the US universities at the graduate school level. The studies that use Survey of Earned Doctorates such as Johnson and Regets (1998) are consistent with this finding. These studies state that the foreign PhD students in the United States are inclined to stay in the United States. Therefore, it is not surprising that we find many students who have foreign undergraduate degrees but US graduate degrees become academics in the United States.

Ioannidis (2004) finds that around a third of the academics in the United States are foreign born. This figure is comparable to our ratio of academics who have foreign undergraduate degrees. However, we mentioned before that foreign educated is not the same as foreign born although a foreign born is likely to get foreign education and vice versa.

The ratio of foreign-educated academics is much lower in Stephan and Levin (2001). One of the main reasons for this discrepancy is the age of the samples. They analyze the academics in the 1990s whereas our sample is drawn at the end of 2015. Our relatively higher ratios may imply the increasing importance of foreign education in the United States.

The rest of the paper analyzes the foreign education of the elite academics in two parts. In the first part, it examines the source countries from where the elite academics get their education. In the second part, it examines the type of institutions in which the foreign-educated elite academics currently work.

4. Source countries that provide undergraduate education to elite academics

In this section, we analyze the source countries that provide education to elite academics. Since there are many more academics who get their undergraduate degrees from non-US universities than those who get their PhD's from non-US universities, we have a richer data-set about the source countries at the undergraduate level. Therefore, we confine our analysis to undergraduate education in order to work with a richer data-set about the source countries.

Table 1 lists all of the 45 countries that provide undergraduate education to at least ten professors. We list the source countries in the first column, the number of professors who get their undergraduate degrees from these countries in the second column and the number of professors divided by the country's population in millions in the third column.

Although professors in the United States get their undergraduate education from many countries, most of the foreign undergraduate education is provided by relatively few countries. A total of 1119 (23%) foreign-educated professors get undergraduate education from India and China. 3170 (two-thirds) foreign-educated professors get their undergraduate education from just ten countries.

Ioannidis (2004) notes that six out of seven highly cited scientists who are born in India and China end up working abroad. Bound et al. (2009) show that the number of Indian and Chinese students are highest among foreign students in US graduate programs. Johnson and Regets (1998) show that Indian and Chinese students have the highest stay rates after their graduate studies in the United States. Thus, it is not surprising that many academics who are educated in India and China have ended up working in the United States.

Israel is the top provider of the undergraduate education when we consider the per person figures. There are 24.22 professors per million of the population who get their undergraduate education from Israel. This rate is more than ten times higher than that of France and Italy.

Brazil, a largely-populated South American country provides undergraduate education to just 35 professors. Bound et al. (2009) show that the number of Brazilian students in US graduate programs is also relatively low. Therefore, the low number of Brazilian-educated students in US graduate schools may be one of the main reasons for the low number of Brazilian-educated academics in the United States.

There are only 41 professors who get their undergraduate degrees from Mexico. This is surprising as Mexico is a populated country and a neighbor to the United States. Mexicans may find it easier to get their undergraduate education in the United States because of the geographical proximity. Therefore, the number of Mexican-origin academics in the United States may be different from the number of Mexican-educated academics in the United States.

There are a high number of academics who get their education from Australia, Canada and the United Kingdom. The ratio of foreign undergraduate students in these countries are more than 10 percent (Marginson & van der Wende 2007). Therefore, some of the academics who get their undergraduate education from these countries may not be originally from these countries.

In the last two columns, we compare the number of professors to the migration from these countries. The migration figures belong to 2000 Census and are extracted from US Census reports. The penultimate column gives the number of professors per thousand migrants who are 25 years or older of the source country to the United States. The ultimate column gives the number of professors per thousand college educated migrants who are 25 years or older. The college-educated migrants is used in many studies such as Docquier and Marfouk (2006) as the brain drain indicator.

The migration data are only partially compatible with our data. Migration data considers the birth origins of people whereas this study considers the country from where they take their undergraduate education.

India and China are the top providers of undergraduate education to professors but have low per migrant figures. In other words, we do not have a high number of professors from India and China once we normalize the figures by the number of

Table 1
Top 45 countries where the undergraduate degrees come from.

	Total	Per Million Population	Per Thousand Migrants	Per Thousand College Educ. Migrants
India	604	0.47	0.72	1.04
China	515	0.38	0.51	1.19
UK	470	7.29	0.77	2.22
Canada	382	10.75	0.53	1.60
Russia	267	1.86	1.09	2.12
Germany	262	3.24	0.41	1.51
Israel	199	24.22	2.23	5.24
Taiwan	174	7.41	0.65	0.98
Greece	149	13.60	0.94	4.73
Italy	148	2.41	0.32	2.33
France	141	2.13	1.09	2.42
Australia	114	4.85	2.29	4.94
Turkey	92	1.21	1.42	3.33
Korea	76	1.51	0.11	0.26
Argentina	66	1.54	0.63	1.81
Belgium	63	5.61	2.10	5.26
Poland	62	1.63	0.16	0.71
Japan	61	0.48	0.22	0.51
Romania	57	2.86	0.53	1.48
Iran	54	0.69	0.22	0.42
Switzerland	51	6.23	1.34	2.88
Egypt	49	0.55	0.51	0.85
Spain	48	1.03	0.65	1.97
Netherlands	46	2.73	0.52	1.40
Mexico	41	0.33	0.01	0.15
Ireland	40	8.67	0.27	2.54
Hungary	39	3.95	0.45	1.50
Brazil	35	0.17	0.23	0.71
Serbia	34	4.77	0.45	2.26
New Zealand	31	6.87	1.58	3.76
South Africa	28	0.52	0.57	1.03
Austria	27	3.16	0.45	1.37
Hong Kong	25	3.45	0.12	0.29
Lebanon	23	5.06	0.25	0.68
Denmark	22	3.90	0.76	2.01
Ukraine	22	0.48	0.10	0.26
Sweden	20	2.06	0.47	1.10
Portugal	18	1.73	0.10	1.31
Bulgaria	16	2.21	0.63	1.18
Venezuela	16	0.52	0.22	0.50
Czech	15	1.43	0.30	0.97
Finland	14	2.56	0.75	7.43
Croatia	12	2.83	0.34	1.52
Chile	11	0.62	0.17	0.57
Norway	10	1.95	0.34	0.97

migrants from these countries. Consequently, the high number of elite brain drain from these countries are consistent with their high migration figures.

In general, our brain drain indicator differs from the standard brain drain indicator that uses the college-educated migrants. For example, there are just 0.26 professors per thousand college-educated migrants from Korea whereas there are 5.26 professors per thousand college-educated migrants from Belgium. Hence, there are different dynamics for the migration of college-educated migrants and the migration of exceptional academic ability who become academics in top US universities.

Table 2 gives the number of professors in terms of geographical continent from where the US academics attained their undergraduate education. Most of the foreign-educated professors get their undergraduate degrees from Asia and Europe. This is consistent with the fact that most of the foreign graduate students in US universities are Asian and European origin (Bound et al., 2009).

We see that number of professors who get education in Europe and Australia is higher than other continents when we consider the per college-educated migrant figures. This may be because of the fact that the ratio of foreign students in European and Australian universities are high. Therefore, there are many students from other continents that use the education in Europe and Australia as the first step to having a graduate education in the US and to become academics there.

We mentioned that the number of professors who get their education from Brazil is very low when we discussed Table 1. The figures are starker when we consider all of South America. The number of professors who get their education from South

Table 2
Source countries grouped by geographical continents (USA excluded).

	Total # of Professors	Per Million Population	Per Thousand Migrants	Per Thousand College Educated Migrants
Europe	2177	2.66	0.50	1.77
Asia	1791	0.42	0.26	0.61
North America	434	1.75	0.04	0.45
South America	147	0.36	0.10	0.42
Australia	145	3.84	1.12	3.92
Africa	101	0.09	0.16	0.37
World	4795	0.69	0.20	0.83

Table 3
Source countries grouped by income level (USA excluded).

	Total # of Professors	Per Million Population	Per Thousand Migrants	Per Thousand College Educated Migrants
High income: OECD	2536	3.38	0.48	1.59
High income: nonOECD	578	1.76	0.43	0.97
Upper middle income	949	0.40	0.08	0.57
Lower middle income	726	0.25	0.13	0.39
Low income	6	0.01	0.02	0.07
World	4795	0.69	0.20	0.83

Table 4
Undergrad Degrees from 10 Countries by PhD graduation year.

(over all foreign undergraduate degrees)			
	1971–1980	1981–1990	1991–2000
India	0.124	0.150	0.118
China	0.002	0.091	0.166
UK	0.170	0.104	0.055
Canada	0.088	0.084	0.071
Russia	0.060	0.050	0.060
Germany	0.034	0.043	0.076
Israel	0.059	0.047	0.029
Taiwan	0.056	0.045	0.020
Greece	0.036	0.036	0.031
Italy	0.015	0.018	0.042

America is lower than that of Greece. Greece which has a small population and is geograhically distant to the United States provides more education to academics in the United States than all of South America combined.

It is also seen that the education providers to academics in the United States is highly concentrated in Africa when we compare Table 1 with Table 2. Table 2 shows that 101 academics get their undergraduate education from Africa. Table 1 shows that there are 49 professors who get their education from Egypt and 28 from South Africa. Therefore more than 75 percent of all African educated academics get their education from these two countries.

Table 3 groups professors in terms of the income group of the country in which undergraduate education occurs. 3114 (65%) professors have undergraduate degrees from high-income countries. The number of professors per million population and per migrant are also significantly higher for high-income countries than that of countries from other income groups.

One of the main factors of why academics in the United States have an undergraduate degree from high-income countries is the quality of education. The universities in high-income countries are comparable to those in the United States. Hence, the students who are educated in these universities have more chances to become academics in the United States.

This study's results are bad news for low and middle-income countries about their potential to raise academics. If there are few top-notch academics in the United States who have their undergraduate education from these countries, then it is probably the case that there are few top-notch academics that are raised from these countries in the world. If the low and middle- countries are not able to raise their own academics and cannot attract top-notch academics from the rest of the world, then they cannot have prestigious institutions. This may be the reason why most prestigious universities are concentrated in the high-income countries.

In Table 4, we lay out the trend for the ratio of undergraduate degrees from the top ten countries that provide highest number of undergraduate education to elite academics. We group the professors in terms of their PhD graduation year for two reasons. First, we could not get the undergraduate graduation date for many professors because of the incompatibility of the degrees between foreign countries and the United States. For example, many European universities do not grant a separate degree to masters and undergraduate degrees. Second, there is a large time lapse between undergraduate and PhD

Table 5
Undergraduate degrees from Australia, Canada, India and United Kingdom.

University	Total UG Degrees	University	Total UG Degrees
Melbourne	24	IIT Madras	65
Sydney U	18	IIT Kanpur	59
Australian Natl U	14	IIT Bombay	55
Univ Queensland	12	IIT Kharagpur	44
Other Australia	46	Other India	371
Univ Toronto	92	Cambridge	134
McGill	80	Oxford	110
UBC	37	Univ London	70
Waterloo	23	Univ Manchester	20
Other Canada	150	Other UK	136

graduation dates for some professors. In these cases, the PhD graduation year would be more representative of start date of academic life.

The analysis does not include professors who got their PhD degrees before 1970 and after 2000 in Table 4 because there are not many observations in those groups. The number of professors who got their PhD degrees before 1970 is low for two possible reasons. First, there may be fewer graduates who got their PhD degrees before 1970 and became academics in prestigious universities than graduates in other decades. Second, more professors who got their PhD degrees before 1970 may have retired compared to professors who got their PhD degrees in other decades simply because of their age. The few professors who got their PhDs after 2000 were very quick to climb the academic ladders to become full professors.

After we group the professors according to their PhD graduation dates, the analysis divides the number of professors who obtain their undergraduate degree from a country by the number of all professors who have foreign undergraduate degrees.

There is a tremendous increase in the number of undergraduate degrees from China. Almost none of the professors who got their PhD degrees in 1970s got their undergraduate degrees from China whereas the highest number of foreign undergraduate degrees is Chinese for the professors who obtained their PhD degrees in the 1990s. Bound et al. (2009) state that the Chinese undergraduates are not admitted into US graduate education in the 1970s. The reasons for the low number of Chinese origin students in 1970s is most probably connected to cultural revolution policies at that time.

It is surprising to see that Russia has no clear upward trend after the fall of the iron curtain. Bound et al. (2009) show that the number of Russian undergraduates in the US graduate schools have increased after the fall of iron curtain. Unfortunately, the analysis is unable to explain why there is no upward trend of Russian academics in the United States. Similarly, we cannot explain the clear decreasing trend of the academics who were educated in the United Kingdom.

Table 5 presents the list of the top four universities from Australia, Canada, India and the United Kingdom that are ranked according to the number of undergraduate degrees obtained by professors. The analysis is able to tell apart different universities as long as they are specified in the CVs. For example, we are unable to differentiate independent colleges within University of London.

Although professors obtain their undergraduate degrees from many universities, most undergraduate degrees are concentrated in few universities except for India. For example, Cambridge provides almost the same number undergraduate degrees as all other universities that are not in top four. Similarly, there are as many professors who get their undergraduate degrees from the top two universities in Australia and Canada as the number of professors who get their undergraduate degrees from all other universities combined that are not in top four. In contrast to these three countries, in India, the undergraduate degrees obtained by professors are not concentrated to a few Indian universities.

Dill and Soo (2005) note many global rankings use the success of graduates as one of their indicators. The number of top-notch academics who are educated in these institutions would provide a good criteria. Therefore, one can evaluate the undergraduate institutions by the potential of their graduates to become elite academics by using the numbers in Table 5.[4]

5. The analysis of foreign-educated professors by the type of institutions in which they currently work

In this section, we analyze the ratio of foreign-educated professors by the type of the institution in which they currently work. We investigate whether public ownership, ranking and academic field of the institutions matter for the ratio of foreign-educated professors.

We find that the ratio of foreign-educated professors in private universities is slighlty less than the ratio in public universities. 33.7 percent of the professors have foreign undergraduate degrees in private universities but 35.0 percent of the professors have foreign undergraduate degrees in public universities. The ratio of foreign PhD degrees is 12.3 and 12.6 percent for private and public universities respectively. However, these differences are not large. As a result, we cannot claim that the low ratio for the foreign-educated professors in the private universities are because of discrimination.

[4] However, the measure is not perfect. For example, there are institutions that attract their graduates by their strong commitment to science so that the graduates do not leave the country to become elite academics in the United States.

Table 6
Ratio of foreign-educated professors by academic field.

Field	UG	Grad	Field	UG	Grad
Chemistry	0.254	0.136	Bio Eng	0.297	0.114
Physics	0.396	0.192	Chem Eng	0.353	0.095
Mathematics	0.509	0.239	Civ & Env Eng	0.400	0.080
Science	0.388	0.191	ECE & CS	0.467	0.110
			Ind Eng	0.474	0.076
Economics	0.382	0.088	Mat Sci Eng	0.432	0.180
Political Science	0.127	0.047	Mech & Aero Eng	0.455	0.114
Psychology	0.170	0.087	**Engineering**	0.430	0.109
Sociology	0.134	0.038			
Social Science	0.213	0.070	History	0.187	0.122
			Philosophy	0.288	0.139
All Fields	0.345	0.125	**Humanities**	0.221	0.128

Table 6 shows the ratio of foreign-educated professors by the academic field in which they work. There is great variability of the ratio of foreign-educated professors across broad academic fields. Natural science and engineering departments are more open to foreign-educated academics than social science and humanities departments.

There is also large variability in ratio of foreign-educated professors within broad academic fields. Half of the mathematics professors have foreign undergraduate degrees whereas the ratio for chemistry professors is merely a quarter. Biological and chemical engineering professors are less likely to have foreign undergraduate degrees than other engineering professors. Economics professors are more than three times more likely to have foreign undergraduate degrees than political science and sociology professors. Philosophy departments are significantly more open to professors who have foreign undergraduate degrees than history departments.

Ioannidis (2004) has similar results for foreign-born academics in his sample of highly-cited researchers. The author finds that economics is more open to foreign-born academics than any other social sciences, physics is more open than chemistry and mathematics is the most open to foreign-born academics. Likewise, Table 6 shows a higher ratio of foreign-educated professors in economics than other social science fields, a higher ratio of foreign-educated professors in physics than in chemistry and mathematics has the highest ratio of foreign-educated professors among all fields.

Our results largely differs from Stephan and Levin (2001) who analyze the ratio of foreign-educated professors in the National Academy of Sciences. The ratio of foreign-educated professors are much lower in their sample. Moreover, their results do not show the relations that are apparent in Table 6. For instance, the ratio of foreign-educated professors is not highest in mathematics in their sample. The difference may stem from the fact that our sample is about 25 years younger.

Ali et al. (2007) show that 75 percent of young assistant professors from top economics departments get their undergraduate degrees abroad. The rate is just 38.2 percent in our analysis. Since we focus on full professors, our figures reflect the historical trends whereas Ali et al. (2007) study the current trends reflected in the junior faculty.

We analyze the trend in the ratio of professors who have foreign undergraduate degrees in Table 7. The professors are grouped in terms of their PhD graduation year for the same reasons we have specified for Table 4.

When we look at the broad academic categories, we see that the ratio of foreign-educated professors who get their PhD degrees more recently is higher. The increase is lower for engineering professors. Social sciences professors who obtain their PhD degrees in the 1990s are twice as more likely to have foreign undergraduate degrees than the professors who graduated in the 1970s. The corresponding ratios for engineering professors are 0.467 and 0.410 respectively.

There is also a consistent increase in the ratio of foreign-educated professors when we look at the narrow academic fields except for engineering fields. In all the natural sciences, social sciences and humanities fields, the professors who got their PhD degrees early are much more likely to have had a foreign undergraduate education. However, this relation does not hold for some engineering fields such as chemical, industrial and mechanical engineering.

The upward trend in the ratio of foreign-educated professors is consistent with the findings of Stephan and Levin (2001). They also note that the ratio of foreign-educated professors increased from 1980s to 1990s in their sample. The upward trend is also consistent with the upward trend in the number of foreign graduates in the United States (Bound et al., 2009) and the increasing trend in the stay rates of foreign students in US graduate schools (Finn 2010; Kim et al., 2011).

In Table 8, the concentration of foreign education by country of origin in all academic fields is measured. First we group the professors in terms of the academic field in which they work. Then, for every academic field, we divide the number of professors who have undergraduate degrees from each country with the number of all professors who have foreign undergraduate degrees.

There is a large amount of concentration of foreign undergraduate education by country of origin in academic fields. 49 (31) percent of the humanities (social sciences) professors who have foreign undergraduate degrees got their undergraduate degrees from Canada and the United Kingdom. One in every five foreign undergraduate degrees obtained by engineering professors are from Indian universities. 26 percent of the natural sciences professors who have foreign undergraduate degrees obtained their degrees from China and Russia.

It is also seen that there are interesting contrasts in concentration of foreign undergraduate education by country of origin in different academic fields. Although, India is very strong in providing undergraduate education to engineering professors,

Table 7
Ratio of Professors who have foreign undergraduate degrees by PhD graduation years.

	1971–1980	1981–1990	1991–2000
Chemistry	0.213	0.221	0.340
Physics	0.311	0.373	0.529
Mathematics	0.382	0.560	0.665
All Science	0.304	0.381	0.513
Bio Eng	0.230	0.301	0.331
Chem Eng	0.500	0.309	0.378
Civ & Env Eng	0.310	0.387	0.465
ECE & CS	0.426	0.444	0.506
Ind Eng	0.444	0.400	0.571
Mat Sci Eng	0.328	0.462	0.463
Mech & Aero Eng	0.484	0.439	0.479
All Engineering	0.410	0.413	0.467
Economics	0.225	0.403	0.484
Political Science	0.095	0.136	0.150
Psychology	0.109	0.183	0.223
Sociology	0.091	0.127	0.186
All Social Sciences	0.133	0.229	0.264
History	0.130	0.185	0.218
Philosophy	0.196	0.277	0.366
All Humanities	0.154	0.213	0.263
All	0.273	0.344	0.410
Observations	3239	4511	4263

Table 8
Ratio of foreign-educated professors by source country and academic field.

	Science	Engineering	Social Science	Humanities
India	0.058	0.207	0.046	0.036
China	0.126	0.119	0.071	0.018
UK	0.096	0.056	0.133	0.324
Canada	0.063	0.047	0.182	0.168
Russia	0.138	0.024	0.009	0.003
Germany	0.077	0.034	0.065	0.078
Israel	0.041	0.035	0.059	0.048
Taiwan	0.023	0.057	0.010	0.006
Greece	0.019	0.049	0.007	0.012
Italy	0.033	0.024	0.053	0.024
All	0.674	0.653	0.634	0.718

not many science professors have undergraduate education from India. The opposite is true for Russia. Russia is the leader in providing undergraduate education to natural sciences professors whereas they are not nearly as good as providing undergraduate education to engineering professors.

Bound et al. (2009) show that the contrasts in concentration of foreign undergraduate education by country of origin happens early in one's career. For example, there are relatively many more Russians in natural science fields and many more Indians in engineering fields at US graduate schools. The strength of undergraduate education in specific academic fields shapes the academic career of the professors.

There are a low number of professors who have their undergraduate degrees in Russia and Taiwan and work in social sciences or humanities fields. The language barrier might make the skilled mobility harder in humanities and social sciences. Another possible explanation is that it may be easier for these countries to keep the humanities and social sciences professors by offering them good job opportunities whereas it may not be as easy for the natural sciences and engineering fields.

The ratio of foreign-educated professors in universities of different ranks is a largely unexplored question in the literature. In our view, it is important for two reasons. First, the ability of the foreign-educated professors to work in the highest rank universities may be a sign of the compatibility of educational systems.[5] Second, the high ratio of the foreign-educated professors in the highest ranked universities show the potential of foreign educational institutions to educate top-notch academics.

In Table 9, the ratio of foreign-educated professors by the rankings of the universities in which they currently work are presented. The ratio of foreign-educated professors has no consistent relation with the rankings of the universities. For

[5] However, it is not a perfect sign. The number of professors who get an education from a specific country is also influenced by political and cultural factors.

Table 9
Ratio of foreign-educated professors by ranking of the university in which they currently work.

Shanghai Rank	UG	Grad
Top 10	0.347	0.124
11 to 25	0.326	0.110
26 to 50	0.342	0.123
51 to 75	0.359	0.128
76 to 100	0.358	0.147

Table 10
Ratio of foreign-educated professors by ranking of university and the academic field.

Science			Social Science		
Top 10	0.363	0.165	Top 10	0.270	0.096
76–100	0.437	0.257	76–100	0.138	0.053
Engineering			Humanities		
Top 10	0.404	0.098	Top 10	0.290	0.171
76–100	0.463	0.118	76–100	0.146	0.092

Table 11
Income group from where the undergraduate degree is taken and ranking.

	Top 10	11–25	26–50	51–75	76–100
High income: OECD	0.659	0.572	0.519	0.465	0.421
High income: nonOECD	0.106	0.115	0.130	0.111	0.142
Upper middle income	0.141	0.196	0.190	0.229	0.242
Lower middle income	0.094	0.118	0.160	0.193	0.192
Low income	0.001	0.000	0.001	0.002	0.003

example, the professors who work in universities ranked 11–25 have lower chances to have a foreign undergraduate degree than professors who work both in higher and lower-ranked universities. When we consider broader ranking categories, we see that the professors from the top 50 universities have a lower ratio of foreign undergraduate degrees than professors from universities ranked 51 to 100 although the difference is rather modest.

Table 10 shows the ratio of foreign-educated professors in terms of the ranking and the academic field of their current institution. We compare the top ten universities to the bottom quarter. The natural sciences and engineering departments in the top ten universities have a lower ratio of foreign-educated professors than universities ranked between 76 to 100. The opposite is true for the social sciences and the humanities professors. That is, the social sciences and humanities professors are less likely to hold foreign undergraduate and graduate degrees if they are from a lower-ranked university.

Table 11 evaluates the success of undergraduate education by income groups. First, we group professors in terms of the ranking of their university. Then, within each ranking category, we divide the number of professors who get their undergraduate degrees from each income group by the number of all professors who have foreign undergraduate degrees.

As already noted in Table 3, 65 percent of undergraduate degrees are attained from a high- income country. Table 11 shows that 76.5 percent of the professors who work in the top ten universities get their undergraduate education from a high-income country. Therefore, the undergraduate institutions of advanced nations are more effective in educating academics in more prestigious institutions.

There is a consistent relation between the ranking of the university and the income group from which the undergraduate degree is taken. The ratio of professors who get their undergraduate degrees from high-income OECD countries decreases as we walk down the ranking ladder. In other words, the professors who get their undergraduate degrees from high-income OECD countries are more likely to work in higher-ranked universities. On the contrary, the professors who get their undergraduate education from other income groups are generally more prevalent in the lower-ranked universities. However, there are exceptions. For example, the professors who get their undergraduate degree from upper middle-income countries are more likely to work in universities ranked 11–25 than in universities ranked 26–50.

It is difficult for a student who has a foreign undergraduate degree to get acceptance from a graduate program in the United States for various reasons. First, the professors in the United States may not know professors from foreign universities that makes the reference letters ineffective. Second, the application procedure was painful before 2000 as snail mail was being used in sending applications and internet sites did not provide enough information. Third, it is difficult for a student who has a foreign undergraduate degree to be successful in the GRE that requires proficiency in English. For all these reasons, we may expect better foreign-educated students admitted to PhD programs than their US counterparts.

The performance of foreign-educated students is important for another reason. As studies such as Borjas (2004) show, foreign-educated students are admitted to US grad programs at the expense of native students. Therefore, it is important to know whether these foreign students are at least good as the US students on whose expense they gain admission.

We analyze whether the students who have foreign undergraduate degrees perform better than those who have US undergraduate degrees in Table 12. First, we group the professors by their PhD granting university and by the ranking of the

Table 12
Ratio of foreign undergraduate degree by graduate institution.

PhD Inst	Top 10	11–25	26–50	51–75	76–100	All	# of Professors
Caltech	0.329	0.310	0.383	0.298	0.324	0.339	378
Columbia	0.253	0.217	0.273	0.298	0.269	0.258	324
Harvard	0.214	0.176	0.161	0.175	0.163	0.186	839
MIT	0.255	0.255	0.257	0.186	0.269	0.245	975
Princeton	0.261	0.211	0.313	0.205	0.174	0.247	603
Stanford	0.305	0.245	0.219	0.267	0.141	0.247	847
UC Berkeley	0.252	0.251	0.186	0.237	0.175	0.226	1116
Univ Chicago	0.268	0.207	0.164	0.210	0.179	0.204	402

university in which they currently work. Within each group, we find the ratio of professors who have foreign undergraduate degrees. For example, 32.9 percent of the professors whose graduate degree is from Caltech and also work in a top ten institution have foreign undergraduate degrees.

If the students who have foreign undergraduate degrees perform better, then we expect a higher ratio of foreign undergraduate degrees for professors who work in higher ranked universities. However, there are no consistent relationships in the data. For example, among Caltech graduates, the ratio of foreign-educated professors who work in top 10 universities is 32.9 percent. The ratio decreases to 31 percent when we consider the ratio of foreign-educated professors who work in universities ranked 11–25. But the ratio increases to 38.3 percent when we consider the ratio of foreign-educated professors who work in universities ranked 26–50. Therefore, our data provides no support for better or worse performances of students who have foreign undergraduate degrees compared to those who have US undergraduate degrees.

6. Conclusion

The role of foreign education is important for training academics in the prestigious universities in the United States. We find that one in three professors get their undergraduate degrees abroad and one in eight professors get their PhD degrees abroad in such universities.

The analysis exploits the richer set of source countries by focusing on foreign undergraduate education. There are 45 countries which provide undergraduate education to at least 10 professors in our data. It is not surprising that China and India are the leaders on this front as the literature reveals that they have the most number of students in US graduate schools and they have the highest stay rates after graduate studies.

Some concentrations in provision of undergraduate studies are also noted. Greece provides more undergraduate degrees to elite academics than the whole continents of South America or Africa. When we examine the universities within Australia, Canada and the United Kingdom, we see that a couple of top universities provide most of the undergraduate education to elite academics in the United States.

Most of the foreign-educated professors get their undergraduate education from high-income countries. This is possibly because the high-income countries have better universities that can provide a strong educational background. But this is problematic for the medium and low-income countries because it signals the lack of potential of their universities to educate elite academics. Since many academics are locally trained, this result may reveal why most prestigious universities are concentrated in few high-income countries.

This paper analyzes the ratio of foreign-educated academics by the type of institutions in which the academics currently work. We find that the ratio of academics vary with the academic field which is consistent with findings in literature.

This study investigates whether the ratio of foreign-educated academics varies with public ownership of the university or the ranking of the university. These questions are largely unexplored in the literature. Surprisingly, we find that there is no significant difference between public and private universities. Their administration structures are different but their attitudes towards foreign-educated professors did not create a difference in their ratios of foreign-educated professors. We also find that the higher-ranked universities hire foreign-educated professors at the same rate as the lower-ranked universities.

The findings also indicate that foreign-educated professors are as likely to work in the highest- ranked universities as their domestically-trained counterparts given that they are from the same graduate school. The performance of foreign-educated students at US graduate schools would contribute to the discussion of the crowding out of natives in US graduate schools.

The present study is unable to capture a complete picture of the role of foreign education in training academics. This is because we focus on academia in the United States. A complete analysis would consider the role of foreign education in other countries. This way, we would learn how the educational systems are feeding each into other by educating academics. Unfortunately, the present paper does not consider other countries because of the missing data issue.

An alternative route is to use a bibliometric methodology as is done by some studies in the literature. The author list can be collected from the top publications such as Nature and analyze the current institutions and educational backgrounds of the authors. The current bibliometric studies are confined to specific academic fields. A broad study which collects data from many fields would enlighten us about the role of foreign education in raising academics in the world.

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