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Paula Stephan
Chiara Franzoni
Giuseppe Scellato

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Choice of Country by the Foreign Born for PhD and Postdoctoral Study: A Sixteen-Country Perspective

Paula Stephan, Chiara Franzoni, and Giuseppe Scellato

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ABSTRACT

We analyze the decisions of foreign-born PhD and postdoctoral trainees to come to the United States vs. go to another country for training. Data are drawn from the GlobSci survey of scientists in sixteen countries working in four fields. We find that individuals come to the U.S. to train because of the prestige of its programs and/or career prospects. They are discouraged from training in the United States because of the perceived lifestyle. The availability of exchange programs elsewhere discourages coming for PhD study; the relative unattractiveness of fringe benefits discourages coming for postdoctoral study. Countries that have been nibbling at the U.S.-PhD and postdoc share are Australia, Germany, and Switzerland; France and Great Britain have gained appeal in attracting postdocs, but not in attracting PhD students. Canada has made gains in neither.

Paula Stephan
Department of Economics
Andrew Young School of Policy Studies
Georgia State University
Box 3992
Atlanta, GA 30302-3992
and Università di Torino
and also NBER
pstephan@gsu.edu

Chiara Franzoni
Department of Management, Economics
and Industrial Engineering
Politecnico di Milano
20133 Milan
Italy
chiara.franzoni@polimi.it

Giuseppe Scellato
Department of Production Systems
and Business Economics
Politecnico di Torino
10129 Turin, Italy
and Bureau of Research in Innovation Complexity
and Knowledge at Collegio Carlo Alberto
giuseppe.scellato@polito.it

1. Introduction

Except for a period in the mid-1990s and another beginning in the late 2000s the percent of PhDs awarded to the foreign born in the United States has grown for many years. By way of example, in 1966, approximately 20 percent of PhDs awarded in engineering and the natural sciences went to foreign-born scientists. By 2010 the figure was just shy of 46 percent.[1] Not only has the percent of PhDs awarded to foreign born increased; the 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 a temporary visa was approximately 40 percent; those who held permanent visas or were citizens was 60 percent (Stephan P. , 2012). By 2008 the situation had reversed: 60 percent of postdoctoral scholars working in the United States 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.[2]

The United States is not the only country that trains the foreign born. In 2004, 22.4 percent of all doctoral candidates in the European Union were training in a country in which they were not a citizen. Three-fourths of these came from non-European Union countries (IISER, 2007). Moreover, in recent years the number of PhD degrees awarded to foreigners has grown considerably in Europe, as well as in Canada, Japan and 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 (National Science Board, 2012, pp. Table 2-42). The largest enumerated group of foreign students in 1999 was 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 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 28.8 percent in 1998-1999 to 51.2 percent in 2008-2009 (National Science Board, 2012, pp. Table 2-40). 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 foreign students; the

[1] Before the impact of 9/11 was felt, the percent stood at slightly more than 50. The percent foreign-born is computed based on total number of PhD recipients who declare their citizenship status. The foreign born are defined to include temporary residents and permanent residents. See Figure 1.

[2] 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.

number of Greek students had declined substantially. Even Japan, which has a reputation 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 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 (National Science Board, 2012, pp. Table 2-41); that from South Korea declined in absolute and percent terms. The number and percent from Indonesia increased.

We know considerably less about the number of foreign born receiving postdoctoral training outside the United States. But what we do know suggests that the presence of the foreign born is substantial among the postdoc population. For example, one study found that 43 percent of the 19,000 postdoctoral fellows in the life sciences in Europe are working outside their country of citizenship. Of these, 44 percent are from another European country; 56 percent are from outside the EU (IISER, 2007).

Despite these facts, virtually nothing is known about what leads perspective PhD students to choose one country over another or what factors lead newly minted PhDs to take a postdoctoral position in one country rather than another. What role, for example, do funding, opportunities for advancement, or lifestyle play? What role does the family of the student play in the decision of where to train? Has the attractiveness of the United States to foreign-born PhD and postdoctoral trainees changed in recent years, relative to that of other countries? Are migration patterns different in different fields? Our ignorance derives from the fact that no database collects consistent information across countries on mobile researchers and on factors affecting their decision to emigrate for training.

The question is of importance for at least two reasons. First, the scientific workforce of a county can be highly dependent on the foreign born, both while in training and subsequent to training. Black and Stephan (2010), for example, infer that 39.6 percent of the graduate student authors of papers published during a six-month period in *Science* in 2007 are foreign born; 59.2 percent of the postdoc authors are noncitizens.[3] Moreover, many immigrants who stay first come to a country for PhD study or for postdoctoral work. In the United States, for example, approximately 22 percent of faculty in science and engineering were not citizens at the time they received their PhD training in the United States (Stephan P. , 2012). Second, benefits from migration also exist for the country of training if and when scientists return to the home country. Scellato et al (2012), for example, find that returnees are more likely to have international coauthors than those who have not been mobile. Returnees' networks also span more countries and perform at a higher level.

[3] 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 & Stephan, 2010).

The purpose of this paper is to examine the comings of the foreign born to the United States for doctoral and postdoctoral study. The data we use were collected by the authors in 2011 as part of the GlobSci project (Franzoni, Scellato, & Stephan, 2012) and cover research active scientists currently working or training in sixteen countries. We begin in Section 2 by briefly summarizing trends in the number of foreign-born PhD recipients and postdoctoral scholars in the United States. In Section 3 we discuss factors affecting the decision to study abroad and review previous studies of student mobility. In section 4 we discuss the data. In Section 5 we estimate the probability of coming for PhD study to the United States vs. going elsewhere. We also estimate a multilogit model of the probability of studying in the United States vs. studying in six other countries. Section 6 examines, in a similar framework, the decision to do postdoctoral study in the United States. Section 7 closes with discussion and conclusion.

Major findings are that students come to the United States for PhD study because of the prestige of its programs and/or career prospects. For recent PhDs we also find evidence that financial support plays a role in attracting students to the United States. Factors that discourage students from coming to the United States for study are the perceived lifestyle in the United States and the availability of exchange programs in other countries. The quality of faculty and the excellence/prestige of its institutions lead individuals to do postdoctoral study in the United States as well as career prospects associated with doing a postdoc in the U.S. The U.S. lifestyle discourages individuals from coming as does the relative unattractiveness of benefits and working conditions provided to postdocs. The likelihood of coming to the U.S. for training has declined significantly for those who received their PhDs after 2000. Countries that have been nibbling at the U.S. PhD and postdoc share are Australia, Germany and Switzerland. Great Britain and France have become more attractive to scientists for postdoctoral study but not for PhD study. Canada has made gains in neither.

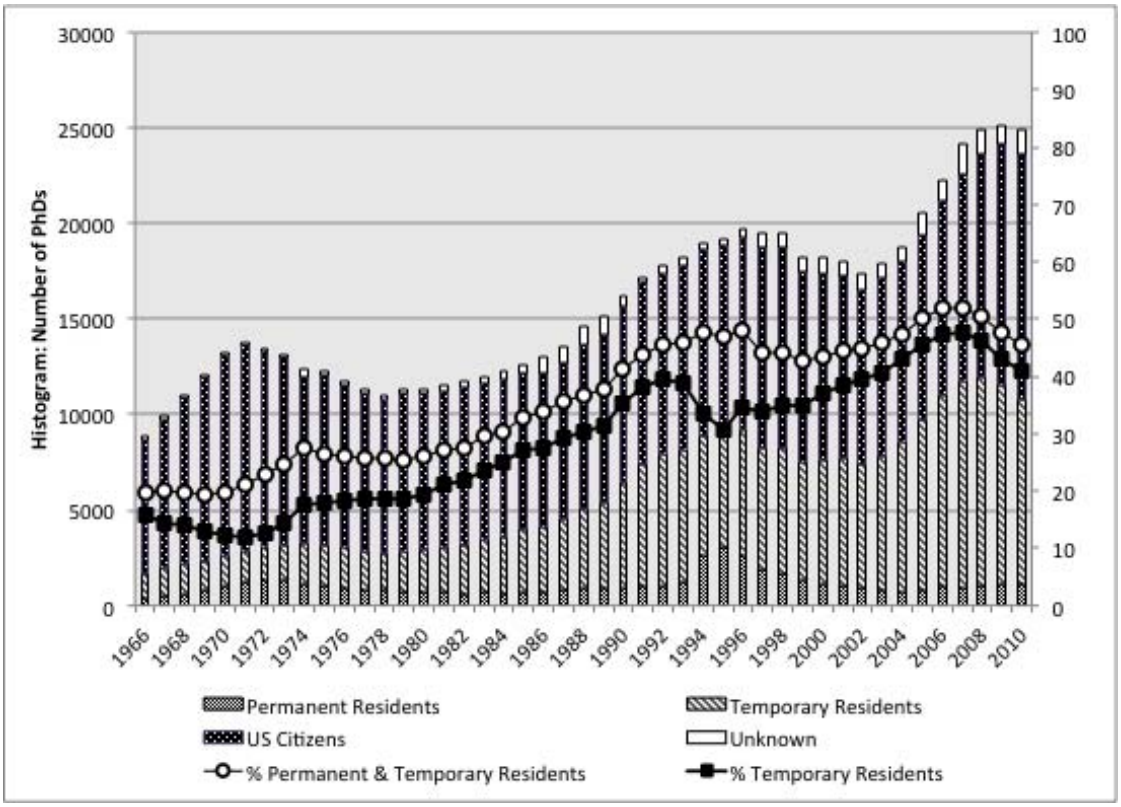
2. Foreign-born PhD Recipients and Postdocs in the United States

In order to provide context for our analysis of the decision to come to the United States for training versus going elsewhere—either as a graduate student or as a postdoctoral fellow—we begin by summarizing trends in the number of PhD degrees awarded to the foreign born as well as trends in the foreign born who are working as postdoctoral scholars in the United States.

2.1 PhD recipients

The percent of foreign-born students receiving PhD training in the U.S. in the natural sciences and engineering has increased consistently since the late 1970s with but two exceptions, the last of which began in the late 2000s and largely reflects events which occurred subsequent to 9/11. As can be seen Figure 1, in the late 1960s to the early 1970s, one in five PhD recipients was foreign. By 2007 more than one in two was foreign. The proportion going to the foreign born grew most dramatically in the late 1980s and early 1990s. [4]

Figure 1 Science and engineering PhDs by citizenship, 1966-2010



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

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

[4] Foreign is defined to include temporary as well as permanent residents. Percents are computed based on those who declare citizenship status. Note that the percent who do not declare citizenship status has increased over time. The number of permanent residents increased in 1992 and the number of temporary residents declined due to the passage of the Chinese Student Protection Act, which bestowed permanent residency status on Chinese students in the United States at the time of the events at Tienanmen Square. All data come from WebCASPER (National Science Foundation, 2012a)

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 P. , 2012).

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 illustrated by the fact that three of the top five undergraduate "feeder" programs to graduate school in the U.S. are outside the United States: Tsinghua University, Peking University and Seoul National University (Mervis, 2008).[5] 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).

2.2 Postdoctoral training

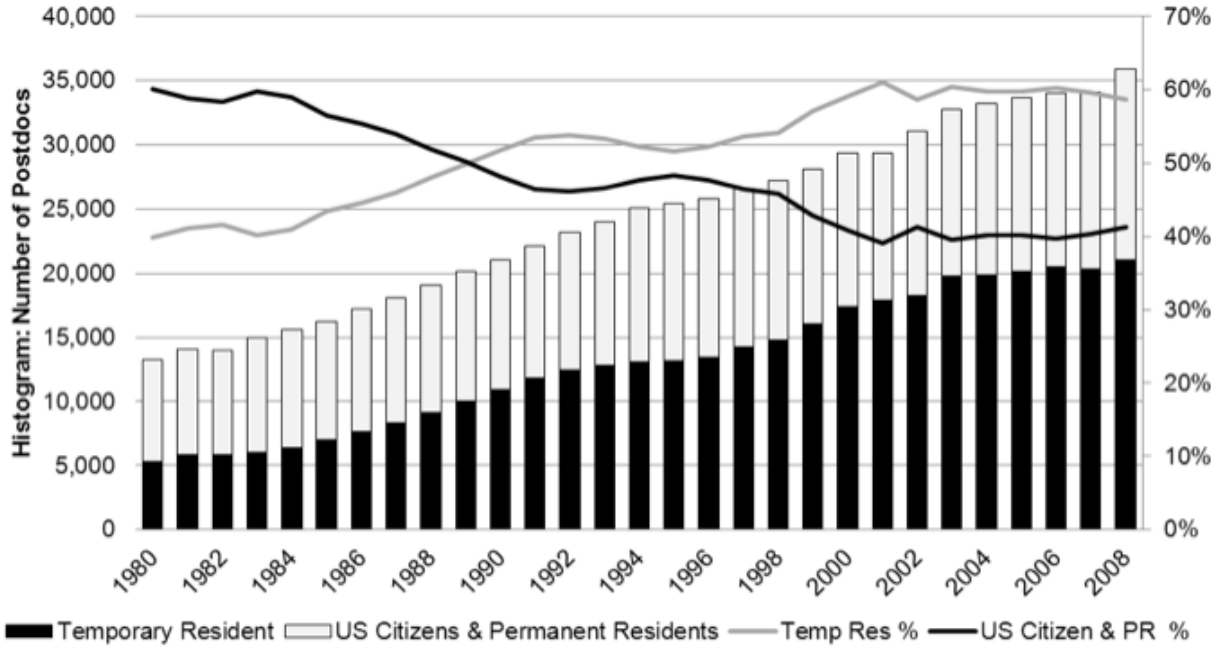
Although postdoctoral training is not a new phenomenon in the United States, the number of individuals holding postdoctoral positions in the United States has increased dramatically in the past thirty or so years, as can be seen from Figure 2, which provides trends in the number of postdoctoral fellows at academic institutions.[6] The data presented are collected from the Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) conducted by the National Science Foundation. The data are collected at the university 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).

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 grown greatly.[7] 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

[5] 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.
[6] 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.
[7] The GSS does not differentiate between citizens and permanent residents.

information on those receiving their PhD in the United States. However, and as noted in footnote 2, 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.[8]

Figure 2 Science and engineering postdocs working in academe, 1980-2008 by citizenship status



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

[8] Stephan and Ma (2005) find two factors to play an especially important role in the decision to take a postdoctoral position among U.S.-trained PhDs. First, 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.

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 life sciences. By 2007, for example, 67 percent of all newly-minted PhDs in the life sciences in the United States who had definite commitments at the time they received their doctorate award were headed to a postdoc position (National Science Foundation, 2012a). 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, 2012a).

3. The Choice to Study Abroad

3.1 Framework for analysis

The choice to study abroad can be considered a two-stage process in which the student first makes a decision regarding whether to seek training abroad and subsequently, if the decision is affirmative, decides where to study. The two decisions are collapsed into one in instances where the student considers studying in only one foreign country over staying at home for training. Key factors influencing the first stage of the decision process are the availability of training programs in the home country and the policy of the home country towards study abroad. Employment options in the home country can also play a role in the decision to study abroad. When academic jobs became scarce in South Korea, for example, the number of South Koreans choosing to study abroad declined, reflecting the perceived advantage of staying in country to study and staying in touch with faculty in order to have a leg up in the job market (Kim, 2010).[9]

Viewed as an investment in human capital, the decision to study abroad involves weighing the present value of the benefits to study abroad against the costs of doing so. Benefits include the opportunity to enhance one's career prospects by studying with highly-productive faculty at a prestigious university, acquiring access to research resources not available in the home country, and building a network of future collaborators. With regard to prestige of programs, 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;[10] seven of

[9] 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).

[10] http://www.arwu.org/ARWU2010.jsp (accessed January 3, 2013). Two of the remaining three belong to the UK; the third belongs to Japan.

the top ten spots on the London Times rankings belong to U.S. institutions, the other three belong to the United Kingdom.[11]

A portion of the benefits of studying abroad are monetary and involve the present value of increased compensation received as a result of training, either by staying for employment in the country of training, or by returning to one's home country and reaping the financial benefits of one's education. The magnitude of the benefit can depend in part upon the extent to which study abroad provides an option for remaining in the country of training. In recent years, for example, Canada and Australia have made it considerably easier for foreign-PhD students to obtain citizenship after completing their degree; training in the United States places one in a relatively good position to receive an H-1B work visa (Bound, Turner et al. 2009).[12] The prospects of finding employment subsequent to training also play a role in the decision of where to study. Poor job prospects likely discourage students from studying in a country such as Italy, where the market for scientists and engineers has been depressed for a number of years, or a country such as Germany, where a low proportion of academic professional rank positions are held by the foreign born.

The benefits of studying abroad for training in science and engineering are not, however, all monetary. They include, for example, the opportunity to work in an environment that promotes research and thus provides increased opportunities to derive satisfaction from "puzzle solving" aspects of research.[13] Benefits also include the opportunity to explore a new environment and living experience. For individuals studying in an English-speaking country for whom English is not their native language, training enhances their ability to write and publish, given the widespread adoption of English as the lingua franca by most scientific fields.

The costs of going abroad for Ph.D study include payment for study, which can be offset by fellowships and assistantships. Some countries, such as Switzerland, offer handsome stipends to PhD students. In the U.S., research assistantships are readily available to the foreign born because faculty with research funding generally rely on students and postdocs to staff their laboratories, and the foreign-born provide a ready source. Although the stipend associated with a graduate research assistantship in the U.S. is not that large, it has a relatively higher value to foreign born from developing and emerging countries than it has to U.S. students.[14] In other countries, financial assistance is not available or not as generous. For some students whose home

[11] http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=421400&c=1 (accessed January 3, 2013).

[12] Lowell 2000 estimates that nearly one-quarter of H-1B visa recipients were first in the U.S. as a foreign student.

[13] Stephan and Levin (1992) and Stephan (2012) argue that scientists are motivated by an interest in ribbon, puzzle, and gold. The ribbon is recognition that accompanies discovery; the puzzle is the "pleasure of finding things out," and the gold is the financial return. In this framework, study abroad can also enhance the probability of receiving more recognition.

[14] Not surprisingly, foreign students are considerably more likely to be a research assistant than are 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, P. 2012).

country provides financial assistance for study abroad, support may not be a major issue in determining where to study.

Differentials in housing costs and the time, and associated uncertainty, of applying for and receiving a visa for study in the destination country in instances where a visa is required are additional factors. Costs also include separation from family and friends and living in an unfamiliar or significantly different environment that can be unappealing or difficult to adjust to. The challenge of training in a foreign language in which one is not proficient also increases costs. Some of these costs may be mitigated by the presence of a large diaspora from one's home country. Some can be mitigated by studying with a faculty member of shared ethnicity.[15]

Costs and benefits to study in a particular country can change over time. By way of example, U.S. visa policy implemented after 9/11 made it substantially more difficult for students, especially in certain countries, to get a visa for study in the United States. Graduate student applications fell in 2004 by 25 percent, the first year the Council of Graduate Schools measured international applications, and by 5 percent in 2005. They increased by 12 percent in 2006 and returned to pre-9/11 levels by 2007 (Alden, 2008).[16] The doubling of funding for the National Institutes of Health (NIH) in the late 1990s and early 2000's greatly increased the demand for graduate students in the biomedical sciences in the United States and consequently increased the possibility of receiving funding for study in the U.S. The bursting of the Information Technology (IT) bubble in 2001 diminished the employment prospects of individuals trained in IT and engineering in the U.S. and thus the attractiveness of studying in the United States. The creation of the EU, with its seamless borders, significantly lowered the costs of students moving between countries in Europe for study. Likewise, the Bologna Reforms that sought to standardize credit hours and degree programs across Europe have facilitated the ease with which students can move between countries. Costs can also be affected by fluctuations in currency values (Chellaraj, Maskus and Mattoo 2008)

The decision to pursue postdoctoral training abroad depends upon many of the same factors as that to pursue doctoral study abroad, such as prestige of the training institution, research resources and future job prospects. Two factors, however, warrant special attention when it comes to the decision of where to do postdoctoral training: the salary provided to trainees and the fringe benefits provided to trainees. Although some of the foreign born who take a postdoc position outside their home country do so with support from

[15] Foreign students are more likely to work for faculty of the same ethnicity than to work for native-born faculty. A study by Esra Tanyildiz (2013) paired labs in eighty-two departments of engineering, chemistry, physics, and biology directed by a foreign faculty member with labs in the same department directed by a "native" principal investigator. The mean paired difference in staffing patterns tells the story: the difference for Chinese students in a laboratory directed by a Chinese principal investigator versus a laboratory directed by a native U.S. faculty member is 37.8 percent; for Korean students it is 29.0 percent; for Indian students it is 27.1 percent.

[16] For the 2004 academic year, graduate applications fell by 45 percent for students from China and by 28 percent from students from India (Council of Graduate Schools 2007).

their country of origin, most receive compensation from the host country and salaries and fringe benefits vary considerably across countries.[17]

In the United States, the National Institutes of Health has long prescribed salaries for postdoctoral fellows supported on training grants or fellowships by level of experience. Many universities have followed these guidelines, not only for postdocs supported on NIH grants but for other postdocs as well, both in and outside the fields of biomedical sciences.[18] In 2012 the starting salary prescribed by NIH was $39,264 and progressed to $49,884 for a postdoctoral fellow with five years of experience.[19]

Historically, postdocs in the United States received few fringe benefits and shared few of the working conditions enjoyed by faculty or staff. Although it may be apocryphal, in the late 1990s it was reported that postdocs at Stanford University did not have library privileges, being neither "fish nor fowl," that is, being neither student nor staff. Postdoc working conditions, as well as job prospects for an independent research career, have been sufficiently bleak to have led postdocs in the United States to form the National Postdoctoral Association in 2003. On some campuses, including Stanford, Yale, Johns Hopkins, the University of Illinois, and the University of Chicago, postdocs are either unionized or have formed a local association. The largest successful organizing campaign to date took place in 2008, when the California Public Employment Relations Board officially recognized the PRO/UAW (the Postdoctoral Researchers Organize/International Union, United Automobile, Aerospace and Agricultural Implement Workers of America) as representing postdocs on the ten-campus California System (Stephan P. , 2012, p. 169).

Over time, and partly in response to the pressure of the National Postdoctoral Association (NPA) and campus postdoctoral organizations, the presence and availability of fringe benefits has grown and working conditions have improved. A survey conducted by the National Postdoctoral Association in the fall of 2011 provides a snapshot view of benefits and working conditions available at that time. Care must be taken in interpreting the results, however, given that almost all of the responding institutions were members of the NPA and are predisposed to take better care of their postdocs than nonmembers. By way of summary, 79 percent of the responding institutions provided health insurance to postdocs; 76 percent provided health

[17] 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 sponsored postdoc 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).

[18] Some universities stipulate slightly higher levels of pay. Stanford University, which stipulates salaries which are approximately 4 to 9 percent above the NIH guidelines, depending upon years of experience, is a case in point. See http://postdocs.stanford.edu/handbook/salary.html (accessed January 17, 2013). See National Postdoctoral Association (2012) for a discussion of the number of institutions that adhere to NIH salary minimums.

[19] Despite the gentlemen's agreement that an individual not hold the position of postdoc for longer than five years, the NIH stipulates salaries for postdocs with up to seven years of experience. In 2012 the stipulated NIH salary for those with seven or more years of postdoc experience was $54,180. See http://grants.nih.gov/grants/guide/notice-files/NOT-OD-12-033.html (accessed January 17, 2013).

insurance to the postdoc's family, as well.[20] In terms of family leave, 39.5 percent of the institutions offered paid maternity leave; 27.6 percent offered paid paternity leave. With regard to paid vacation, 27 percent of postdocs who were classified as employees received none; 44 percent of those who were not classified as employees received none. In terms of holidays, 14.8 percent of postdoc employees received no paid holidays; 35 percent of the postdocs who were non-employees received no paid holidays. In terms of sick leave, 24 percent of employees received paid sick leave; 43 percent of the postdocs who were not employees received no paid sick days.[21]

It is difficult to get consistent data regarding the pay postdoctoral fellows receive in other countries or the availability of fringe benefits for postdoctoral fellows. But the evidence that does exist suggests that pay and benefits are often above or equivalent to those received in the United States. A postdoctoral fellow in Switzerland, for example, earns 5,200 CHF a month after taxes plus a "thirteenth"-month payment of the same amount in December. A postdoctoral fellow in Belgium (Flanders) with two years of experience received an annual salary of 47,200 (euros) before taxes in 2008; 25,836 euros after taxes and social contributions. In addition, Flemish postdocs received a year-end bonus of 843 euros and a holiday bonus of 1480.[22] Postdoctoral fellows in Germany receive beginning salaries between 3600 and 3926 euros a month, depending upon whether they are pursuing the Habilitation or hired directly into a "junior professor/postdoc position."[23] Not all countries pay postdoctoral salaries that are higher than those in the United States. Postdoc salaries in Canada range from $35,000 to $40,000 (Canadian dollars);[24] a postdoc in Italy receives approximately 25,000 euros.

Fringe benefits and working conditions also vary across countries. In Switzerland, for example, a citizen of the EU working as a postdoc is covered by Swiss unemployment insurance after working a minimum of two years. This means that if she loses her position as a postdoc or her contract ends she has the right to receive 80 percent of her salary for a maximum of two years. A postdoctoral fellow in Italy has five months of mandatory leave for the birth of a child during which she receives a full salary and can take up to three additional months at no pay. Postdocs in Germany receive a monthly family allowance of 150 euros if married and 154 euros per month for each of the first two children; for the third and subsequent children the

[20] At 23 percent of these institutions the postdoc paid nothing for his own health insurance; at 10 percent the postdoc paid 51 percent or more of the cost of his insurance. The comparable figures for family insurance are that 8 percent paid nothing; 18 percent paid 51 percent or more.
[21] National Postdoctoral Association Institutional Survey on Postdoctoral Compensation, Benefits and Professional Development Opportunities, released April 2, 2012.
[22] http://www.ugent.be/en/living/money/incomeresearcher.htm (accessed January 17, 2013).
[23] In order to qualify for a full professorship in Germany one typically did a Habilitation after receiving one's PhD, working as a research assistant for a full professor. Recent reforms allow individuals who first have the position "junior professor/postdoc" to qualify for a full professorship. The starting salary for those doing the Habilitation (A13) is 3600 euros. That for those doing the junior professor/postdoc option (W1) is 3926.84 euros.
[24] http://thenode.biologists.com/changes-in-canadian-postdoc-funding/ (accessed January 17, 2013).

family allowance increases substantially. Although no national comparisons exist, in most countries postdocs have longer paid vacation periods than in the United States and more holidays, reflecting national differences that place the United States at or near the top of OECD countries in terms of the average number of hours worked per year.[25] Postdocs in many countries are more likely to be provided with health insurance than in the United States, given the widespread presence of national health insurance plans in many countries.

3.2 Empirical studies of the choice to study abroad

Empirically, international flows of graduate students can be examined in several ways. One approach focuses upon migration patterns between a set of countries. Another focuses on international flows to a specific country or reasons for coming to study within a country. Almost all studies, to the best of our knowledge, examine flows after the decision to study abroad has been made; only one study to date has examined the decision to go abroad rather than to remain in the home country. No study has information regarding the choice set under consideration for students who choose to study abroad. No study, to the best of our knowledge, examines the decision to do a postdoc abroad.

Perkins and Neumayer (2011) use OECD data for the period 2005 to 2009 to model tertiary student flows between countries. They hypothesize that benefits to studying abroad are positively related to the per capita income and quality of education in the destination country as measured by the Times World University Rankings. They also argue that English speaking countries are likely to attract students, given the importance that English has assumed in recent years in both the business and scientific communities. Moreover, they argue that benefits can include the opportunity to study in a country that is less politically restrictive than one's country of origin. They argue that costs increase with visa restrictions and as the distance between source and destination countries grows; they also see costs as inversely related to the migrant stock of individuals from the destination country and the sharing of a common language. The data support most of their hypotheses. The English speaking variable, however, is never significant; the democracy variable is significant but has the wrong sign, and, in terms of magnitude of effects, the quality of education variable, while significant, has a minimal effect compared to many of the other variables.

Beine, Noël and Ragot (2012) use the same OECD data to examine student flows for the slightly earlier period 2004-2007. Cost variables included in the analysis are a measure of distance between the two countries, a measure of annual tuition fees, and the cost of living, including cost of rent and food, for an academic year. The authors also control for the existence of a common official language and a measure of the total migration stock from origin country i to destination country j as a proxy for network effects.

[25] See http://stats.oecd.org/Index.aspx?DatasetCode=ANHRS (accessed January 17, 2013).

Benefits relate to the number of universities classified in the Shanghai top 500 ranking in the country of destination. They find distance between countries to be a strong and negative predictor of the number of students flowing from one country to another. A common language facilitates mobility between countries. Flows also increase as the size of the network increases. Higher living costs in the destination country discourage mobility; more institutions ranked in the top Shanghai rankings increases mobility.

Bessey (2007) examines flows of international students to Germany for the years 1997-2002. The data, which count the number of incoming students at a given period in time to Germany who do not have a German "Abitur" (university entrance diploma) do not permit differentiation between graduate students vs. non-graduate students; nor do they permit differentiation between students on short-term study programs vs. those who have come to Germany for a longer period of study. She finds flows to be positively related to the population of the sending country and the stock of students from the country already studying in Germany. Flows are negatively related to distance (or a dummy variable for origin continents other than Europe) and to coming from a country that was judged "partly free" and "not free" on the Freedom House Index.

A logical extension of the human capital framework for analyzing study abroad is to think of the number of international students who study in a specific country as a function of the supply of those willing to come and the demand in the country for doctoral students, especially international doctoral students. Bound, Turner, and Walsh (2009) do precisely this, examining flows of international-PhD students to the United States for study in science and engineering during the period 1955-2005 using data from the Survey of Earned Doctorates. They argue that key factors affecting demand are growth in the number of students who have received a BA degree and are thus at risk of studying in the United States as well as changes in the political arena. They find a fairly strong relationship between the rate of growth in BA degrees in a country and the growth in PhDs awarded (7 years later) in the United States to citizens from that country. South Korea is a case in point, as is India. The case for China is even stronger. Examples of changes in political circumstances that have affected the demand for study in the United States are the opening of diplomatic relations between China and the United States in 1979; the collapse of the former Soviet Union, the fall of the Shah of Iran in 1979 and the taking of hostages at the American Embassy in Iran in 1979.

The supply of opportunities for foreigners to study in the United States also depends upon the demand for graduate training from U.S. students, as well as faculty demand for students to staff their labs. Bound, Turner and Walsh argue that while the supply of slots at top PhD programs is reasonably inelastic, at lower tier institutions the supply is considerably more elastic. They show that it is precisely these programs that witnessed the largest increase in foreign students.

Van Bouwel and Veugelers (2012) use data from the MORE survey of researchers conducted in 2010 to study the mobility decisions of European doctoral students. An initial criterion for inclusion in the study was the

presence of a mobility experience between Europe and the United States. However, those with no mobility experience or with mobility experience only within Europe were not excluded from the study. The authors model the decision to study abroad as well as the decision to study in a different country within Europe vs. the decision to study in North America. They find individuals in the life sciences and those from countries whose publications have a relatively higher Impact Factor to be more likely to remain at home vs. study abroad. When they examine whether one remains at home or goes to North America vs. elsewhere in Europe, they again find that relatively low Impact Factor of journal publications in the home country act as a push toward studying abroad, although the push is stronger for studying in Europe vs. studying in the United States. They also find that students from countries with a larger number of institutions in the top 500, as measured by the Shanghai rankings, are less likely to leave for study in Europe, although the variable is not significantly related to study in North America. They conclude that mobility for graduate study in Europe is more driven by push factors than is mobility for graduate study to North America.

Aslanbeigui and Montecinos (1998) study factors leading international students to pursue PhD-training in economics in the United States, surveying students in 51 programs. Reasons students give for coming include that few PhD programs in other countries are able to compete with those offered in the United States and the availability of financial support for study in the United States. Indeed, 55 percent of their respondents said that financial support was an important factor in their choice.

While the six studies provide examples of how benefits and cost affect flows of students, they also demonstrate challenges faced in studying flows. For example, data limitations preclude the first three studies from examining flows of doctoral students. Instead the three study flows of all tertiary students, regardless of graduate status. This is problematic in the sense that one would expect different variables to play a different role for graduate study vs. undergraduate study. The costs of tuition and living are a case in point. While most undergraduates pay for such expenses themselves, many graduate students are supported on stipends that cover both tuition and at least part of the cost of living while studying. The Bound, Turner and Walsh paper focuses exclusively on studying flows of students coming for PhD study. However, due to lack of data it focuses exclusively on students coming to the United States. Moreover, although the authors are able to measure certain key variables, such as the production of undergraduate degrees in the country of origin, they are not able to obtain measures of some other key variables, such as how financial support packages that students receive vary over time and across fields. A strength of the Van Bouwel and Veugelers' paper is that it includes individuals who remain in country for training and thus the authors can model the decision to leave one's home country for study. A weakness, however, is the low response rate of the survey (approximately 11 percent) and the fact that the survey initially focused on individuals who had had a mobility experience and thus oversamples individuals with mobility experiences. Moreover, although the authors model the selection process leading to mobility, they do not control for selection in estimating actual mobility

patterns. A key contribution of the Aslanbeigui and Montecinos study is that it actually asks students why they came and how they perceive benefits. Yet the study is limited to but one field and the data are only analyzed in a summary manner.

The above discussion suggests that in order to more fully understand what leads graduate students to study in one country rather than another one needs a data set on flows of doctoral students across a number of countries. One would also like to be able to differentiate between the decision to study abroad vs. the decision to go to a specific country for study abroad. The GlobSci data allow us to do precisely this for flows of PhD students. Another advantage of the GlobSci data for studying PhD flows is that the data include self-reported reasons for studying abroad which can be used to measure the importance of various costs and benefits to study abroad. Moreover, the data permit a fairly similar treatment of flows of postdoctoral scholars who also arguably make decisions about where they will go for training by weighing the benefits and costs of study abroad in a similar manner.

4. 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.[26] We then randomly picked a selection of 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.[27] 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.

[26] IF was taken from the latest available release of the Journal Citation Report of Thomson-Web of Science®.
[27] 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.

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. In the subsequent sections we will refer to this set of countries as "core countries". 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 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 encountered somewhat similar problems in a later effort to survey scientists in South Korea. We thus decided not to survey researchers based in China or South Korea.

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 eight other languages: French, Chinese, German, Italian, Japanese, Korean, 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 countries. The largest number of responses is for the United States (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.[28] Response rate bias is discussed in the Supporting Information of Franzoni, Scellato and Stephan (2012).

Table 1 Response rate for the 16 core countries

	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%**

Here we define the foreign born to be those who received their doctoral training or postdoctoral training in a country other than where they resided at age 18. We consider different sub-samples of the foreign born.

The first sample includes foreign born who received their PhD in a core country in 2000 or later, or are currently training in a core country. We refer to this group of 1129 as the **Recent-PhD** 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 core countries relocate to a country (such as China) that is not included in our survey. The second sample, with no time constraints, is restricted to those who resided in a core country at age 18 and received their PhD in a different country. We construct the second sample in this way in order to capture individuals who trained abroad but have subsequently returned to their home country. This **Core-Country PhD** sample has 1258 individuals in it. In a similar way we construct two subsamples for those who migrated for a postdoc position: a **Recent-Postdoc** sample of 1933 individuals and a **Core-**

[28] Walsh, Cohen and Cho (2005) find in a sample of U.S. scientists that undelivered emails accounted for approximately 3.2 percent. Roach and Sauermann (2010) find that undelivered emails accounted for 6.3 percent in a sample of junior U.S. scientists.

Country Postdoc sample of 5090 individuals. Table 2 summarizes the criteria for inclusion in the different samples used in the analyses. Since we will model the migration decision towards the US vs. other countries, in our estimates we do not include researchers who lived in the U.S. at age 18. In some model specification we will account for sample selection of the mobile researchers by using the full sample of respondents, including non-mobile ones.

Table 2 Criteria for inclusion in the sub-samples.

SAMPLE	NUM	CRITERIA
Recent PhD	1129	Respondents who received their PhD in 2000 or later in a country different from where they lived at age 18.
Core-Country PhD	1258	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	1933	Respondents who received their PhD in 2000 or later and had postdoctoral training in a country different from where they lived at age 18.
Core-Country Postdoc	5090	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 sub-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 summary statistics for selected countries.

A strength of the GlobSci survey is that it asked mobile researchers to assess on a five point scale the importance a number of factors played in their decision to study abroad. These factors can be broken into those that reflect benefits and those that reflect costs. On the benefit side, researchers were asked to assess the importance that the prestige/research excellence of the institution played in their decision to study abroad; the importance they ascribed to study abroad for improving their future career prospects and the appeal of the lifestyle or international experience in their decision to study abroad. On the cost side, they were asked the degree to which their study abroad was facilitated by contact with somebody (a professor, colleague, friend) in the host country, the availability of an exchange program or joint program between institutions, and the availability of financial support from the home country and from the host country for study. They were also asked to assess the importance that family and personal reasons played in their decision to study abroad.

Table 3 Summary statistics of sub-samples of PhD

SAMPLE	RECENT PHD	CORE-COUNTRY PHD
	mean	**mean**
Female	0.26	0.22
Age	38.27	47.34
Biology	0.23	0.30
Chemistry	0.24	0.26
Earth & Environment	0. 31	0. 27
Materials Science	0.22	0.17
Country of origin (selected)	%	%
AUSTRALIA	1.33	3.26
BELGIUM	0.8	1.99
BRASIL	3.45	11.84
CANADA	3.37	10.49
SWITZERLAND	1.42	2.62
CHINA	15.5	0
GERMANY	6.64	11.92
DENMARK	0.8	1.19
SPAIN	3.01	5.8
FRANCE	3.54	6.2
UK	2.13	7.71
INDIA	6.73	15.98
ITALY	9.39	14.31
JAPAN	1.06	3.42
KOREA	3.1	0
NETHERLANDS	0.89	2.31
RUSSIA	2.75	0
SWEDEN	0.71	0.95
OTHER	33.38	0
Country of PhD (selected)	%	%
AUSTRALIA	5.05	3.90
CANADA	4.78	6.20
SWITZERLAND	5.58	7.47
GERMANY	8.41	6.76
FRANCE	5.58	8.35
UK	13.46	16.69
USA	36.94	37.92
OTHER	20.2	12.71

Table 4 Summary statistics of sub-samples of Postdocs

SUB SAMPLE	RECENT POSTDOC	CORE-COUNTRY POSTDOC
	mean	**mean**
Female	0.25	0.20
Age	38.04	48.60
Biology	0.25	0.33
Chemistry	0.29	0.38
Earth & Environment	0.25	0.145
Materials Science	0.20	0.14
Country of origin	%	%
AUSTRALIA	2.83	4.03
BELGIUM	1.49	2.04
BRASIL	2.39	4.56
CANADA	4.57	5.95
SWITZERLAND	1.99	2.77
CHINA	7.86	0
GERMANY	9	11.10
DENMARK	0.65	1.38
SPAIN	9.05	12.24
FRANCE	11.44	12.36
UK	4.13	9.31
INDIA	5.67	8.61
ITALY	9.65	10.31
JAPAN	3.88	10.65
KOREA	1.29	0
NETHERLANDS	2.59	2.81
RUSSIA	1.79	0
SWEDEN	1.99	1.89
OTHER	17.74	0
Country of Postdoc (selected)	%	%
AUSTRALIA	4.28	2.37
CANADA	5.24	5.2
SWITZERLAND	4.83	4.38
GERMANY	8.91	7.66
FRANCE	5.64	6.71
UK	13.39	12.88
USA	38.97	46.38
OTHER	18.74	14.42

Those who did postdoctoral study outside the country of residence at age 18 were asked the importance of a slightly different set of factors regarding their reason for studying abroad. These include excellence/prestige of the foreign institution in my area of research; outstanding faculty, colleagues or research team; better research infrastructures and facilities; greater availability of research funds; better wage/monetary compensation; better fringe benefits (parental leaves, pension, insurance, ...); better working conditions (vacations, hours of work, ...); opportunity to improve my future career prospects; opportunity to improve my

future job prospects in the country where I lived when I was 18, appeal of the lifestyle or international experience; family or personal reasons and the opportunity to extend research networks.

Table 5 reports the definition of the variables used in estimates of the mobility equations. Note that factor analysis was been used to construct three of the variables included in the postdoctoral equations because of the presence of significant correlations among specific factors (See Section 6 for a discussion).

Table 5 definition and description of variables related to the motivation for training abroad (PhD and Postdoc)

Variables PhD migration	**Motivation for PhD abroad**
PRESTIGE	prestige/ research excellence of the institution
CAREER	opportunity to improve my future career prospects
CONTACT	contact with somebody (a professor, colleague, friend…) in the host country
LIFESTYLE	appeal of the life style or international experience
FAMILY	family or personal reasons
EXCHANGE_PROG	availability of an exchange or joint programs between institutions
FELLOWSHIP_HOST	fellowship that I obtained from the host country / institution
FELLOWSHIP_ORIGIN	fellowship that I obtained from the country where I lived when I was 18
NO_PROGRAM	few if any good PhD programs in the country where I lived when I was 18
Variables Postdoc migration	**Motivation for Postdoc abroad**
BENEFITS	better fringe benefits (parental leaves, pension, insurance, ...); better working conditions (vacations, hours of work, etc.)
RESEARCH_EXCELLENCE	excellence/ prestige of the foreign institution in my area of research; outstanding quality of faculty
SALARY	better wage / monetary compensation
RESEARCH_ENDOWMENT	greater availability of research funds; better research infrastructures and facilities
FAMILY	family or personal reasons
LIFESTYLE	appeal of the life style or international experience
CAREER	opportunity to improve my future career prospects
NETWORK	opportunity to extend my network of international relationships

5. Choice of PhD location

We explore factors related to the probability that students who leave their country of origin for PhD-training come to the United States versus go to another country. As discussed above, two different samples are used, depending upon the country of origin and time of study. For recent PhDs (2000 or later) we include all

individuals, regardless of their country of origin, who studied (or are studying) for a PhD in a country different from where they lived when they were 18. The second sample is restricted to those who resided in a core country at age 18 and received their PhD in a different country. Included in the analysis are self-reported measures of the importance that different factors played in the decision to study abroad. Country of origin dummy variables are also included. For the Core Country sample, time period dummies are included as well. The inclusion of country and time period dummies allow us to control implicitly for variables such as distance and size of diaspora that arguably do not change significantly over the time period of analysis or for which one cannot obtain time variant measures. Table 6 reports marginal effects of probit models for the different subsamples[29].

Models II and IV control for the absence of a program in the home country; Models I and III do not. All models contain time period dummies for PhD year of respondents (70s, 80s, 90s, while the omitted time period is 2000s). For the Core Country sample (Models I and II) we find that those who place a higher weight on the prestige/research excellence of the institution as a reason for attending are more likely to train in the United States than elsewhere. Those who reported that opportunities for career advancement played a strong role in their decision to go abroad for study are also more likely to train in the United States as are those who report placing higher importance on the role that contacts played in facilitating their study abroad. Likewise, those who reported that the unavailability of a program in their home country (Model II) played an important role in their studying abroad are more likely to study in the United States. On the other hand, the availability of exchange programs plays an important role in encouraging individuals to go elsewhere than the United States for study, likely reflecting the ease of moving across EU borders. Those who report that the appeal of lifestyle or international experience played an important role in their decision of where to pursue a PhD were significantly less likely to attend PhD programs in the United States than to go elsewhere for study. Family factors discourage individuals (at the 10 percent level in Model II) from coming to the United States for PhD study. Gender is not significantly related to coming to the U.S. for training. Canadians, Indians and Japanese are significantly more likely to train in the United States than are those from Sweden (the omitted origin country dummies).[30] Italians are significantly less likely. With regard to time trends, we find that there has been a significant contraction in the relative attractiveness of the U.S. for Ph.D. students during the 2000's (the omitted time period dummy). As a robustness check we run the probit model for the Core-Country sample using response rates as observation weights. The results, which are very similar to those presented in Table 6, are reported in the Appendix.

[29] Marginal effects are computed at means of independent variables.
[30] Estimated effects for origin country dummies are not reported in the table but are available from the authors.

Table 6 Decision to take a PhD in the US.

Samples	Core Countries PhD		Recent PhD		Core Countries PhD	
					Second stage	Selection Eq. PhDabroad=
Dep Variable	PhD US =1	PhD US =1	PhD US =1	PhD US =1	PhD US=1	1
Models	I	II	III	IV	V	VI
PRESTIGE	0.044***	0.040**	0.059***	0.054***	0.042**	
	(0.016)	(0.016)	(0.019)	(0.019)	(0.019)	
CAREER	0.062***	0.059***	0.031	0.026	0.059**	
	(0.018)	(0.018)	(0.022)	(0.023)	(0.024)	
CONTACT	0.021*	0.022**	0.010	0.009	0.021*	
	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)	
LIFESTYLE	-0.036***	-0.037***	-0.060***	-0.064***	-0.033*	
	(0.014)	(0.014)	(0.015)	(0.016)	(0.018)	
FAMILY	-0.018	-0.020*	-0.006	-0.006	-0.014	
	(0.011)	(0.011)	(0.013)	(0.013)	(0.013)	
EXCHANGE_PROG	-0.032**	-0.033**	-0.076***	-0.076***	-0.026*	
	(0.013)	(0.013)	(0.015)	(0.015)	(0.015)	
FELLOW_HOST	-0.001	-0.003	0.029**	0.027**	0.001	
	(0.011)	(0.011)	(0.013)	(0.013)	(0.011)	
FELLOW_ORIGIN	-0.010	-0.010	-0.005	-0.009	-0.003	
	(0.013)	(0.013)	(0.015)	(0.015)	(0.012)	
NOPROGRAM		0.034***		0.041***		
		(0.012)		(0.013)		
PHD_70	0.137**	0.136**			0.235***	-0.117**
	(0.057)	(0.057)			(0.078)	(0.055)
PHD_80	0.118**	0.118**			0.251***	-0.159***
	(0.047)	(0.047)			(0.062)	(0.046)
PHD_90	0.095***	0.103***			0.147***	-0.066*
	(0.036)	(0.036)			(0.052)	(0.038)
FEMALE	0.015	0.018	-0.012	-0.017	0.090*	-0.085**
	(0.037)	(0.037)	(0.036)	(0.037)	(0.047)	(0.038)
AVG_NOPROGRAM						0.068**
						(0.032)
Constant					1.105***	-1.313***
Country origin dummies	Yes	Yes	Yes	Yes	Yes	
Field dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,258	1,258	1,129	1,129	1,258	11,228
Wald Chi-sq	284.901***	283.477	283.609	285.986	117.232***	
Pseudo R-sq	0.190	0.195	0.230	0.237		
Chi-sq LR Indep Eq.					2.82*	

Heteroskedasticity-robust standard errors in parenthesis. Significance levels: *90% ,**95%,***99%
Marginal effects for probit models on the sub-sample of Core Countries PhD (Model I-II) and Recent PhD (Models III– IV). Heckman probit sample selection model on the sub sample of Core Country PhD (Models V-VI).

The results are somewhat similar for the Recent PhD sample (Models III and IV) as for the Core Sample. Prestige/research excellence is positively and significantly related to coming to the United States for study as

is the unavailability of programs; lifestyle factors and availability of exchange programs discourage students from coming to the United States versus going elsewhere for study. For this sample, but not for the more restricted sample, we find that those who report that financial assistance from the host country played a strong role in their decision of where to train are more likely to study in the United States. In results not reported here, we also find that China is significantly more likely to send students for study to the U.S. than any other country.

As discussed above, the choice to study abroad can be considered a two-stage process in which the student first makes a decision regarding whether to seek training abroad and subsequently, if the decision is positive, decides where to study. This suggests that rather than model where one trains, conditional upon the decision to leave one's country of origin for training, one first model the probability that a student decides to go abroad for training and, having controlled for selection, proceed to model where individuals who choose to train abroad actually train. While such an approach is arguably a more appropriate estimating strategy, its execution requires data for all individuals who received a PhD, not simply those who received a PhD abroad. The GlobSci survey provides such data, but only for individuals from Core Countries; not for those from non-core countries. Thus we can only model selection for those in the Core Country sample.

We use this sample to estimate a two-stage model of the probability that an individual: i) chose to receive training outside his or her country of residence at age 18 and ii) selects the U.S. as the training destination country vs. another country. The model follows a standard Heckman sample selection approach[31]. The variables used in the selection equation measures the availability of appropriate programs for study in the home country. The measure (AVG_NOPROG) is computed as the country average given by those who chose to train outside their country of origin to the reason "few if any good PhD programs in the country where I lived when I was 18" for training abroad. By construction the variable provides a time-averaged indication of the perceived lack of PhD programs in a specific country.[32]

Estimates of the sample selection model are presented in Table 6, columns V and VI. We begin by noting that the AVG_NOPROG variable is a positive and significant predictor that the student chooses to leave the country of origin for training. We also find that women are less likely to leave for PhD training than are men. Once we control for selection in estimating the probability of training in the United States vs. elsewhere, we find the results to be qualitatively similar to those found without correction for selection. It is interesting to note that although women are less likely to leave their home country for study abroad, conditional upon leaving, women are more likely to come to the U.S. for PhD study than go elsewhere.

[31] The model has been estimated with the Heckprob routine of the econometric software Stata 11.
[32] The average effect is because the variable is constructed based on answers of individual who have migrated from a country at different points in time.

Table 7 presents results from a multinomial logit model for the decision to attend a PhD program in the U.S. vs. attend a program in six other countries (Australia, Canada, France, Germany, Great Britain and Switzerland), each of which account for 4 percent or more of the foreign-trained Core sample. Collectively, these six countries plus the U.S. bestowed about 87% 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 table reports relative risk ratios[33]. The coefficients on the variable PHD YEAR should help in identifying which countries are taking the U.S. share of foreign born PhD students.

The results suggest that students who place a higher value on lifestyle factors as a reason for where they train are more likely to go to France, Great Britain, Australia and Canada (10 percent level of significance for France and Australia) than come to the U.S. for study. Family reasons play a role in attracting mobile students to Australia, Switzerland, and Germany (10 percent level) vs. coming to the U.S. for study. Individuals who rate the prestige of the hosting institution higher as a reason for choosing a program are less likely to study in Australia, Canada and France (10 percent level) than come to the U.S. for study and more likely to go to Switzerland (10 percent level). Career prospects lead students to choose PhD programs in the U.S. vs. Canada and France. Contacts play a role in drawing students to the U.S. rather than to Germany, Great Britain and Switzerland (10 percent level). The availability of financial support for study provided by the host country leads students to choose Australia, Switzerland and Canada (10 percent level latter two) over the United States. The availability of exchange programs encourages students to attend programs in the EU and discourages students from attending programs in Switzerland (10 percent level) relative to the United States, consistent with the hypothesis that exchange programs benefit PhD programs in the EU by attracting students from other EU countries. Three countries have been nibbling on the U.S. PhD share in recent years: Australia, Switzerland and Germany while there is some support for the hypothesis that Canada has been losing PhD students to the United States.

By way of summary, the empirical results, regardless of which of the two samples we use, support the hypothesis that benefits as well as costs play a role in determining where students go for PhD study. The findings remain qualitatively similar after controlling for selection. In terms of benefits, the prestige of U.S. program and/or career prospects associated with training in the United States leads individuals to come to the United States to study rather than to go elsewhere. For the recent sample, the availability of financial assistance also plays a role, consistent with the hypothesis that students are sensitive to the cost of training

[33] The application of a multinomial probit model with sample selection based on the use of an inverse Mills' ratio proved unsuccessful because of difficulties in the treatment of the maximum likelihood function. For this reason we adopted a standard multinomial logit model. Previous evidence for the probit models with and without correction for sample selection suggests that results are not affected by selection in terms of sign and confidence level. We have tested for the i.i.a. assumption of the multinomial logit specifications through Hausman tests based on the mlogtest routine for Stata 11.

when making their decisions regarding where to study.[34] The importance of cost factors is further underlined by the fact that exchange programs, which are widely available within the EU, discourage individuals from studying in the United States vs. going elsewhere for study. The U.S. lifestyle clearly detracts from individuals coming for study in the United States: regardless of sample, and regardless of estimating strategy, those who report that lifestyle played an important role in their decision of where to study are less likely to come to the U.S. vs. go elsewhere for study. Countries where lifestyle factors play a role in attracting students are Australia, Canada, France and Great Britain. Evidence from the Core Country 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 are Australia, Germany and Switzerland.

Table 7 Decision to take a PhD. US versus six alternative destinations.

PhD Country	Australia	Canada	Switzerland	Germany	France	Great Britain
PRESTIGE	0.567***	0.736**	1.312*	0.974	0.767*	0.915
	(0.096)	(0.098)	(0.205)	(0.146)	(0.114)	(0.100)
CAREER	0.747	0.672***	0.797	0.985	0.512***	0.914
	(0.141)	(0.096)	(0.123)	(0.168)	(0.077)	(0.109)
CONTACT	0.895	0.948	0.843*	0.780**	0.950	0.814***
	(0.107)	(0.089)	(0.078)	(0.077)	(0.091)	(0.056)
LIFESTYLE	1.339*	1.266*	1.107	0.931	1.564***	1.217**
	(0.202)	(0.158)	(0.139)	(0.112)	(0.212)	(0.111)
FAMILY	1.293**	1.138	1.249**	1.201*	0.995	1.078
	(0.152)	(0.106)	(0.125)	(0.118)	(0.100)	(0.078)
EXCHANGE_PROG	0.907	0.913	0.810*	1.556***	1.556***	1.179**
	(0.146)	(0.114)	(0.099)	(0.167)	(0.155)	(0.091)
FELLOW_HOST	1.553***	1.216*	1.213*	1.002	0.876	0.953
	(0.230)	(0.130)	(0.123)	(0.104)	(0.086)	(0.069)
FELLOW_ORIGIN	1.176	1.029	0.789**	1.056	1.112	1.148*
	(0.172)	(0.119)	(0.093)	(0.114)	(0.108)	(0.083)
NOPROGRAM	0.870	0.752**	0.863	0.900	0.789**	0.910
	(0.125)	(0.087)	(0.089)	(0.093)	(0.081)	(0.067)
FEMALE	1.153	0.791	0.900	1.069	1.097	0.870
	(0.467)	(0.280)	(0.282)	(0.325)	(0.325)	(0.201)
PHD YEAR	1.036**	0.978*	1.034**	1.055***	0.998	1.005
	(0.018)	(0.012)	(0.016)	(0.016)	(0.014)	(0.010)
Country origin dummies	Yes					
Field dummies	Yes					
Observations	1,098					
Wald Chi-sq	926.5***					
LogLik	-1335.430					
PseudoR-sq	0.258					

Significance levels: *90% ,**95%,***99%. Multinomial logit model for PhD destination. Estimates based on the Core country PhD sample. Baseline outcome: USA. Relative risk ratios reported.

[34] Its lack of significance in the Core Country Sub-sample may reflect the absence of individuals in the sample from countries such as China and South Korea, for whom financial assistance may be critical.

6. Choice of postdoc location

We employ a similar strategy to that which we used in studying PhDs to estimate the probability that a postdoc who trains outside his or her country of origin comes to the United States vs. go elsewhere. The independent variables, however, are somewhat different, reflecting the fact that those who left the country for postdoctoral training were asked slightly different (and more) questions regarding the importance that various factors played in their decision to leave the country for training. In three instances we use factor analysis to group together variables that are highly correlated. In particular, we create the variable BENEFIT based on responses to the importance that fringe benefits (parental leaves, pension, insurance, etc.) and working conditions (vacations, hours of work, etc.) played in the decision of where to train; the variable RESEARCH_ENDOW, based on responses to the postdoc's assessment regarding the importance of the research infrastructure and facilities and availability of funds for research in the decision as to where to train; and the variable RESEARCH_EXCELLENCE, based on responses to the question regarding the importance of the prestige of the institution and the quality of faculty and colleagues in making the decision regarding where to train.

Results for the Core Country Postdoc sample are presented in columns I-II; those for the Recent Postdoc sample are presented in column III-IV of Table 8. To check for robustness, we also estimate the two postdoc models with and without controlling for whether the individual received his or her PhD in the United States (dummy variable PHD US in models II and IV). While the variable is positive and highly significant in all models, its inclusion has little effect on the marginal effects of the other variables. For the Recent Postdoc sample, we find that RESEARCH_EXCELLENCE plays a positive and significant role in the decision to train in the United States vs. elsewhere. Fringe benefits and working conditions provided for postdocs in the United States (BENEFIT) prove to be a definite detractor for coming to the U.S., consistent with the hypothesis that the relatively low level of fringe benefits and poor working conditions provided by U.S. institutions to postdocs impose a cost on postdocs studying in the United States. The opportunity to extend one's network is seen as detracting from the decision to train in the U.S., vs. elsewhere, at the 10 percent level of significance. This may reflect the dominance of individuals from EU countries in the sample and the attractiveness of working with researchers in other countries in close proximity, after study, in the decision regarding where to train. Other factors are not found to be significantly related to the decision to train in the U.S.

Table 8 Decision to take a Postdoc in the US.

Samples	Core Countries Postdoc		Recent Postdoc		Core Countries Postdoc	
Models	Postdoc US=1		Postdoc US=1		Second stage Postdoc US=1	Selection Postdoc abroad=1
	I	II	III	IV	V	VI
BENEFITS	-0.083***	-0.081***	-0.108***	-0.117***	-0.206***	
	(0.012)	(0.012)	(0.020)	(0.021)	(0.030)	
SALARY	0.012	0.008	0.016	0.015	0.031	
	(0.009)	(0.009)	(0.014)	(0.014)	(0.022)	
RESEARCH EXCELLENCE	0.070***	0.068***	0.105***	0.095***	0.174***	
	(0.012)	(0.012)	(0.019)	(0.020)	(0.029)	
RESEARCH ENDOWMENT	0.047***	0.043***	-0.010	-0.020	0.121***	
	(0.012)	(0.012)	(0.021)	(0.022)	(0.030)	
FAMILY	-0.014**	-0.019***	-0.010	-0.013	-0.029*	
	(0.007)	(0.007)	(0.010)	(0.011)	(0.016)	
LIFESTYLE	-0.017**	-0.013*	-0.034***	-0.034**	-0.045**	
	(0.008)	(0.008)	(0.012)	(0.013)	(0.019)	
CAREER	0.035***	0.034***	0.028	0.035*	0.085***	
	(0.011)	(0.011)	(0.020)	(0.021)	(0.027)	
NETWORK	-0.031***	-0.019**	-0.029*	-0.002	-0.082***	
	(0.009)	(0.009)	(0.015)	(0.017)	(0.023)	
PHD US		0.368***		0.574***		
		(0.027)		(0.027)		
PHD ABROAD						0.731***
						(0.043)
FEMALE	-0.018	-0.020	-0.011	-0.009	-0.084*	-0.212***
	(0.019)	(0.019)	(0.028)	(0.030)	(0.049)	(0.030)
PHD_70	0.149***	0.152***			0.416***	0.343***
	(0.025)	(0.025)			(0.064)	(0.043)
PHD_80	0.110***	0.118***			0.313***	0.302***
	(0.022)	(0.022)			(0.055)	(0.036)
PHD_90	0.048***	0.054***			0.165***	0.309***
	(0.019)	(0.019)			(0.048)	(0.030)
Constant					-0.273	-0.384***
					(0.222)	(0.096)
Country origin dummies	Yes	Yes	Yes	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,090	5,090	1,933	1,933	5,090	11,228
Wald Chi-sq	561.0***	634.3***	326.738	562.665	596.5***	
LogLik	-3188.604	-3114.867	-1128.481	-1010.517	-10247.180	
Pseudo R-sq	0.091	0.112	0.126	0.218		
LR Test indep eq.					6.12**	

Significance levels: *90% ,**95%,***99%. Marginal effects for probit models on the sub-samples Core Country Postdoc (Models I-II) and Recent Postdoc (Models III – IV). Heckman probit sample selection model on the sub sample of Core Country PhD (Models V-VI).

RESEARCH_EXCELLENCE also plays a positive and significant role in the decision to train in the U.S. vs. elsewhere for individuals who hail from core countries and study abroad (Column I and II, Table 8). But Research Excellence is not the only factor that attracts individuals to the U.S. from core countries for postdoctoral training. RESEARCH_ENDOWNMENT also plays a significant and positive role, as does the opportunity to improve future career prospects. When it comes to costs, the fringe benefits and working conditions provided by U.S. institutions to postdocs are found to significantly detract from coming to the U.S., as are family reasons and the perceived lifestyle in the U.S. With regard to home country, compared to Swedes, Japanese are more likely to come to the U.S. to do a postdoc while Australians, and those from Brazil, Australia, Spain, Italy and the Netherlands are less likely to come.[35] We also find evidence that the probability of coming to the U.S. for postdoctoral work has declined over time.

As in the case for PhD study, one could argue that the decision to train outside one's country of nativity is a two stage process, where first one decides whether to train abroad and then one decides, conditional upon going abroad, where to go. In order to account for this selection process, we estimate a two stage-model, where in the first stage we model the decision to have a postdoc abroad and in the second stage we model whether the destination country is the U.S. vs. all other countries. As above, we estimate the two-stage model only for the Core Country Postdoc sample for which we have observations on those who did not leave the country. The selection equation includes the dummy variable "PHD ABROAD" which equals one for those respondents who migrated for their PhD. The variable is highly significant in the selection equation; the variable FEMALE is negative and significant, indicating that women are less likely to leave their country for postdoctoral training. The coefficients in the second stage of the equation are quite similar in terms of sign and significance to those of the equation in which we do not control for selection.

Multinomial logit results for the decision to do a postdoc in the United States (baseline) vs. train in one of six other countries are presented in Table 9. The strength of this approach is that it permits one to see if variables play different roles in the decision to go to specific countries vs. come to the U.S. for training. Perhaps not surprisingly, there is evidence that the effects vary considerably by country. By way of example, RESEARCH ENDOWMENT attracts individuals to Switzerland rather than the United States, but leads people to favor the United States over Australia, France, and Great Britain. RESEARCH EXCELLENCE is reported as playing a strong role in coming to the United States for postdoc work vs. going to Australia, Canada or France. Career prospects play a significant role in the decision to come to the United States vs. go to Australia, France, Germany and Switzerland. The possibility of enhancing one's network draws researchers to Germany and Great Britain vs. coming to the United States, while the lifestyle of Australia and Great Britain (10 percent level) draws researchers to these countries. Respondents rate benefits and working

[35] Estimated effects for origin country dummies are not reported in the table but are available from the authors.

conditions as playing a positive and significant role in attracting them to all countries save Switzerland vs. coming to the United States. On the other hand, postdoctoral salaries discourage postdocs from going to Canada and France vs. the United States, but not surprisingly, given the generous support provided, encourage them gong to Switzerland. Finally, in terms of time trends, with the exception of Canada, all countries have been nibbling on the United States' share of postdoctoral trainees. In the Appendix we show the results for a multinomial logit model specification in which we also control for the fact that an individual had a PhD in the US.

Table 9 Decision to take a Postdoc. US versus six alternative destinations.

Postdoc Country	Australia	Canada	Switzerland	Germany	France	Great Britain
BENEFITS	1.890***	1.391***	1.118	1.478***	1.508***	1.169**
	(0.307)	(0.163)	(0.121)	(0.138)	(0.154)	(0.090)
SALARY	1.038	0.779***	1.353***	0.969	0.853**	0.982
	(0.132)	(0.069)	(0.111)	(0.069)	(0.066)	(0.055)
RESEARCH EXCELLENCE	0.579***	0.546***	0.947	0.944	0.747***	0.934
	(0.079)	(0.053)	(0.114)	(0.089)	(0.069)	(0.070)
RESEARCH ENDOWMENT	0.603***	1.097	1.317**	1.052	0.712***	0.700***
	(0.104)	(0.126)	(0.167)	(0.106)	(0.074)	(0.053)
FAMILY	1.027	1.120*	1.049	1.048	1.073	1.000
	(0.088)	(0.065)	(0.066)	(0.054)	(0.059)	(0.042)
LIFESTYLE	2.262***	1.074	0.991	0.981	1.079	1.087*
	(0.301)	(0.078)	(0.076)	(0.059)	(0.069)	(0.053)
CAREER	0.660***	1.072	0.806**	0.756***	0.793***	0.937
	(0.097)	(0.107)	(0.086)	(0.064)	(0.071)	(0.067)
NETWORK	1.112	1.016	1.021	1.209**	1.097	1.165**
	(0.150)	(0.087)	(0.093)	(0.091)	(0.087)	(0.071)
FEMALE	0.865	1.006	1.055	0.942	1.363**	1.210*
	(0.233)	(0.186)	(0.199)	(0.141)	(0.197)	(0.137)
PHD YEAR	1.050***	0.994	1.024***	1.021***	1.021***	1.018***
	(0.012)	(0.006)	(0.008)	(0.006)	(0.006)	(0.005)
Country origin dummies	Yes					
Field dummies	Yes					
Observations	4,259					
Wald Chi-sq	1432.3***					
LogLik	-5478.0					
Pseudo R-sq	0.116					

Significance levels: *90% ,**95%,***99%. Multinomial logit model for Postdoc destination. Estimates based on the Core country Postdoc sample. Baseline outcome: USA. Relative risk ratios reported.

By way of summary, the empirical results, regardless of which of the two samples are used, support the hypothesis that individuals come to the United States for postdoctoral study because of the research excellence of its programs. But the level of fringe benefits and the quality of working conditions detract from individuals coming to the U.S., as does the lifestyle. When we restrict the sample to those living in one of the sixteen core countries at age 18 we find that the research infrastructure and facilities and the availability of funds for research (RESEARCH_ENDOWMENT) also play a significant role in attracting individuals to the U.S. for postdoctoral training as does the opportunity to enhance one's career prospects. Family, and the opportunity to extend one's network, however, lead individuals to go elsewhere for training. The same findings persist in determining whether postdocs come to the United States or go to one of six other countries for training when we estimate a multinomial logit model; however, not all effects hold for all countries nor have the same directional effects. Finally, we find evidence that all countries, save Canada, have been nibbling at the U.S. postdoc share.

7. Conclusion and Discussion

The GlobSci data provide the most comprehensive view that currently exits of the flows of scientists across the sixteen countries. The data also have the advantage that they include individuals from emerging countries such as India and Brazil as well as from non-European and non-American countries of Australia and Japan. Moreover, the data provide insights as to what factors played a significant role in the decision behind going abroad to the destination country for training and provide some insight into how perceived benefits and costs affect the decision to train abroad. Another advantage of the data is that for the sixteen core countries the selection process can be modeled and controlled for, in the sense of who among those who get a PhD or train for a postdoc choose to leave the country vs. stay in country for study or training.

The data are not, however, without limitations. In particular, we were unable to collect data from scientists currently working in China or South Korea. 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. For each of the two decisions, we use two 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 subsequent to training. The second sample, referred to as the Core Country sample, focuses only on individuals from the sixteen core countries and thus censoring presents less of a problem.

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 a 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 exchange programs elsewhere. The evidence from the Core Sample suggests that there has been a significant decline in recent years in the probability of receiving a PhD in the United States vs. receiving one from another country. The data suggest that Switzerland, Germany and Australia have been nibbling at the U.S. share.

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. For both the Recent Sample and the Core Sample we find that the prestige of the host institution and the quality of faculty and colleagues draws individuals to the United States for training. The quality of the research infrastructure and facilities and the availability of funds for research also play a role in attracting individuals from Core Countries to do postdoctoral work in the United States as do career prospects associated with training in the U.S. In general, the perceived lifestyle in the United States and family reasons discourage foreign born individuals from coming. The level of fringe benefits and the quality of working conditions available to postdoctoral scholars in the U.S. discourage individuals from doing postdoctoral work in the U.S. vs. elsewhere. This finding will hardly come as a surprise to postdocs in the United States who lack paid health insurance coverage -especially for their families- and a formal family leave policy and have few if any specified holidays or vacation days. The availability of fringe benefits and the quality of working conditions, however, is changing in the United States and in future these factors may play less of a role in discouraging individuals from coming to the U.S. for training. Finally, we find that the foreign born are increasingly drawn to five of the six alternative countries that we model - Australia, France, Germany, Switzerland and the UK. The exception is that we find no evidence that Canada is a competitor at the postdoctoral level.

What do our results suggest concerning the ability of the United States to continue to attract the foreign born for PhD study and postdoctoral training? First, our results suggest that the U.S.'s ability to continue to draw individuals to come for training depends upon its ability to remain a top producer of research. At a minimum, this requires directing resources to university research. In recent years the flow of resources to

universities for research and development has been almost flat in real terms except for the two years that American Recovery and Reinvestment Act (ARRA) funding was available, and Federal budget problems mean that resources could decline in the future (National Science Foundation, 2011; National Science Foundation, 2012b). Second, career prospects play a role in attracting individuals for training to the United States. In recent years prospects in the United States have not been stellar. Career prospects, however, are relative and compared to many European countries the United States has been doing reasonably well when it comes to employment opportunities for newly-trained scientists. Third, visa policies both in the United States and elsewhere play a role in where the foreign born go for study and postdoctoral training. Policies implemented in the wake of 9/11 affected flows to the United States and policies of other countries have affected flows. Visa reform in the U.S., which is a topic of current discussion, has the potential of affecting future flows of trainees to the U.S. Fourth, in the long run the real challenge to the United States' training hegemony is likely to come from China --not from Europe-- in terms of retaining native students for PhD study and postdoctoral training as well as attracting foreign students to China for training. In the short run, however, the tremendous growth in the number of undergraduates in training in China should increase the demand for those coming abroad for training[36]. The Chinese have had a strong tradition of coming to the United States and that is unlikely to change in the near future.

[36] In 2002, there were 884,000 bachelor's degrees awarded in China in S&E compared with 475,000 in the United States (National Science Foundation, 2007). The dramatic investment that China is making in higher education is expected to produce 195 million community college and university graduates by the end of the decade. Many, but not all, will have degrees in science and engineering. http://www.nytimes.com/2013/01/17/business/chinas-ambitious-goal-for-boom-in-college-graduates.html (accessed January 25, 2013).

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Appendix

A.1 Sample weights

In the set of estimates presented in tables A1 and A2 we use probability weights equal to the inverse of the complete response rate of the related core-country panel.

Table A1 Probit model with probability weights.

Dep Var	PhD US=1
PRESTIGE	0.043***
	(0.016)
CAREER	0.061***
	(0.019)
CONTACT	0.021*
	(0.011)
LIFESTYLE	-0.038***
	(0.014)
FAMILY	-0.020*
	(0.012)
EXCHANGE_PROG	-0.028**
	(0.014)
FELLOW_HOST	-0.006
	(0.012)
FELLOW_ORIGIN	-0.008
	(0.013)
PHD_70	0.139**
	(0.057)
PHD_80	0.126***
	(0.048)
PHD_90	0.106***
	(0.037)
FEMALE	0.020
	(0.038)
Country dummies	Yes
Field dummies	Yes
Observations	1,258

Estimation based on Core-country PhD sample. Equivalent to Table 6 column I.

Table A2 Probit model with probability weights.

Dep var	US Postdoc=1
BENEFITS	-0.080***
	(0.012)
SALARY	0.007
	(0.009)
RES_EXCELLENCE	0.063***
	(0.012)
RESEARCH_ENDOW	0.042***
	(0.013)
FAMILY	-0.022***
	(0.007)
LIFESTYLE	-0.015*
	(0.008)
CAREER	0.036***
	(0.011)
NETWORK	-0.019**
	(0.010)
US PHD	0.370***
	(0.026)
FEMALE	-0.016
	(0.019)
PHD_70	0.153***
	(0.025)
PHD_80	0.119***
	(0.022)
PHD_90	0.054***
	(0.019)
Country dummies	Yes
Field dummies	Yes
Observations	5,090

Estimation based on Core-country Postdoc sample. Equivalent to Table 8 column II.

A.2 Alternative model specifications

Below we present the multinomial logit model specification for postdoc abroad in which we also control for the fact that a respondent migrated to the US for a PhD.

Table A3 Multinomial logit model for Postdoc destination.

Postdoc Country	AUS	CAN	CHE	DEU	FRA	GBR
BENEFITS	1.908***	1.381***	1.106	1.474***	1.500***	1.158*
	(0.313)	(0.163)	(0.121)	(0.139)	(0.155)	(0.090)
SALARY	1.045	0.789***	1.376***	0.981	0.865*	0.996
	(0.133)	(0.071)	(0.114)	(0.071)	(0.068)	(0.056)
RES_EXCELLENCE	0.579***	0.545***	0.946	0.947	0.743***	0.934
	(0.080)	(0.053)	(0.115)	(0.090)	(0.070)	(0.071)
RESEARCH_ENDOW	0.611***	1.129	1.365**	1.077	0.726***	0.715***
	(0.105)	(0.131)	(0.175)	(0.110)	(0.076)	(0.055)
FAMILY	1.042	1.150**	1.081	1.074	1.103*	1.028
	(0.090)	(0.068)	(0.069)	(0.056)	(0.062)	(0.044)
LIFESTYLE	2.248***	1.062	0.962	0.966	1.062	1.068
	(0.301)	(0.078)	(0.075)	(0.059)	(0.069)	(0.053)
CAREER	0.658***	1.078	0.809**	0.762***	0.794**	0.937
	(0.097)	(0.108)	(0.087)	(0.065)	(0.071)	(0.068)
NETWORK	1.073	0.964	0.972	1.147*	1.039	1.105
	(0.146)	(0.083)	(0.090)	(0.087)	(0.083)	(0.068)
US PHD	0.295***	0.180***	0.143***	0.230***	0.135***	0.132***
	(0.129)	(0.079)	(0.068)	(0.070)	(0.059)	(0.046)
FEMALE	0.865	1.015	1.065	0.958	1.388**	1.223*
	(0.234)	(0.188)	(0.202)	(0.145)	(0.202)	(0.140)
PHD_year	1.051***	0.995	1.026***	1.023***	1.022***	1.019***
	(0.012)	(0.007)	(0.008)	(0.006)	(0.007)	(0.005)
Field dummies	Yes					
Country dummies	Yes					
Observations	4,259					
Chi2	1559.417					
LogLik	-5414.483					
PseudoR2	0.126					

Estimates based on the Core country Postdoc sample. Baseline outcome: USA. Relative risk ratios reported. Model specification with the inclusion of the US PHD dummy.