The Comings of the Foreign-born for PhD and Postdoctoral Study: A Sixteen Country Perspective

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Abstract

We analyze the decisions of foreign-born PhD and postdoctoral trainees in four fields of science to come to the United States vs. another country for study. Data are drawn from the GlobSci survey conducted in 2011 of research active scientists residing in sixteen countries. We find that in both cases the United States is the most common destination country. Individuals come to the U.S. to study because of the prestige of the program and/or career prospects. For recent trainees, the availability of financial assistance also plays an important role. When we expand the data to a longer time span, we find that the attractiveness of the U.S. compared to other countries for the PhD declines for those who received their degree after 2000; for postdoctoral training it has declined since 1990. Factors that discourage the foreign born from getting a PhD in the U.S. vs. another country are the perceived U.S. life style and the availability of fewer exchange programs, compared to those in other countries, especially in the EU. The relative attractiveness of fringe benefits discourages the foreign born from taking a postdoc position in the U.S. The countries that have been nibbling at the U.S. share include Australia, Germany, Great Britain, Japan and Switzerland. France has gained appeal in attracting postdocs, but not in attracting PhD students. Canada has made gains in neither.

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1. Introduction

The scientific workforce is highly mobile. In the United States, for example, approximately 39 percent of doctoral-trained scientists and engineers working in country were born outside the country (table 3-17 (National Science Board 2012)). Among faculty, the figure is approximately 35 percent (Stephan, How Economics Shapes Science 2012). If we restrict the focus to foreigners who were not citizens at the time they received their PhD training in the U.S., the percent falls to about 22 percent (Stephan, How Economics Shapes Science 2012). The difference between the two reflects not only that many come after receiving their PhDs but also that a not insignificant number of those who are born abroad and work in the U.S. emigrated at a very early age and were citizens at the time they received their PhD.

With but slight hiccups, the number of foreign born students who receive PhD training in the U.S. has been growing for a number of years, as has the percent. By way of example, in 1980, approximately one out of four PhDs awarded in the natural sciences and in engineering went to foreign-born scientists. By 2008 the figure was close to 50 percent (Stephan, How Economics Shapes Science 2012). Not only have the number and percent of foreign born receiving PhDs increased; the number and percent who hold postdoctoral training positions in the United States has also grown. For example, in 1980, the percent of postdocs who were in the United States on temporary visas was approximately 40 percent; those who held permanent visas or were citizens was 60 percent (Stephan, How Economics Shapes Science 2012). By 2008 the situation had reversed: 60 percent of postdoctoral scholars working in the U.S. were in the U.S. on temporary visas; 40 percent were citizens or permanent residents. While many of these foreign-born postdocs received their PhDs in the U.S., a number came to the U.S. after having received a doctorate degree in another country.[4]

But the U.S. is not the only country that trains foreign born and in recent years the number of PhD degrees awarded to foreigners has grown considerably in Europe, Canada, and Japan, as well as in Australia. By way of example, in 1999 only 14.8 percent of students enrolled in graduate programs in the natural sciences and engineering in Canada was foreign; by 2008 the number had increased to 25.6 percent (Table 2-42 (National Science Board 2012)). The largest enumerated group of foreign students in 1999 were from China (14.0 percent), followed closely by those from the United States (13.2 percent) and France (12.3 percent) and distantly by India (4.0 percent). During the interval, the growth in the number of Chinese students was especially notable, increasing by 187 percent but the growth of Indian students was even more dramatic (287 percent increase). The percent, although not the actual number of students, from the United States and France declined. Or consider the United Kingdom where the percent of foreign students in graduate programs in the natural sciences and engineering increased from approximately 28.8 percent in 1998-1999 to 51.2 percent in 2008-2009 (table 2-40 (National Science Board 2012)). Greece was the largest of the enumerated source countries in the earlier period, contributing about 13.6 percent. France, Germany and China were closely tied in second position, each contributing around 5.0 percent. The number of Indian graduate students was not enumerated in 1999. By 2008-2009, when Indians were enumerated, they represented 13.4 percent of all foreign students in the UK. Chinese students represented approximately 9 percent of all foreign students and the number of Greek students had declined substantially. Even Japan, which has a tradition of being somewhat insular when it comes to educating foreign students and poses serious language challenges for many, has experienced an increase. In 2004 foreign students represented 8.4

[4] A National Science Foundation researcher extremely familiar with postdoctoral data in the U.S. estimates that almost five out of ten postdocs working in academe in the United States earned their doctorate outside the United States and that four out of five postdocs with temporary visas earned their doctorate outside the U.S.

percent of those enrolled in graduate school in the natural sciences and in engineering; in 2010 they represented 10.9 percent. China and South Korea were the dominant source countries in both periods. During the six year interval the Chinese student population grew by 50 percent in the natural sciences and engineering (Table 2-41 (National Science Board 2012)); that from South Korea declined in absolute and percent terms. The number and percent from Indonesia increased.

The Bologna Reforms that sought to standardize credit hours and degree programs across Europe have arguably contributed to increased competition for foreign-born graduate students by making the educational system in Europe more compatible and competitive with the Anglo-Saxon systems (Malamud 2010). Stories abound, for example, of entrepreneurial consulates placing posters near U.S. consulates, offering "faster" processing of documents for graduate study in their country than that provided by the U.S. The formation of the European Union also greatly facilitated the enrollment of students from member countries in graduate programs in another European country, as did the Bologna Reforms. In the last five years (2007-2012), the Marie Curie fellowship program has sponsored the mobility of 10470 PhD and Post-docs trainees across the EU member states (EU Commission 2012). Financial support from programs such ERASMUS, further facilitated students moving across country boarders for education.[5]

Despite these trends, we know virtually nothing about what leads perspective PhD students to choose one country over another or what factors lead newly minted PhDs to take a postdoc position in one country instead of another. What role, for example, do funding, opportunities for advancement, or life style play? What role does the family of the student play in the decision of where to train? Has the US attractiveness of foreign-born PhD and post-doctoral trainees changed in recent years, relative to that of other countries? Are migration patterns different in different fields? Our ignorance is largely because no database collects consistent information across countries on mobile researchers and factors affecting their decision to emigrate for training.

The purpose of this paper is to examine the comings of the foreign-born for doctoral and postdoctoral study. The data we use were collected by the authors in 2011 as part of the GlobSci project and cover research active scientists currently working or training in sixteen countries. In section 2 we discuss the data. In Section 3 we review what is known about foreign-born students in the U.S. as well their propensity to choose one country over another. We then present our estimates for factors relating to the probability of coming to study for a PhD in the United States. We estimate two types of models: one where the decision is the U.S. vs. any other country; the other represents a multinomial logit model, which estimates the likelihood of studying in the U.S. vs. studying in seven other countries. In all cases we restrict the analysis to those who choose to leave their country of origin for study or training. Section 4 examines, in a similar framework, the decision to do postdoctoral study in the US, beginning with a review of what we know about postdoctoral scholars in the U.S. and factors affecting their decision to train in the U.S. Section 5 closes with discussion and conclusion.

[5] The European Commission reports that approximately 1.67 million students have taken part in the program since it started in 1987 (Malamud 2010).

2. The GlobSci Survey

We surveyed active researchers in the four scientific disciplines of biology, chemistry, earth and environmental sciences, and materials science during the period February-June 2011. In order to construct the sample, we selected all journals classified by ISI as belonging to one of the four disciplinary fields and sorted them by Impact Factor (IF) for all subfields in each of the four disciplines.[6] We then randomly picked a selection of four journals from each quartile of the Impact Factor distribution in each subfield of the four disciplines, thus obtaining four samples of journals by field stratified by Impact Factor. In aggregate, this process identified approximately 30 percent of all journals published in the four fields. See (Franzoni, Scellato and Stephan 2012).

Starting from these four lists of journals, we next downloaded the full record of all scientific articles published therein in 2009. From the affiliation information of the articles, we retrieved the email address of the corresponding authors.[7] In case of multiple corresponding authors for a single article, we picked the first name in the list. We randomly selected one record in the case of corresponding authors appearing repeatedly in the corresponding author list.

In order to build country panels, we coded these records, based on the final digits of the domain of the email address (e.g. ".au" for Australia; ".be" for Belgium, etc.). We identified U.S. authors by email addresses ending in ".edu," thereby restricting the U.S. sample to academic researchers.

We prepared 16 country panels. Surveyed countries are: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, India, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, United Kingdom, United States. This procedure produced a sample of 47,304 unique email addresses of scientists divided in 16 country panels (Table 1). Country panel sizes vary considerably, reflecting by construction the size of the country research-active population. The largest panel was in the U.S., with 14,059 observations; the smallest was in Denmark with 513.

China was initially included in the survey. However, a low response rate of less than 5 percent for a test sample of Chinese addresses suggested that respondents were either not receiving the invitation or had problems responding to the invitation. We thus decided not to survey researchers based in China.

Panelists were invited to answer by email. Invitations were sent, one country at a time, during the spring and early summer of 2011 and each panelist was invited a maximum of three times. The survey was initially developed in English and then translated into six other languages: French, German, Italian, Japanese, Portuguese and Spanish. The online questionnaire was developed through the platform Qualtrics® that supports multiple languages. Each country survey and the related invitation email was administered in its primary language (two languages in the case of Canada). The platform automatically deployed the language in which the recipient had set her browser, and let the respondent switch from one language to another at any point while filling-out the questionnaire.

Table 1 reports a summary of the 19,183 answers by country of respondent. Country responses reflect both the size of the underlying research-active population of scientists as well as variations in response rates across

[6] IF was taken from the latest available release of the Journal Citation Report of Thomson-Web of Science®.
[7] The four fields were chosen in part because 95 percent or more of all articles in these disciplines contain an email address for the corresponding author. More specifically, in 2009 the estimated number of records that did not report an email address for the corresponding author was 0.9% in biology, 3.6% in chemistry, 2.9% in earth and environmental sciences and 4.5% in materials science.

countries. The largest number of responses is for the US (5,165 answers) and the smallest is for Denmark (227). The overall response rate is 40.6 percent; the high is 69.0 percent for Italy, the low is 30.3 percent for Germany; 11 countries have a response rate of between 35.0 percent and 45.0 percent. Answers are further divided into complete answers and partial (usable) answers (answers from respondents who began the survey, but dropped-out before reaching the last question). The total dropout rate was 5 percent. The response rate, conditional on the respondent completing the survey, is 35.6 percent. Reported response rates do not take into account undelivered invitations due to such things as incorrect email address, retirement or death and consequently underestimate the response rate.[8] Response rate bias is explored in the Appendix.

Table 1 Response rate by country

	PANELS	TOTAL ANSWERS	OF WHICH COMPLETE	OF WHICH DROPOUT	TOTAL RESPONSE RATE	COMPLETE RESPONSE RATE
Australia	1,571	676	610	66	43.0%	38.8%
Belgium	706	302	244	58	42.8%	34.6%
Brazil	1,537	762	692	70	49.6%	45.0%
Canada	2,455	1,020	897	123	41.5%	36.5%
Denmark	513	227	208	19	44.2%	40.5%
France	3,839	1,618	1,367	251	42.1%	35.6%
Germany	4,380	1,326	1,147	179	30.3%	26.2%
India	1,380	627	484	143	45.4%	35.1%
Italy	2,779	1,917	1,759	158	69.0%	63.3%
Japan	5,250	1,860	1,678	182	35.4%	32.0%
Netherlands	1,036	391	345	46	37.7%	33.3%
Spain	2,303	1,228	1,080	148	53.3%	46.9%
Sweden	882	353	301	52	40.0%	34.1%
Switzerland	919	356	320	36	38.7%	34.8%
UK	3,695	1,355	1,183	172	36.7%	32.0%
U.S.	14,059	5,165	4,512	653	36.7%	32.1%
Total	**47,304**	**19,183**	**16,827**	**2,356**	**40.6%**	**35.6%**

For this study we restrict the analysis to foreign-born individuals either currently in training or working at a university in one of the 16 countries. We define the foreign born to be those training or working in a country other than where they resided at age 18. For recent foreign-born PhDs (defined to be those who received their PhD in 2003 or later or who are still in training) we place no other restrictions on the sample. We refer to this group of 951 individuals as the **RECENT PhD Sub-sample**. Included are all individuals, regardless of country of origin, who studied (or are studying) for a PhD in a country different from where they lived when they were 18. This recent sample minimizes effects that arise due to censoring when foreign born who train in one of the 16 countries relocate to a country (such as China) that is not included in our survey. For the foreign-born who received their PhD in an earlier period we make the further restriction that their country of origin (at age 18) be one of the 16 core countries. We construct this restricted sample in order to capture individuals who trained abroad but have subsequently returned to their home country. This **Core Country PhD Sub-sample** has 1,306 individuals in it. It excludes individuals from, among other places,

[8] Walsh, Cohen and Cho (2007) find in a sample of U.S. scientists that undelivered emails accounted for approximately 3.2 percent. Roach and Sauermann (2011) find that undelivered emails accounted for 6.3 percent in a sample of junior U.S. scientists.

China and South Korea. In a similar way we construct a **Recent Postdoc Sub-sample** of 1531 individuals and a **Core Country Postdoc Sub-sample** of 4,000-plus individuals.[9]

Table 2 summarizes the criteria for inclusion in the sub-samples used in the analyses.

Table 2 Criteria for inclusion in the sub-samples.

SUB-SAMPLE	NUMBER	CRITERIA
Recent PhD	951	Respondents who received their PhD in 2003 or later in a country different from where they lived at age 18.
Core-country PhD	1306	Respondents who received their PhD in a country different from where they lived at age 18 and their country of origin is a core country.
Recent Postdoc	1531	Respondents who received their PhD in 2003 or later and had postdoctoral training in a country different from where they lived at age 18.
Core-country Postdoc	4634	Respondents who had postdoctoral training in a country different from where they lived at age 18 and their country of origin is a core country.

Summary statistics for the four samples are presented in Table 3 and Table 4. Included are gender, age, country of origin, and country of training. In the case of country of training – either PhD or Postdoc – we report the incidence of selected countries that will be analyzed in our econometric models.

Table 3 Summary statistics of sub-samples of PhD

SUB SAMPLE	RECENT PHD	CORE-COUNTRY PHD
	mean	**mean**
Female	0.272	0.212
Age	37.7	47.5
Biology	0.2368	0.3081
Chemistry	0.2446	0.2589
Earth & Environment	0.2992	0.2650
Materials Science	0.2194	0.1681
Country of origin	**%**	**%**
AUSTRALIA	1.13	3.41
BELGIUM	0.69	1.89
BRASIL	4.6	9.99
CANADA	2.86	10.14
SWITZERLAND	0.95	2.57
CHINA	14.74	-
GERMANY	5.9	12.11
DENMARK	0.69	1.06
SPAIN	2.34	5.68
FRANCE	3.38	6.36

[9] All samples exclude U.S. scientists who trained outside the United States.

UK	1.91	7.8
INDIA	7.11	15.29
ITALY	7.11	13.85
JAPAN	3.47	6.81
KOREA	2.43	-
NETHERLANDS	1.13	2.12
RUSSIA	2.17	-
SWEDEN	0.69	0.91
OTHER	36.7	0.00
Country of PhD (selected)	**%**	**%**
AUSTRALIA	4.77	3.86
CANADA	6.07	6.06
SWITZERLAND	4.86	7.27
GERMANY	8.59	6.74
FRANCE	6.5	7.72
UK	10.32	16.35
JAPAN	5.72	4.31
USA	34.95	35.43
OTHER	18.22	12.26

Table 4 Summary statistics of sub-samples of Postdocs

SUB SAMPLE	RECENT POSTDOC	CORE-COUNTRY POSTDOC
	mean	**mean**
Female	0.254	0.2050
Age	39.3	48.6
Biology	0.2627	0.3319
Chemistry	0.3067	0.3836
Earth & Environment	0.2389	0.1446
Materials Science	0.1917	0.1399
Country of origin	**%**	**%**
AUSTRALIA	1.71	3.93
BELGIUM	1.5	2.06
BRASIL	3.89	4.54
CANADA	3.42	5.83
SWITZERLAND	1.76	2.65
CHINA	8.03	-
GERMANY	8.08	11.27
DENMARK	0.83	1.43
SPAIN	8.45	12.31
FRANCE	8.6	12.42
UK	3.78	9.26
INDIA	6.79	9.08
ITALY	12.8	10.22
JAPAN	4.4	10.46
KOREA	0.88	-
NETHERLANDS	1.76	2.72
RUSSIA	1.76	-
SWEDEN	1.4	1.82

OTHER	20.16	0.00
Country of Postdoc (selected)	**%**	**%**
AUSTRALIATRALIA	4.25	2.35
CANADA	5.9	5.21
SWITZERLAND	4.58	4.41
GERMANY	8.55	7.69
FRANCE	6.45	6.72
UK	12.74	12.77
JAPAN	3.14	2.18
USA	39.71	46.43
OTHER	14.68	12.24

3. PhD Location

3.1 Review: evidence on foreign-born PhDs

The number of foreign-born students receiving PhD training in the U.S. in the natural sciences and engineering, with rare exception, has increased consistently over time. As can be seen from Figure 1, in the late 1960s to the early 1970s, one in five PhD recipients was foreign. By 2008 almost one in two was foreign. The proportion going to the foreign born grew most dramatically in the late 1980s and early 1990s. Fields vary considerably in terms of how foreign they are. Engineering has the largest tradition of attracting foreign-born students. Since the late 1970s, the number of engineering PhD degrees going to foreigners has exceeded the number going to U.S. citizens; in 2008, the percentage stood at 61.5 percent. Math and computer science programs are also heavily populated by students from abroad; slightly over 57 percent of the degrees in the field went to foreign students in 2008; in the physical sciences, 44.4 percent were awarded to foreign students in 2008. The field least populated by the foreign born is the life sciences, but even in this field by 2008 fully one third of the PhD recipients are foreign born (Stephan, How Economics Shapes Science 2012).[10]

Almost half the noncitizens receiving a PhD in the United States currently come from just three countries: China, India, and South Korea. Their importance is illustrateded by the fact that three of the top five undergraduate "feeder" programs to graduate school in the U.S. are outside the U.S.: Tsinghua University, Peking University and Seoul National (Mervis 2008).[11] In the 1970s, the largest number of foreign-born PhDs trained in the United States came from India (13.3 percent) and Taiwan (13.2 percent). The next largest number came from the United Kingdom (4.5 percent) and South Korea (4.1 percent).

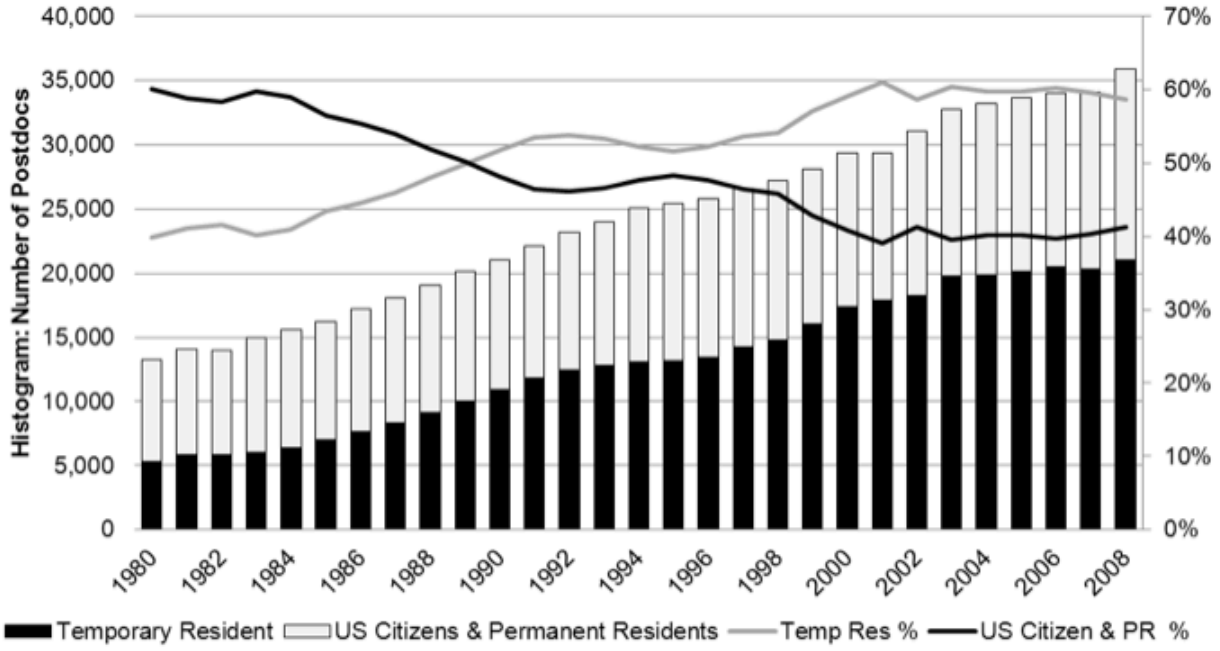
U.S. PhD programs have attracted increasing numbers of foreign students because of trends both within the United States as well as outside the United States. In terms of trends within the United States, low salaries of PhDs relative to those in other occupations, the long time to degree, and stagnant pay for faculty have contributed to making a PhD relatively less attractive than other degrees to U.S. citizens, especially U.S. men. Another key factor is that faculty with research funding need students to staff their laboratories and the foreign-born provide a ready source. Although the stipend associated with a graduate research assistantship is not that large, it has a relatively higher value to foreign born from developing countries than it has to U.S. students. Not surprisingly, foreign students are considerably more likely to be a research assistant than are

[10] Foreign is defined to include temporary as well as permanent residents. All data come from WebCASPER (National Science Foundation 2010) (Bound, Turner and Walsh 2009)

[11] Tsinghua University is first, Peking is second, Seoul National is fourth. Third place belongs to the University of California-Berkeley and fifth place belongs to Cornell University.

citizen-students (49 percent vs. 21 percent). The difference reflects the larger range of alternatives and resources available to citizens, including employer support and the availability of fellowships and grants (Stephan, How Economics Shapes Science 2012). The importance of foreign students to knowledge production in the United States is illustrated by Black and Stephan's finding that 39.6 percent of the graduate student authors of papers published during a six month period in *Science* in 2007 are foreign; 59.2 of the postdoc authors are noncitizens. (Black and Stephan 2010).[12] Foreign students have also often been less selective than U.S. students in choosing programs (Bound, Turner and Walsh 2009).

Figure 1 Number of Science & Engineering Postdocs Working in Academe, 1980-2008 by Citizenship Status



Source: (Stephan, How Economics Shapes Science 2012).

[12] The methodology followed the approach used by Bill Kerr, and draws on the same ethnic-name database that he used to identify the ethnicity of U.S. inventors (Kerr 2008). Limitations of using ethnicity to infer citizenship are discussed by the authors (Black and Stephan 2010).

Events within a country also influence the number of students coming to the United States. For example, when academic jobs became scarce in South Korea, the number of South Koreans choosing to come to the U.S. declined, reflecting the perceived advantage of staying in country to study and in touch with faculty in order to have a leg up in the job market (Kim 2010).[13] More importantly are changes in emigration policy on the part of a country, such as the change that occurred in 1981 when China partially lifted restrictions on students studying in the U.S. and then totally lifted restrictions in 1984 (Bound, Turner and Walsh 2009). Fluctuations in currency values also play a role. The depreciation of the Bhat, for example, during the East Asian financial crisis was accompanied by a decline in the number of students from Thailand studying in the United States.

Clearly students who want to get a PhD outside their home country have more options for study than the U.S. and these options, as noted in the introduction, have been growing as PhD programs in Europe, Japan and Australia have expanded. Some countries, such as Switzerland, offer handsome stipends to PhD students. But in other instances, financial assistance is not available or not as generous. For some students whose home country provides financial assistance for study abroad, support may not be a major issue in determining where they study. Choice of where to study can also be influenced by perceived opportunities for staying and obtaining a position subsequent to training. This could be a factor in discouraging students from studying in a country such as Italy, where the market for scientists and engineers has been depressed, or a country such as Germany where a low proportion of academic professorial rank positions are held by the foreign born. Life style factors can also play a role. For example, students from an EU country may be attracted to another EU country on the basis of the life style the country offers. Finally, the quality and prestige of its programs clearly play a role in attracting students to study in one country over another. In this respect the United States holds a distinct advantage. Seventeen of the top twenty spots on the Shanghai Jiao Ton University's rankings are held by institutions in the United States[14]; seven of the top ten spots on the *London Times* rankings belong to U.S. institutions, the other three belong to the United Kingdom.[15]

3.2 Analysis: Choice of PhD location

In the analysis that follows we explore factors related to the probability that students who leave their country of origin to get a PhD come to the United States versus go to another country to study. We first estimate a logit model of the probability of the foreign-born training in the U.S. vs. training in an alternative country (see Table 3). We include dummy variables for field, gender, and the reported value on a five point sliding scale of the importance of five factors in the respondent's decision to study abroad. The five factors are: (1) prestige/research excellence of the institution; (2) opportunity to improve future career prospects; (3) family or personal reasons; (4) appeal of life style or international experience; and (5) contact with someone, a professor, colleague or friend, in the host country. We also include four self-reported variables that reflect the availability of financial assistance or of programs. Once again, these are measured on a five point sliding scale. The four are: (1) financial support obtained from the host country or institution (here referred to as scholarship); (2) fellowship obtained from country where living at age 18; (3) availability of an exchange or

[13] A similar phenomenon is occurring among Japanese, but in this instance among Japanese postdoctoral students. Although in the past many young Japanese used to come to the United States and Europe for postdoctoral training, today, facing a challenging job market, they are more likely to stay close to home, fearing that they may not find a job upon their return (Arai 2010).

[14] http://www.arwu.org/ARWU2010.jsp. Two of the remaining three belong to the UK; the third belongs to Japan.

[15] http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=421400&c=1

joint program between institutions; (4) few or no good PhD programs in country where they were living at age 18. The three models presented in Table 5 employ different controls for country of origin.

Table 5 Decision to take a PhD in the US. Logit model on the sub-sample of Recent PhD

	Model I	Model II	Model III
FELLOW_ORIGIN	0.076	0.058	0.098
	(0.067)	(0.069)	(0.087)
PHD_SCHOLARSHIP	0.197***	0.201***	0.203***
	(0.063)	(0.065)	(0.076)
EXCHANGE_PROG	-0.467***	-0.484***	-0.554***
	(0.072)	(0.076)	(0.093)
NOPROGRAM	0.133**	0.189***	0.266***
	(0.063)	(0.067)	(0.078)
PRESTIGE	0.359***	0.291***	0.350***
	(0.107)	(0.107)	(0.115)
CAREER	0.030	0.024	0.140
	(0.112)	(0.116)	(0.128)
CONTACT	0.020	0.027	0.093
	(0.059)	(0.063)	(0.074)
LIFESTYLE	-0.257***	-0.219***	-0.351***
	(0.076)	(0.078)	(0.089)
FAMILY	0.035	-0.006	-0.023
	(0.063)	(0.066)	(0.075)
BIO	-0.053	-0.032	0.173
	(0.245)	(0.248)	(0.269)
CHEM	-0.030	0.011	0.101
	(0.236)	(0.236)	(0.266)
MATERIAL	0.374*	0.425*	0.573**
	(0.218)	(0.227)	(0.251)
female	0.136	0.157	0.217
	(0.172)	(0.182)	(0.213)
CHN	1.554***	1.523***	
	(0.208)	(0.223)	
IND	1.256***	1.197***	
	(0.293)	(0.302)	
ITA		-1.224***	
		(0.378)	
DEU		-0.689	
		(0.426)	
BRA		-0.032	
		(0.421)	
JPN		0.171	
		(0.455)	

FRA		-0.656	
		(0.617)	
CAN		0.947**	
		(0.408)	
IRN		-1.609**	
		(0.751)	
KOR		1.700***	
		(0.526)	
Constant	-2.221***	-2.019***	-2.166
	(0.603)	(0.651)	(1.334)
Country of origin dummy	Selected	Selected	All
Observations	951	951	951
Chi2	157.798	181.973	193.626
LogLik	-515.154	-493.577	-418.803
PseudoR2	0.156	0.192	0.242

Heteroskedasticity-robust standard errors in parenthesis.

Regardless of the type of country control variable employed, we see that receipt of financial assistance from the host country is a powerful factor in the foreign-born choosing the U.S. vs. another location, as is the absence of few or no good PhD programs in their country of origin. We also find that prestige of the program plays an important role in the decision to study in the United States. On the other hand, the presence of exchange programs is a major reason individuals do not come to the U.S., likely reflecting the ease of moving across EU boarders. Lifestyle/international experience in the U.S. is a distinct detractor. In terms of field of study, those getting degrees in materials science are more likely (10 percent level of significance) to study in the U.S. than elsewhere, compared to those in the other three fields. In terms of country of origin, Model I controls only for China and India as countries of origin; Model II includes origin country dummies which combined account for 90% of respondents and in Model III we include all origin country dummies. We find that Chinese, Indians and South Koreans, as well as Canadians, are significantly more likely to come to the U.S. for study than to other countries; Italians and Iranians are significantly less likely. The strong Chinese, Indian and South Korean effect should not come as a surprise given that the three nationalities represent the three most likely source countries for foreign-born PhDs in the U.S. But their significance also suggests that despite competition from other countries for students, the U.S. still holds a comparative advantage when it comes to attracting students from these countries.

Table 6 Decision to take a PhD in the US. Logit model on the sub-sample of Core Country PhD

	Model I	Model II
FELLOW_ORIGIN	-0.073	-0.083
	(0.061)	(0.061)
PHD_SCHOLARSHIP	0.001	0.002
	(0.052)	(0.052)
EXCHANGE_PROG	-0.173***	-0.172***
	(0.065)	(0.065)

NOPROGRAM	0.132**	0.145**
	(0.056)	(0.056)
PRESTIGE	0.150**	0.153**
	(0.072)	(0.071)
CAREER	0.297***	0.300***
	(0.084)	(0.084)
CONTACT	0.095*	0.094*
	(0.051)	(0.051)
LIFESTYLE	-0.135**	-0.132**
	(0.064)	(0.064)
FAMILY	-0.111**	-0.110**
	(0.053)	(0.054)
BIO	-0.181	-0.230
	(0.203)	(0.206)
CHEM	-0.315	-0.341*
	(0.206)	(0.207)
MATERIAL	-0.076	-0.091
	(0.207)	(0.208)
female	0.142	0.143
	(0.168)	(0.169)
PHD_year (log)	-31.694**	-
	(12.595)	
PhD (1990-2000)	-	-0.008
		(0.170)
PhD (2001-2010)	-	-0.502***
		(0.175)
Constant	238.917**	-1.706***
	(95.679)	(0.573)
Country of origin dummy	All	All
Observations	1,306	1,306
Chi2	231.382	237.640
LogLik	-698.082	-695.219
PseudoR2	0.178	0.181

Heteroskedasticity-robust standard errors in parenthesis.

Table 6 presents logit estimates of the decision to study in the U.S. for the Core Country sub-sample which excludes individuals from countries such as China and South Korea but includes foreign-born PhD recipients from core countries regardless of date of PhD. The longer time period permits an analysis of whether the propensity to train in the United States has changed over time. In Model I, the time trend variable is measured as the log of PhD year and shows that, at least for this "core" sample, the propensity to study in the U.S. has declined overtime. When we substitute the three dummy variables for the log of PhD year, we see coefficients consistent with the decrease occurring in the last decade.

As in the previous estimates, we see that the presence of an exchange program diminishes the probability of studying in the U.S., as does the lifestyle of the U.S. Family/personal factors also play a role in dissuading students from coming to the U.S. Pull factors include the prestige of the university and the career prospects associated with receiving a degree from the U.S. Having a contact in the U.S. is significant at the 10 percent level.

Table 7 presents multinomial results for the decision to attend graduate school in the U.S. vs. one of seven other countries. Collectively, these seven countries plus the U.S. bestowed more than 90 percent of the PhDs to foreign-born students in the core country PhD sample. In all equations, the baseline destination is the U.S. The coefficients on the variable of PhD year should help in identifying which countries are taking the U.S. share of foreign born PhD students. Five of the seven countries in this respect stand out: Austria, Germany, Switzerland, the UK and Japan (10 percent level of significance). Canada and France are the exceptions.

Table 7 Location decision of PhDs. Mutinomial-logit model on the sub-sample of Core Country PhD

	Australia	Canada	France	Germany	Japan	Switzerland	U.K.
PHD_year (log)	74.323**	-35.309	18.375	121.388***	52.723*	97.525***	38.861**
	(32.499)	(22.040)	(23.174)	(27.394)	(29.494)	(25.639)	(16.799)
FELLOW_ORIGIN	0.108	-0.043	0.122	0.012	0.410***	-0.275**	0.058
	(0.129)	(0.109)	(0.089)	(0.098)	(0.129)	(0.113)	(0.067)
PHD_SCHOLARSHIP	0.367***	0.180*	-0.251***	-0.083	0.066	0.054	-0.191***
	(0.129)	(0.098)	(0.087)	(0.091)	(0.131)	(0.088)	(0.062)
EXCHANGE_PROG	-0.133	-0.035	0.574***	0.445***	0.372***	-0.081	0.228***
	(0.150)	(0.120)	(0.091)	(0.097)	(0.135)	(0.117)	(0.071)
NOPROGRAM	-0.215*	-0.300***	-0.003	-0.044	0.339***	-0.061	0.007
	(0.128)	(0.107)	(0.091)	(0.094)	(0.129)	(0.090)	(0.065)
PRESTIGE	-0.628***	-0.359***	-0.240*	-0.050	-0.460***	0.018	-0.138
	(0.154)	(0.128)	(0.132)	(0.143)	(0.172)	(0.134)	(0.098)
CAREER	-0.231	-0.346**	-0.426***	0.009	-0.693***	-0.290**	0.011
	(0.167)	(0.136)	(0.133)	(0.158)	(0.171)	(0.137)	(0.111)
CONTACT	-0.064	-0.054	-0.000	-0.082	-0.052	-0.104	-0.129**
	(0.109)	(0.089)	(0.088)	(0.092)	(0.131)	(0.082)	(0.062)
LIFESTYLE	0.342**	0.376***	0.536***	-0.007	-0.171	0.234**	0.301***
	(0.144)	(0.118)	(0.125)	(0.109)	(0.149)	(0.106)	(0.082)
FAMILY	0.268**	0.161*	-0.124	0.203**	0.210*	0.047	-0.005
	(0.112)	(0.090)	(0.092)	(0.091)	(0.122)	(0.089)	(0.067)
BIO	0.564	0.396	0.122	-0.096	-0.770*	1.139**	0.366
	(0.558)	(0.412)	(0.381)	(0.365)	(0.434)	(0.521)	(0.259)
CHEM	0.210	0.560	0.689*	0.528	-0.421	1.789***	0.191
	(0.605)	(0.417)	(0.370)	(0.349)	(0.420)	(0.510)	(0.275)
MATERIAL	1.035*	0.395	0.419	-0.347	-0.842*	1.342***	0.117
	(0.533)	(0.424)	(0.379)	(0.381)	(0.451)	(0.512)	(0.272)
female	-0.066	-0.174	0.445	0.160	-1.623***	0.192	0.113
	(0.387)	(0.337)	(0.274)	(0.284)	(0.625)	(0.280)	(0.211)

Constant	-566.734**	267.548	-141.499	-924.82***	-400.30*	-742.84***	-296.47**
	(246.926)	(167.403)	(176.072)	(208.207)	(224.093)	(194.843)	(127.636)
Observations	1,145						
Chi2	448.493						
LogLik	-1797.474						
PseudoR2	0.111						

The results suggest that the strength of financial assistantship in Australia and Canada (10 percent level of significance) lead individuals to choose these countries over the U.S.; their absence discourages PhD students from heading to Great Britain and France rather than to the U.S. Relative to the U.S., having funds for study from one's home country promotes studying in Japan but discourages studying in Switzerland. The presence of exchange programs plays a large role in attracting students to the UK, France, and Germany rather than the U.S., consistent with the EU hypothesis expressed above. Exchange programs also boost attendance in PhD programs in Japan relative to the U.S. The prestige of the program (or lack of prestige) relative to the prestige in the U.S. discourage students from attending PhD programs in Canada, Japan, Australia and France (10 percent level). Career prospects in France, Switzerland, Canada and Japan discourage students from coming to these countries for study compared to the U.S. Contacts play an important role in attracting students to the U.S. relative to Great Britain. The importance of lifestyle factors persists, providing an edge to Great Britain, France, Canada, Switzerland and Australia relative to the U.S. The time trend variable is consistent with the hypothesis that PhD enrollment of foreign students has been growing in Great Britain, Switzerland, Germany, Australia and Japan (10 percent level of significance) relative to the U.S. over time.

By way of summary, the empirical results, regardless of which sample we use, support the hypothesis that individuals come to the U.S. to study because of the prestige of the program and/or career prospects. For the more recent sample, the availability of financial assistance also plays an important role. Its lack of significance in the more restricted sample, that covers a longer period of time, may reflect the absence of individuals in the sample from countries such as China and South Korea, for whom financial assistance may be critical. Factors that discourage the foreign born from getting a PhD in the U.S. vs. another country are the perceived U.S. lifestyle and the availability of an exchange program. The evidence from the restricted sample suggests that there has been a significant decline in the probability of coming to the United States vs. going to another country for training. The countries that have been nibbling at the U.S. share include Great Britain, Switzerland, Germany, Australia and Japan.

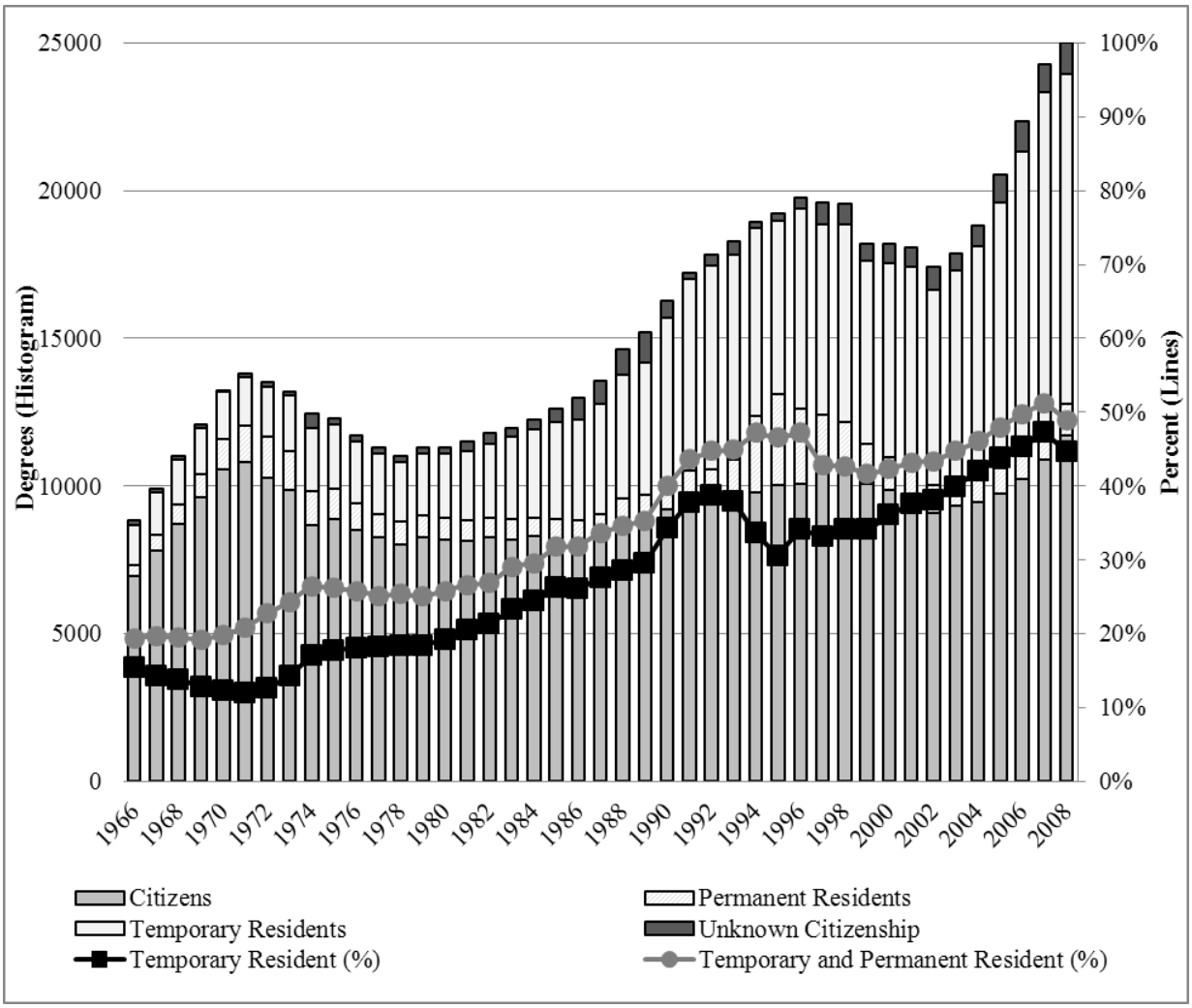
4. Postdoc Location

4.1 Review: evidence on foreign-born Postdocs

Postdoctoral training is not a new phenomenon. The concept and position have existed for almost a century in the United States when they were first introduced by the Rockefeller Foundation and the National Research Council (Assmus 1993) in 1919. However, in the past thirty or so years, the numbers of individuals holding postdoctoral positions in the United States has increased dramatically, as can be seen from Figure 2 which provides trends on the number of postdocs in academic institutions. The data presented are collected from the Survey of Graduate Students and Post-doctorates in Science and Engineering (GSS) conducted by the National Science Foundation. The data are collected at the university level—not the department level--and understate the number of postdoctoral positions at universities partly because creative titles bestowed on

postdoctoral positions can mask the actual number. Moreover, not all institutions or programs are covered by the GSS survey. For example, the survey excludes individuals working in academic departments without graduate programs and at Federally Funded Research Centers (FFRDCs).

Figure 2 Science and engineering PhDs by citizenship and gender, 1966-2008.



Source: (Stephan, How Economics Shapes Science 2012) For purposes of consistency over time, "medical/health sciences" and "other life sciences" are excluded from totals.

The figure clearly shows that not only has the number of postdoctoral scholars in the United States grown but the percent of these who are in the United States on temporary visas has also greatly grown. While many foreign postdocs receive their PhD training in the United States, a not insignificant number are believed to have arrived after completion of their PhD. Exact estimates, however, are difficult to make because the primary survey of PhDs working in the United States, the Survey of Doctorate Recipients, only collects information on those receiving their PhD in the United States. However, and as noted in footnote 4, at least one researcher believes that as many as fifty percent of all postdocs working in the United States received their PhD outside the United States.

The postdoc position has long been the norm in the biomedical sciences. The doubling of the NIH budget between 1998-2003 further encouraged the expansion of postdoctoral positions in the biomedical sciences. The postdoc position also has a long tradition in the physical sciences. In other fields the postdoctoral position has been considerably less common, although in very recent years the percent of engineers taking a postdoc upon graduation has increased dramatically—undoubtedly in response to the absence of other positions in the current economy (National Science Foundation 2012).

Stephan and Ma (2005) studied factors that lead individuals trained in the United States to take a postdoc position in the United States. They find two factors to play an especially important role. First, they find evidence that the state of the academic labor market in the United States is inversely related to the probability of taking a postdoc position upon graduation. Second, they find that upon graduation foreign-born PhD recipients are significantly more likely to take a postdoc than their citizen classmates. One reason that individuals on temporary visas are more likely to take a postdoctoral position than those who are not temporary residents is that the job options available to them are more limited because of visa restrictions.

Some of the foreign born and foreign trained who come to take a postdoc position in the United States do so with support from their country of origin. By way of example, Switzerland, through the Swiss National Science Foundation, provides funds for PhD recipients to do postdoctoral training abroad and the Marie Curie program of the EU Commission since 2007 has begun to sponsor post-doc training away from Europe. During the last five years it sponsored 439 scholarships for EU citizens to study in the U.S. (EU Commission 2012).

Little information is available on the number of postoctoral scholars working in other countries, nor on the proportion of them who are foreign born. One exception is a study (Empirica 2005) which found that 43% of postdocs working in the life sciences in Europe are away from their country of origin.

4.2 Analysis: Choice of Postdoc location

Table 8 provides estimates of the probability of the foreign born taking a postdoc in the United States vs. another country for the Recent Postdoc sub-ample, which includes 1531 foreign born individuals who received a PhD in 2003 or later, regardless of country of origin. Three models are estimated that vary in terms of specification of country controls. Independent variables include self-reported measures on a five-point sliding scale of the availability of research funds, the value of the salary, and the value of the benefits, such as parental leaves, pension and insurance. Regardless of specification, the foreign born who received a PhD in the U.S. are more likely to take a postdoctoral position here; faculty quality plays an important role in choosing the U.S. over another country for training, as do career prospects. As in the case of PhDs, we find that lifestyle is a major factor discouraging individuals from coming to the U.S. for a postdoctoral position. We also find evidence that benefits provided for postdocs in the United States relative to benefits provided to postdocs in other countries discourage the foreign born from coming to the United States for postdoctoral training. Results in model I indicate that Indians and Chinese are significantly more likely to take a postdoc position than the benchmark, represented by all other possible origin countries. Model II shows a higher relative incidence of postdoc taking in the United States relative to other countries for individuals from Canada, Great Britain, Japan, France, and Italy, as well as India and China. Russians are significantly less likely to come to the U.S.

Table 8 Decision to take a Postdoc in the US. Logit model on the sub-sample of Recent Postdoc

	Model I	Model II	Model III
PHD_US	2.825***	3.054***	2.921***
	(0.230)	(0.251)	(0.277)
PRESTIGE_DEST	0.119	0.169*	0.166
	(0.095)	(0.100)	(0.106)
FACULTY_QUAL	0.372***	0.361***	0.370***
	(0.101)	(0.104)	(0.109)
RESEARCH_FACILITY	-0.155*	-0.129	-0.143
	(0.084)	(0.089)	(0.093)
RESEARCH_FUNDS	0.070	0.088	0.101
	(0.074)	(0.075)	(0.077)
SALARY	-0.022	0.027	0.035
	(0.070)	(0.072)	(0.076)
BENEFIT	-0.362***	-0.396***	-0.413***
	(0.095)	(0.099)	(0.104)
NETWORK	-0.009	-0.004	-0.021
	(0.080)	(0.082)	(0.087)
CAREER_POSTDOC	0.234**	0.296***	0.341***
	(0.102)	(0.106)	(0.110)
PERSONAL	-0.069	-0.053	-0.065
	(0.052)	(0.055)	(0.058)
LIFE	-0.200*	-0.276**	-0.314***
	(0.112)	(0.117)	(0.121)
BIO	0.236	0.173	0.247
	(0.194)	(0.202)	(0.209)
CHEM	0.132	0.017	0.015
	(0.186)	(0.196)	(0.202)
MATERIAL	0.303	0.218	0.269
	(0.190)	(0.197)	(0.206)
female	-0.189	-0.139	-0.128
	(0.150)	(0.158)	(0.168)
AGE	0.045***	0.042***	0.048***
	(0.007)	(0.008)	(0.008)
IND	0.958***	1.371***	
	(0.262)	(0.298)	
CHN	0.676***	1.001***	
	(0.254)	(0.280)	
ITA		0.381*	
		(0.227)	
FRA		0.723***	
		(0.273)	
ESP		-0.343	
		(0.336)	

DEU		0.457*	
		(0.271)	
JPN		2.072***	
		(0.318)	
BRA		0.547*	
		(0.322)	
GBR		1.424***	
		(0.375)	
CAN		1.243***	
		(0.355)	
CHE		0.561	
		(0.481)	
NLD		-0.437	
		(0.578)	
RUS		-2.743***	
		(1.014)	
AUS		0.286	
		(0.574)	
Constant	-5.494***	-6.607***	-8.442***
	(0.660)	(0.745)	(1.341)
Origin country dummy	Selected	Selected	All
Observations	1,474	1,474	1,474
Chi2	280.972	306.231	305.356
LogLik	-782.023	-738.273	-698.324
PseudoR2	0.196	0.241	0.243

Table 9 provides the estimates for the restricted postdoc sample of 4,634 individuals. Specification I includes the log of PhD year; specification II includes three time dummies for PhD year periods. The time trend variables in both specifications are significant and indicate a decline over time in the propensity of coming to the U.S. to take a postdoc position vs. going elsewhere. The dummy variables suggest that the rate of decline accelerated post 2000. The other findings are somewhat similar to those for the Recent Sample. Specifically, those who received their PhD in the U.S. are more likely to take a postdoc position in the U.S. and career prospects and faculty quality are a powerful draw in bringing the foreign born to train in the U.S. as a postdoc, as are the availability of research funds. Those in the biomedical biological sciences are also more likely to come to the U.S. vs. those in all other fields. Personal factors and value of fringe benefits (parental leaves, pension, insurance) discourage the foreign born from taking a postdoc position in the United States rather than in another core country.

Table 9 Decision to take a Postdoc in the US. Logit model on the sub-sample of Core Country Postdoc

	Model I	Model II
PHD_US	1.835***	1.835***

	(0.176)	(0.176)
PHD_year (log)	-45.740***	-
	(6.788)	
PhD (1990-2000)	-	-0.353***
		(0.078)
PhD (2001-2010)	-	-0.606***
		(0.088)
PRESTIGE_DEST	0.090*	0.089*
	(0.047)	(0.047)
FACULTY_QUAL	0.190***	0.192***
	(0.049)	(0.049)
RESEARCH_FACILITY	-0.046	-0.046
	(0.043)	(0.044)
RESEARCH_FUNDS	0.153***	0.151***
	(0.039)	(0.039)
SALARY	0.031	0.033
	(0.040)	(0.040)
BENEFIT	-0.333***	-0.326***
	(0.053)	(0.053)
NETWORK	-0.068*	-0.065
	(0.041)	(0.041)
CAREER_POSTDOC	0.124**	0.118**
	(0.048)	(0.048)
PERSONAL	-0.078***	-0.079***
	(0.029)	(0.029)
LIFE	-0.096	-0.100
	(0.062)	(0.062)
BIO	0.376***	0.365***
	(0.103)	(0.104)
CHEM	0.020	0.021
	(0.101)	(0.101)
MATERIAL	-0.159	-0.170
	(0.124)	(0.123)
female	-0.100	-0.115
	(0.084)	(0.084)
Constant	345.162***	-1.990***
	(51.533)	(0.334)
Country of origin dummy	All	All
Observations	4,634	4,634
Chi2	543.186	545.504
LogLik	-2832.365	-2831.135
PseudoR2	0.117	0.117

Finally, in Table 10 we estimate a multinomial logit model of the probability of coming to take a postdoc in the U.S. vs. going to one of seven other countries. The negative sign on the log of the PhD year variable is consistent with the hypothesis that over time postdocs have become increasingly more likely to choose other countries—with the exception of Canada-- over the United States. All countries that increasingly attracted PhD students (Australia, Germany, Japan, Switzerland, and the UK) also show a growing capacity to attract postdoc trainees, in comparison to the U.S. The evidence also suggests that over time the attractiveness of France for postdoc training has increased relative to the United States. This stands in contrast to our findings regarding the relative appeal for the foreign born of France over time for PhD study. This postdoc pattern may in part be caused by programs such as the Marie Curie fellowships that have largely supported intra-EU mobility of postdocs in recent years. With regard to other variables, we find that faculty quality attracts postdocs to the U.S. rather than to Great Britain, Japan and France and career prospects attract foreign-born postdocs to the U.S. rather than to Germany, Switzerland and Australia. Those in the biological sciences are more likely to choose the U.S. over Germany or France (10 percent level of significance). Research facilities play a positive role in attracting postdocs to Germany and Switzerland over the U.S.

Historically, the fringe benefits provided to postdocs in the United States have been minimal and in some instances virtually nonexistent. Here we find that, relative to the U.S., benefits play an important role in foreign born postdocs going to Germany, France, Canada, Australia and the UK (10 percent level of significance) instead of coming to the United States. On the other hand, postdoctoral salaries discourage postdocs from going to Canada or France vs. the United States, but not surprisingly, given the generous support provided, encourage them gong to Switzerland. Salaries in Japan also draw postdocs to study there. The U.S. life style encourages individuals to choose the U.S. instead of Great Britain or Canada (10 percent level of significance) for postdoctoral training.

Table 10 Location decision of Postdocs. Mutinomial-logit model on the sub-sample of Core Country Postdoc

	Australia	Canada	France	Germany	Japan	Switzerland	UK
LOG_PHD_year	94.870***	-11.979	39.651***	40.255***	95.447***	38.403**	37.799***
	(23.817)	(13.548)	(13.471)	(12.065)	(23.839)	(15.894)	(10.525)
PRESTIGE_DEST	-0.299**	-0.435***	-0.155*	0.004	-0.034	-0.019	0.061
	(0.140)	(0.094)	(0.089)	(0.091)	(0.158)	(0.115)	(0.072)
FACULTY_QUAL	-0.225	-0.157	-0.203**	-0.089	-0.487***	-0.101	-0.149**
	(0.146)	(0.100)	(0.087)	(0.091)	(0.154)	(0.119)	(0.071)
RESEARCH_FACILITY	-0.106	0.057	-0.014	0.193**	-0.112	0.319***	0.019
	(0.136)	(0.096)	(0.086)	(0.083)	(0.153)	(0.106)	(0.063)
RESEARCH_FUNDS	-0.304**	0.020	-0.260***	-0.120	0.138	-0.079	-0.301***
	(0.123)	(0.084)	(0.076)	(0.073)	(0.143)	(0.094)	(0.057)
SALARY	0.019	-0.287***	-0.178**	-0.009	0.275**	0.319***	0.023
	(0.127)	(0.093)	(0.082)	(0.073)	(0.127)	(0.084)	(0.058)
BENEFIT	0.458***	0.377***	0.420***	0.392***	0.219	0.069	0.155*
	(0.163)	(0.122)	(0.108)	(0.096)	(0.158)	(0.112)	(0.080)
NETWORK	0.044	-0.014	0.080	0.211***	0.348**	0.002	0.155**
	(0.136)	(0.086)	(0.080)	(0.076)	(0.141)	(0.091)	(0.061)
CAREER_POSTDOC	-0.396***	0.043	-0.198**	-0.257***	-0.155	-0.222**	-0.008

	(0.149)	(0.102)	(0.092)	(0.086)	(0.162)	(0.108)	(0.074)
PERSONAL	-0.032	0.099	0.056	0.054	0.113	0.041	0.020
	(0.089)	(0.060)	(0.058)	(0.053)	(0.094)	(0.065)	(0.044)
LIFE	1.768***	0.264*	0.190	-0.119	-0.119	0.136	-0.081
	(0.223)	(0.138)	(0.122)	(0.114)	(0.206)	(0.145)	(0.092)
BIO	0.087	-0.278	-0.360*	-0.839***	-0.299	-0.305	0.094
	(0.361)	(0.231)	(0.212)	(0.177)	(0.306)	(0.267)	(0.160)
CHEM	0.127	0.040	0.238	-0.205	-0.059	0.316	0.168
	(0.367)	(0.223)	(0.199)	(0.162)	(0.289)	(0.249)	(0.158)
MATERIAL	1.059***	0.473*	0.139	-0.608***	-0.422	0.599**	0.106
	(0.363)	(0.253)	(0.239)	(0.214)	(0.370)	(0.273)	(0.187)
female	-0.022	0.014	0.313**	-0.028	-0.819**	0.046	0.172
	(0.276)	(0.189)	(0.150)	(0.152)	(0.340)	(0.192)	(0.117)
Countyr of origin dummy	All	All	All	All	All	All	All
Constant	-733.760	92.069	-301.164***	-306.605***	-728.072***	-294.701**	-287.121***
	(848.174)	(102.867)	(102.285)	(91.618)	(181.093)	(120.690)	(79.904)
Observations	4,191						
Chi2	1590.880						
LogLik	-5650.509						
PseudoR2	0.123						

By way of summary, the empirical results support the hypothesis that individuals come to the United States for postdoctoral study because of the quality of programs and career prospects, and, in the case of the restricted sample, the availability in some instances of research funds. The foreign born who received their PhD in the U.S. are more likely to take a postdoc position in the United States than elsewhere. Lifestyle plays an important role in discouraging the recently trained foreign born from coming to the United States to take a postdoc position. Personal factors also discourage the foreign born from coming to the United States as do the benefits provided to postdocs. Evidence from the restricted sample suggests that there has been a significant decline in the probability of taking a postdoc position in the United States by the foreign born relative to going elsewhere for study.

5. Conclusion and Discussion

The GlobSCi data provide the most comprehensive view that currently exits of the flows of scientists across the sixteen countries. It is not, however, without its limitations. In particular, we were unable to collect data from scientists currently working in China. Moreover, although the survey determined location of training, it provides no information on the choice set that scientists faced at the time they made their decision to study abroad. The survey also did not collect data on variables that could reflect variation in the ability of the trainees, such as the name of the undergraduate institution they attended.

Here we use the GlobSci data to study the probability that those who leave their country of origin for training, either as a doctoral student or as a postdoctoral fellow, come to the United States. We use four distinct sub-samples in order to address the fact that the survey is limited to sixteen countries. One of the

samples, referred to as the "recent sample" focuses exclusively on individuals trained quite recently in order to minimize issues arising from censoring if and when individuals return to a country not covered by the survey. The second sample, referred to as the restricted sample, focuses only on individuals from the sixteen core countries.

Regardless of which sample we use, the empirical results support the hypothesis that individuals come to the U.S. for PhD study because of the prestige of program and/or career prospects. For the more recent sample, the availability of financial assistance also plays an important role. Its lack of significance in the more restricted sample, that covers a longer period of time, may reflect the absence of individuals in the sample from countries such as China and South Korea for whom financial assistance may be critical. Factors that discourage the foreign born from getting a PhD in the U.S. vs. another country are the perceived U.S. lifestyle and the availability of an exchange program. The evidence from the restricted sample suggests that there has been a significant decline after 2000 in the probability of receiving a PhD in the United States vs. receiving one from another country. The countries that have been nibbling at the U.S. share include Great Britain, Switzerland, Germany, Australia and Japan.

Similar factors are significantly related to the probability that a foreign born scientist comes to the United States for postdoctoral study instead of going elsewhere. Specifically, the perceived quality of programs and career prospects draw individuals to take a postdoc position in the United States as does faculty quality. The availability of research funds also plays a role. In general, the perceived lifestyle in the United States or personal factors discourages foreign born individuals from coming as does the value of the fringe benefits associated with a postdoctoral position. We find, using the restricted sample, that the foreign born are increasingly drawn to six of the seven alternative countries that we model -the UK, Germany, France, Switzerland, Japan and Australia. The exception is that we find no evidence that Canada is a competitor at the postdoctoral level.

In short, although the number of foreign born coming to the United States for either PhD study or to take a postdoctoral position has grown, the empirical work strongly suggests that the relative attractiveness of the United States among foreign born graduate students and postdocs is declining. This decline would accelerate if the quality or prestige of U.S. programs were to decline.

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Appendix

A1. Non-response bias

We assess non-response bias along three dimensions. First, we compare early and late respondents; second, we compare respondents against non-respondents and third, we compare full-respondents against those who dropped-out. In all instances the comparison is done for two known characteristics for the entire panel and sample: total citations received by the underlying article and number of coauthors. Total citations arguably are positively correlated with the eminence of the scientist and could potentially reflect differentials in the propensity to answer related to how busy the respondent is. The number of co-authors is positively correlated with the amount of time it took to answer the questionnaire given that number of coauthors was a basis for a branching question in the survey. Therefore, the number of coauthors is potentially associated with dropping out of the survey. Tests for equality of means are performed for each pair of country samples.

Mean differences by country for early and late respondents are reported in Table A- 1. Early-respondents are those who completed the survey during the first and second round and late-respondents are those who completed the survey during third round. Regardless of country or measure, there is no significant difference at the 5 percent confidence level.

Comparison statistics for non-respondents vs. respondents are reported in Table A- 2. Authors of more highly-cited papers living in France, Italy, Spain and the U.S. are less likely to respond than those with lower-cited papers. Authors of papers with more co-authors living in Brazil, Germany, Italy and the U.S are also less likely to have answered.

Table A- 1 - Two-groups comparisons. T-Tests. Hypothesized difference (early respondents – late respondents)=0

Core country	Total Cites	Number of authors
	mean diff. (st. err.)	mean diff. (st. err.)
Australia	0.174	-0.393
	(0.200)	(0.287)
Belgium	-0.084	0.575
	(0.329)	(0.450)
Brazil	0.148	0.144
	(0.083)	(0.227)
Canada	-0.208	-0.372
	(0.132)	(0.219)
Denmark	0.192	-0.367
	(0.481)	(0.519)
France	0.047	-0.167
	(0.133)	(0.216)
Germany	-0.140	-0.042
	(0.221)	(0.238)

India	-0.093	0.119
	(0.117)	(0.217)
Italy	-0.049	-0.334
	(0.117)	(0.230)
Japan	0.151	-0.060
	(0.157)	(0.241)
Netherlands	0.045	0.250
	(0.254)	(0.364)
Spain	-0.099	-0.040
	(0.138)	(0.203)
Sweden	-0.123	-0.531
	(0.317)	(0.448)
Switzerland	-0.297	-0.357
	(0.438)	(0.438)
UK	0.165	0.173
	(0.182)	(0.235)
U.S.	0.199	0.074
	(0.106)	(0.102)

*p<0.05

Table A- 2 Two-groups comparisons. T-Tests. Hypothesized difference (non-respondent – respondent)=0

Core country	Total Cites	Number of authors
	mean diff. (st. err.)	mean diff. (st. err.)
Australia	-0.039	0.035
	(0.098)	(0.142)
Belgium	-0.268	-0.274
	(0.162)	(0.222)
Brazil	0.088	0.397
	(0.046)	(0.125)*
Canada	0.009	0.160
	(0.063)	(0.105)
Denmark	-0.002	-0.114
	(0.224)	(0.242)
France	0.122	0.029
	(0.058)*	(0.094)
Germany	0.158	0.205
	(0.092)	(0.099)*
India	0.029	0.008
	(0.052)	(0.096)
Italy	0.181	0.288
	(0.061)*	(0.120)*
Japan	0.089	0.112
	(0.052)	(0.080)
Netherlands	0.069	0.031
	(0.124)	(0.178)
Spain	0.161	0.051
	(0.064)*	(0.095)
Sweden	-0.040	0.089
	(0.133)	(0.188)
Switzerland	0.212	0.206
	(0.200)	(0.200)

UK	0.143	0.123
	(0.083)	(0.108)
U.S.	0.354	0.146
	(0.052)*	(0.049)*

*p<0.05

Results of test comparisons for full-respondents against partial respondents (dropouts) are reported in Table A- 3. Results indicate that more cited authors from Belgium were more likely to dropout. The opposite is true for more cited authors from India, who were more likely than less-cited authors to take the survey in full. Dutch authors with more coauthors are also more likely to have completed the survey in full.

Table A- 3 - Two-groups comparisons. T-Tests. Hypothesized difference (complete – dropout)=0

Core country	Total Cites	Number of authors
	mean diff. (st.err.)	mean diff. (st.err.)
Australia	-0.162	-0.637
	(0.224)	(0.371)
Belgium	-0.962	-0.120
	(0.405)*	(0.463)
Brazil	-0.065	-0.298
	(0.104)	(0.299)
Canada	0.168	-0.257
	(0.150)	(0.242)
Denmark	0.029	-0.293
	(0.670)	(0.650)
France	0.192	0.278
	(0.122)	(0.197)
Germany	-0.096	-0.387
	(0.207)	(0.236)
India	0.196	0.064
	(0.084)*	(0.175)
Italy	-0.069	-0.417
	(0.105)	(0.239)
Japan	0.176	0.079
	(0.144)	(0.214)
Netherlands	0.565	0.872
	(0.290)	(0.438)*
Spain	0.111	-0.068
	(0.117)	(0.192)
Sweden	0.401	-0.161
	(0.300)	(0.387)
Switzerland	-0.832	-0.479
	(0.517)	(0.455)
UK	0.015	-0.063
	(0.175)	(0.282)
U.S.	-0.130	0.105
	(0.101)	(0.118)

* p<0.05