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Original Article

Global competition for scientific talent: evidence from location decisions of PhDs and postdocs in 16 countries

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Abstract

We analyze the decisions of foreign-born PhD and postdoctoral trainees in four natural science fields to come to the United States vs. go to another country for training. Data are drawn from the GlobSci survey of research scientists in 16 countries. A major reason individuals report coming to train in the United States is the prestige of its programs and/or career prospects; perceived lifestyle in the United States is a major factor individuals report for training elsewhere. The availability of exchange programs elsewhere is associated with fewer PhD students coming to the United States. The relative unattractiveness of fringe benefits in the United States is associated with going elsewhere for postdoctoral training. Countries that have been nibbling at the US 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.

JEL classification: F22,J24,J61

1. Introduction

The United States plays a leading role in educating foreign-born doctoral researchers in science and engineering, training more than 4 times as many foreign doctoral students as the UK, 10 times more than Spain, 10 times more than Switzerland and Sweden combined, and 12 times more than Australia. But the United States, as these data clearly show, is not alone in training the foreign-born. In 2004, for example, 22.4% 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 (EU) countries (IISER, 2007). More importantly, in recent years, the number of PhD degrees awarded to foreigners has grown considerably in Europe, as well as in Canada and Australia. For example, in 1999, only 14.8% of students enrolled in graduate programs in the natural sciences and engineering in Canada were

foreign; by 2008, the number had increased to 25.6% (National Science Board, 2012: Tables 2–42). In the UK, the percent of foreign students in graduate programs in the natural sciences and engineering increased from 28.8% in 1998–1999 to 51.2% in 2008–2009 (National Science Board, 2012: Tables 2–40). Even Japan, which has a reputation for 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% of those enrolled in graduate school in the natural sciences and in engineering; in 2010, they represented 10.9% (National Science Board, 2012: Tables 2–41).

The United States also plays a major role in training foreign postdoctoral scholars. In 2011, for example, slightly more than 54% of the 42,103 postdoctoral scholars working in the United States at research universities were in the United States on temporary visas.[1] Although we know considerably less about the number of foreign-born receiving postdoctoral training outside the United States, what we do know suggests that the presence of the foreign-born is substantial among the postdoctoral population. For example, one study found that 43% of the 19,000 postdoctoral fellows in the life sciences in Europe are working outside their country of citizenship. Of these, 44% are from another European country; 56% are from outside the EU (IIS07; IIS07).

Attracting the foreign-born for training, and encouraging them to stay, is of policy importance, given the role that the foreign-born play in the host country. First, as trainees they contribute to the productivity of the scientific enterprise. Stuen and colleagues (2012) find the publications and citations of departments to be positively related to the number of foreign-born graduate students; Black and Stephan (2010) infer that 39.6% of the graduate-student authors of US papers published during a 6-month period in *Science* in 2007 are foreign-born, 59.2% of the postdoctoral authors are foreign. Gurmu *et al.* (2008) find the patenting activity of top universities to be positively and significantly associated with the number of postdoctoral researchers on temporary visas.[2] Second, a large percent of trainees stay after completing their programs of study and work. The recent 5-year stay rate in the United States for PhDs is 66%; it is higher in computer science, the life sciences, and engineering (Finn, 2014). The stay rate for respondents to the GlobSci survey who received their PhD outside their country of origin between 2000 and 2005 is 59.6%; the stay rate in the United States is 76.2%.[3] The foreign-born who stay contribute to the workforce in academe, government, and industry (Freeman, 2010). For example, in the United States, approximately 22% of faculty in science and engineering were not citizens at the time they received their PhD training in the United States (Stephan, 2012). There is some evidence that those who stay exhibit higher performance than natives in science (Gaulé and Piacentini, 2013; Franzoni *et al.* 2014). Part of this premium, but not all, may be due to positive selection.[4] Third, the foreign-born, because of their higher propensity to choose careers in science and engineering, contribute disproportionately to innovation, as measured by patent counts (Hunt and Loiselle-Gautier, 2010; Kerr and Lincoln, 2010). Moreover, there is evidence of positive spillovers (Hunt and Gautier-Loiselle, 2010; Kerr and Lincoln, 2010).[5] Fourth, the foreign-born who stay serve as anchors for international networks (Scellato *et al.* 2015). Fifth, the foreign-born who return are more likely to have international coauthors than those who have not been mobile and to perform at a higher level (Freeman, 2014; Scellato *et al.*, 2015). Many of their collaborators are from the host country and were met while they were at the same institution, often when the returnee was in training. (Freeman *et al.*, forthcoming).

Despite the important role the foreign-born play in the host country, little is known about what leads prospective PhD students to choose one country over another or what factors lead newly minted PhDs to take a postdoctoral

1 The figure excludes the social sciences and psychology, as well as the medical sciences, where some of the positions labeled as "postdoctorate" in National Science Foundation's Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) are held by physicians rather than PhDs (see Stephan *et al.*, 2015).

2 The results are for both top 110 institutions and top 25 institutions, where top 110 includes all institutions covered by Science Watch; top 25 was defined based on program National Research Council rankings of programs.

3 The overall stay rate for those who received their PhD after 2005 is 73.4%; the stay rate for those training in the United States is 88.0%.

4 Grogger and Hanson (2013) find evidence that the foreign-born who intend to stay in the United States after receiving a PhD are more able than those who do not intend to stay. Franzoni *et al.* (2014) find, after controlling for selection, that mobile scientists, many of whom moved for PhD study, are more productive.

5 Spillovers are not always positive. Borjas and Doran (2012) find evidence of negative spillovers in the fields of mathematics that were dominated by the former Soviet Union. They interpret crowding out as being due to constraints in labor markets and space in top math journals.

position in one country rather than another; nor is much known concerning which countries are nibbling at the United State's role in graduate training. Yet, as the above discussion points out, the question is of critical importance, given the key role that trainees, and trainees who stay, play in the production of new knowledge, the developments of innovative activities, and, more generally, their contributions to the workforce. Although prior research shows that training choices are related in part to macroeconomic and political factors, such as business cycles (Sakellaris and Spilimbergo, 1999) and migration policies in the sending and receiving countries (Alden, 2008; Chellaraj *et al.*, 2008; Bound *et al.*, 2009), we have limited understanding and minimal evidence concerning the role that funding for study, opportunities for advancement, lifestyle, or family play in affecting the choices of prospective trainees at the individual level. Nor do we know how the relative attractiveness of the United States to foreign-born trainees has changed in recent years. Our ignorance derives from the fact that no database collects consistent information across countries on mobile researchers by type of tertiary training and on factors affecting their decision to emigrate for training.

The purpose of this article is to examine the comings of the foreign-born to the United States for doctoral and postdoctoral study in four fields of natural sciences. The data we use were collected by the authors in 2011 as part of the GlobSci project (Franzoni *et al.*, 2012) and cover research active scientists currently working or training in 16 countries. In Section 2, we discuss factors affecting the decision to study abroad and review previous studies of student mobility. The data are discussed in Section 3. In Section 4, we estimate the probability of coming for PhD study to the United States vs. going elsewhere. We also estimate a multinomial logit model of the probability of studying in the United States vs. studying in six other countries. Section 5 examines, in a similar framework, the decision to do postdoctoral study in the United States. Section 6 closes with discussion and conclusion.

Major findings are that going to the United States for PhD study is associated with the prestige of its programs and/or career prospects. For recent PhDs, we also find a positive association with the availability of financial support in the United States. Factors that are associated with fewer students going to the United States for study are the perceived lifestyle in the United States and the availability of exchange programs in other countries. The perceived quality of faculty, the excellence/prestige of institutions, and the prospect of careers for postdocs are associated with postdoctoral study in the United States vs. elsewhere. Factors associated with study elsewhere are the perceived relative unattractiveness of fringe benefits and working conditions provided to postdocs in the United States. Our data also show that, for those who received their PhD after 2000, the likelihood of coming to the United States for training has declined. Countries that have been nibbling at the US PhD and postdoctoral 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. The choice to study abroad

2.1 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, the policy of the home country toward studying abroad, and macroeconomic conditions in the home country. 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 the country to study and staying in touch with faculty to have a leg up in the job market (Kim, 2010).[6] 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

6 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).

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 20 spots on the Shanghai Jiao Ton University's rankings are held by institutions in the United States[7]; 7 of the top 10 spots on the London Times rankings belong to US institutions, the other 3 belong to the UK.[8]

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 or a third country and reaping the financial benefits of one's education. The magnitude of the benefit can depend in part upon the extent to which studying 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 *et al.* 2009).[9] 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 all monetary. They include, for example, the opportunity to work in an environment that promotes research and thus provides increased opportunities to experience the satisfaction derived from "puzzle solving" aspects of research and to receive the reputation that can accompany research.[10] 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 PhD 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 United States, 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 United States is not high, it has a relatively higher value to foreign-born from developing and emerging countries than it has to US students.[11] In other countries, financial assistance is not available or not as generous. For some students whose home country provides financial assistance for study abroad, support may not be a major issue in determining where to study.

Differentials in housing costs and the time it takes, 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 are also psychological and include separation from family and friends and living in an unfamiliar or significantly different environment. 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.[12]

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

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

9 Lowell (2000) estimates that nearly one quarter of H-1B visa recipients were first in the United States as a foreign student.

10 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.

11 In the United States, foreign students are considerably more likely to be a research assistant than are citizen students (49% vs. 21%).The difference reflects the larger range of alternatives and resources available to citizens, including employer support and the availability of fellowships and grants (Stephan, 2012).

12 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 82 departments of engineering, chemistry, physics, and biology directed by a

Costs and benefits to study in a particular country can change over time. By way of example, US visa policy implemented after 9/11 initially 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% and by 5% in 2005. They increased by 12% in 2006 and returned to pre9/11 levels by 2007 (Alden, 2008).[13] The doubling of funding for the National Institutes of Health (NIH) in the late 1990s and early 2000s 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 United States. The bursting of the Information Technology (IT) bubble in 2001 diminished the employment prospects of individuals trained in IT and engineering in the United States 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 *et al.*, 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 (Lepori *et al.*, 2015; Janger and Nowotny, 2013). 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 postdoctoral position outside their home country do so with support from their country of origin, most receive compensation from the host country and salaries and fringe benefits vary considerably across countries.[14]

In the United States, the NIH has long prescribed salaries for postdoctoral fellows supported on training grants or fellowships. Many universities follow these guidelines, not only for postdocs supported on NIH research grants but for other postdocs as well, both in and outside the fields of biomedical sciences.[15] In 2012, the starting salary prescribed by the NIH was $39,264. It was raised to $42,000 in the winter of 2014.[16]

Historically, postdoctoral researchers in the United States received few fringe benefits and shared few of the working conditions enjoyed by faculty or staff. A survey conducted among 30 US universities by the National Academies in 2000, found that seven universities provided only information about medical benefits that the postdocs could purchase at their own expenses (in some cases with a discount) and two provided no medical benefits whatsoever (National Academies, 2000: 146). Only half of the universities provided vacation time as a mandatory benefit of all postdocs, irrespective from the source of funding, 13 provided sick leave, and only 9 provided maternity or paternity leave. Perhaps more striking is that 3 of the 30 universities did not provide access to library, email, and computer access privileges as a complimentary service to all postdocs (National Academies, 2000: 150).

Postdoctoral 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 have formed the National Postdoctoral Association (NPA)

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 vs. a laboratory directed by a native US faculty member is 37.8%; for Korean students it is 29.0%; for Indian students it is 27.1%.

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

14 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 5 years, it sponsored 439 scholarships for EU citizens to study in the United States (EU Commission, 2012).

15 Some universities stipulate slightly higher levels of pay. Stanford University, which stipulates salaries which are approximately 4%–9% above the NIH guidelines, depending upon years of experience, is a case in point. See http://postdocs.stanford.edu/handbook/salary.html (accessed May 16, 2014). See National Postdoctoral Association (2012) for a discussion of the number of institutions that adhere to NIH salary minimums.

16 Despite the gentlemen's agreement that an individual not hold the position of postdoc for longer than 5 years, the NIH stipulates salaries for postdocs with up to 7 years of experience. In 2014, the stipulated NIH salary for those with 7 or more years of postdoc experience was $55,272. See http://www.nhlbi.nih.gov/funding/policies/nrsa.htm (accessed May 16, 2014).

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 Postdoctoral Researchers Organize/International Union, United Automobile, Aerospace and Agricultural Implement Workers of America as representing postdocs on the 10-campus California System (Stephan, 2012: 169).

Over time, and partly in response to the pressure of the NPA and campus postdoctoral organizations, the presence and availability of fringe benefits for postdocs has grown and working conditions have improved. A survey conducted by the NPA in the fall of 2011 provides a 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% of the responding institutions provided health insurance to postdocs; 76% provided health insurance to the postdoc's family.[17] In terms of family leave, 39.5% of the institutions offered paid maternity leave; 27.6% offered paid paternity leave. With regard to paid vacation, 27% of postdocs who were classified as employees received none; 44% of those who were not classified as employees received none. In terms of holidays, 14.8% of postdoc employees received no paid holidays; 35% of the postdocs who were nonemployees received no paid holidays. In terms of sick leave, 24% of employees received paid sick leave; 43% of the postdocs who were not employees received no paid sick days.[18]

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 the equivalent of about $5850 (CHF5200) a month after taxes plus a "13th"-month payment of the same amount in December. A postdoctoral fellow in Belgium (Flanders) with 2 years of experience received an annual salary of about $65,075 (€47,200)[19] before taxes in 2008; $35,620 (€25,836) after taxes and social contributions. In addition, Flemish postdocs received a year-end bonus of $1158 [€843 euros and a holiday bonus of $2040 (€1480)].[20] Postdoctoral fellows in Germany receive beginning salaries between $4963 and $5412 (€3600 and €3926) a month, depending upon whether they are pursuing the habilitation or hired directly into a "junior professor/postdoc position."[21] Not all countries pay postdoctoral salaries that are higher than those in the United States. Postdoc salaries in Canada range from $32,890 to $37,588 (CAD35,000 to 40,000)[22]; a postdoc in Italy receives approximately $34,465 (€25,000).

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 2 years. This means that if she loses her position as a postdoc or her contract ends, she has the right to receive 80% of her salary for a maximum of 2 years. A postdoctoral fellow in Italy has 5 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 $207 (€150) if married and $212 (€154) per month for each of the first two children; for the third and subsequent children the 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

17 At 23% of these institutions, the postdoc paid nothing for his own health insurance; at 10%, the postdoc paid 51% or more of the cost of his insurance. The comparable figures for family insurance are that 8% paid nothing; 18% paid 51% or more.

18 National Postdoctoral Association Institutional Survey on Postdoctoral Compensation, Benefits and Professional Development Opportunities, released April 2, 2012.

19 Based on the average exchange rate of January 1, 2014.

20 http://www.ugent.be/en/living/money/incomeresearcher.htm (accessed January 17, 2013).

21 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 $4962 (€3600). That for those doing the junior professor/postdoc option (W1) is $5412 (€3926).

22 http://thenode.biologists.com/changes-in-canadian-postdoc-funding/ (accessed May 14, 2014).

number of hours worked per year.[23] 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.

2.2 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 of students in selected disciplines of hard sciences between a set of countries. Another focuses on international flows to a specific country or reasons for coming to study within a country. With rare exception, almost all studies examine flows after the decision to study abroad has been made. 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 postdoctoral study abroad.

Perkins and Neumayer (2011) use OECD data for the period 2005–2009 to model tertiary student flows, regardless of the type of tertiary degree pursued, 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 hypothesize 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 hypothesize that costs increase with visa restrictions as the distance between source and destination countries grows; they also hypothesize that costs are 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 *et al.* (2014) 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. 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 to Germany at a given period in time who do not have a German "Abitur" (university entrance diploma) do not permit differentiation between graduate students vs. nongraduate 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. Bessey 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.

Sakelleris and Spilimbergo (1999) use Institute of International Education data to examine how the enrollment of foreign students in the United States—both at the graduate and undergraduate level—relates to the business cycle. For OECD countries, they find the relationship to be countercyclical; for non-OECD countries, they find it to be procyclical. They interpret the results as implying that enrollment from OECD countries is sensitive to opportunity costs—which are lower during a business cycle—while enrollment from non-OECD countries is driven primarily by ability to pay and credit constraints, which are procyclical.

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 depending upon the demand for training by foreign students willing to come and the supply of positions in the destination country in doctoral programs, especially positions for international doctoral students. Bound *et al.* (2009) do precisely this, examining flows of international PhD students

23 See http://stats.oecd.org/Index.aspx?DatasetCode=ANHRS (accessed May 16, 2014).

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 the demand of students willing to come 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 of students wishing to 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.[24]

Van Bouwel and Veugelers (forthcoming) use data from the MORE survey of researchers conducted in 2010 to study the mobility decisions of European doctoral students. Although an initial criterion for inclusion in the study was the presence of a mobility experience between Europe and the United States, 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 high 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 a relatively low Impact Factor of journal publications in the home country acts 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% of their respondents said that financial support was an important factor in their choice.

While the seven 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 four studies from examining flows of doctoral students. Instead the four study flows of all tertiary students, regardless of graduate vs. undergraduate 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 *et al.*, paper focuses exclusively on studying flows of students coming for PhD study. However, 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%) 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 one field, and the data are only analyzed in a summary manner.

The above discussion suggests that to more fully understand the factors associated with a student's choice to train in one country rather than another, one needs data 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

24 The supply of positions in US universities for foreign students depends in part upon the demand for graduate training from US students, as well as faculty demand for students to staff their labs. Bound, Turner, and Walsh argue that while the number of slots at top PhD programs is reasonably fixed, 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.

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 arguably make similar decisions about where they will go for training by weighing the benefits and costs of study abroad.

3. The GlobSci survey

To investigate our research questions, we use responses from the GlobSci survey, a multi-country investigation that was conducted in 2011 among publication-active scientists in biology, chemistry, earth and environmental sciences, and materials science. Sample construction, survey methodology, response rate reports, and bias checks have been discussed extensively in prior publications. See Franzoni *et al.* (2012). Here we limit the discussion to summarizing important features of the data.

Respondents of the GlobSci survey represent publication-active scientists whose main affiliation is in one of the 16 surveyed countries: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, India, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Individuals were asked to report their country of origin, defined as the country in which the respondent lived at the age of 18. They were then asked information on whether they had studied, trained, or worked in a foreign country, defined as a country different from the one reported as their country of origin. The information allowed us to map, among other things, foreign mobility for PhD and for postdoctoral training.

By design, the GlobSci survey includes individuals native to non-surveyed countries—such as China or South Korea—living in one of the 16 surveyed countries in 2011. This means that the sample is censored for natives of non-surveyed countries since it only captures those who went abroad for training and stayed—not those who went abroad for training and subsequently returned to their native country, or a third, non-surveyed country. In contrast, the sample is not censored for natives from one of the 16 surveyed countries. To ensure that the results are not confounded by this censoring issue, we focus the analysis primarily on individuals from surveyed countries. In an effort to include individuals from non-surveyed countries while minimizing issues related to censoring, we also include estimates for a recent PhD sample. We refer to these as the Surveyed Country PhD sample ($n = 1129$) and the Recent PhD sample ($n = 1258$). In a similar way, we construct two subsamples for those who migrated for postdoctoral training: Surveyed Country Postdoctoral sample ($n = 5090$) and Recent Postdoctoral sample ($n = 1933$). We caution the reader that the results for these recent samples may still be partly affected by censoring issues, due to the fact that we are not collecting answers from individuals that after international mobility for either PhD or postdoc in a surveyed country have moved back before 2011 to a non-surveyed country.

Table 1 summarizes the criteria for inclusion in the different samples used in the analysis. Since we model the migration decision toward the United States vs. other countries, we do not include researchers who lived in the United States at the age of 18 in the analysis. Note that in some models, we account for sample selection of the mobile researchers by using the full sample of respondents in the surveyed origin country, including nonmobile scientists.

Summary statistics for the four subsamples are presented in Tables 2 and 3. 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

Table 1. Criteria for inclusion in the subsamples

Sample	Number	Criteria
Recent PhD	1129	Respondents who received their PhD in 2000 or later in a country different from where they lived at the age of 18.
Surveyed Country PhD	1258	Respondents who received their PhD in a country different from where they lived at the age of 18 and their country of origin is a surveyed 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 the age of 18.
Surveyed Country Postdoc	5090	Respondents who had postdoctoral training in a country different from where they lived at the age of 18 and their country of origin is a surveyed country.

Table 2. Summary statistics of subsamples of PhD

Sample	Recent PhD Mean	Surveyed Country PhD 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
Brazil	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

statistics for selected countries. The GlobSci survey asked mobile researchers to assess on a five-point scale with 0.1 step increments the importance a number of factors played in their decision to study or take a postdoctoral position abroad. From a methodological point of view, it is important to acknowledge that these responses represent a personal evaluation of reasons behind a decision made sometime in the past; they do not necessarily represent preferences at the time the decision was made. Moreover, the observed outcome of country of study may not have been the first choice of the respondent. Suppose, for example, that a respondent initially sought to do a PhD in a prestigious, yet highly selective institution, and failed to be admitted. Suppose the same person was then admitted to do a PhD in a not-so-prestigious institution and decided to accept the offer, in part because of the relatively high quality of life offered by the second location. It is quite possible that the respondent, thinking retrospectively, would downplay the importance of prestige of the institution and instead stress the importance of life quality in responding to the GlobSci Survey. This type of reporting bias, typical of survey responses collected *ex post*, cannot be eliminated from our data and suggest that the responses correlate to outcomes and do not necessarily represent *ex ante* preferences. The results of our analysis should, therefore, be interpreted with caution, taking into account the personal and self-reported nature of the data.

Table 3. Summary statistics of subsamples of postdocs

Subsample	Recent Postdoc Mean	Surveyed Country Postdoc 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
Brazil	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

With this caveat in mind, we distinguish between factors associated with the choice of country into those that reflect benefits and those that reflect costs associated with a specific location. 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, etc) 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.

Those who did postdoctoral study outside the country of origin 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, etc); better working conditions (vacations, hours of work, etc); opportunity to improve my future

Table 4. Definition and description of variables related to the motivation for training abroad (PhD and postdoc)

Variables PhD migration	Minimum	Maximum	Mean	Standard deviation	Reasons for PhD abroad
PRESTIGE	1	5	4.120	1.017	Prestige/research excellence of the institution
CAREER	1	5	4.335	0.943	Opportunity to improve my future career prospects
CONTACT	1	5	3.202	1.408	Contact with somebody (a professor, colleague, friend . . .) in the host country
LIFESTYLE	1	5	3.789	1.145	Appeal of the life style or international experience
FAMILY	1	5	2.498	1.361	Family or personal reasons
EXCHANGE_PROG	1	5	2.274	1.335	Availability of an exchange or joint programs between institutions
FELLOWSHIP_HOST	1	5	3.499	1.432	Fellowship that I obtained from the host country / institution
FELLOWSHIP_ORIGIN	1	5	2.293	1.382	Fellowship that I obtained from the country where I lived when I was 18
NO_PROGRAM	1	5	2.753	1.363	Few if any good PhD programs in the country where I lived when I was 18
Variables postdoc migration					Reasons for postdoc abroad
BENEFITS*	−1.175	2.079	−0.000	0.852	Better fringe benefits (parental leaves, pension, insurance, etc); Better working conditions (vacations, hours of work, etc)
RESEARCH_EXCELLENCE*	−3.230	0.710	−0.000	0.775	Excellence/ prestige of the foreign institution in my area of research; outstanding quality of faculty
SALARY	1	5	2.977	1.191	Better wage / monetary compensation
RESEARCH_ENDOWMENT*	−2.324	0.984	−0.000	0.775	Greater availability of research funds; better research infrastructures and facilities
FAMILY	1	5	2.451	1.257	Family or personal reasons
LIFESTYLE	1	5	3.748	1.049	Appeal of the life style or international experience
CAREER	1	5	4.331	0.820	Opportunity to improve my future career prospects
NETWORK	1	5	3.930	0.972	Opportunity to extend my network of international relationships

Summary statistics are computed for all migrants for PhD or postdoc. *Variable derived through factor analysis of different self-reported reasons to migrate. Reasons for mobility are defined on a 1–5 scale with a 0.1 step (1: Totally unimportant reason; 5: Extremely important reason).

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 4 reports the definition of variables used in estimates of the mobility equations and their means and standard deviations. Note that factor analysis was used to construct three of the variables included in the postdoctoral equations because of the presence of significant correlations among specific items used in the questionnaire. 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_ENDOWMENT, 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.

4. Choice of PhD location

We explore factors associated with the probability that students who leave their country of origin for PhD training come to the United States vs. go to another country. As discussed above, two different samples are used, depending upon the country of origin and time of study: The Surveyed Country sample, which is restricted to those who resided in a core country at age 18 and received their doctoral training in a different country from where they lived at age 18, and the Recent PhDs (2000 or later). 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 in the analysis. In the analysis of the Surveyed Country sample, we also include time period dummies for PhD year of respondent (70s, 80s, and 90s, while the omitted time period is 2000s). We do not include time period dummies in the analysis of the Recent PhD sample. The inclusion of country and time period dummies (in the case of the Surveyed Country sample) allows 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-varying measures. Table 5 reports marginal effects of probit models for the two different subsamples.[25]

Models II and IV control for the absence of a program in the home country. For the Surveyed 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 is associated with more individuals going elsewhere than the United States for study, possibly 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 are negatively associated (at the 10% level in model II) with going to the United States for PhD study. Gender is not significantly related to location decisions for training. With regard to time trends, we find that there has been a significant contraction in the relative attractiveness of the United States for PhD students during the 2000s (the omitted time period dummy).

The magnitude of the effects of the analyzed variables, evaluated at the sample mean in the baseline model I in Table 5, show that a one-standard deviation increase of PRESTIGE leads to a 12.7% increase (from 35.6% to 40.11%) in the likelihood of observing mobility toward the United States for PhD training. The corresponding effect associated with the variable CAREER is +16.4% (from 35.6% to 41.4%). The dummy variable for those who moved during the 1980s indicates that they were 33.1% more likely to train in the United States than are those who trained in the 2000s. As a robustness check, we run the probit model for the Surveyed Country sample using response rates as observation weights. The results, which are very similar to those presented in Table 5, are reported in Annex A, Table A1.

To examine whether the results vary by the income status of the country, as the work of Sakellaris and Spilimbergo (1999) finds for tertiary students coming from a wide array of countries to the United States, and as an additional robustness check, we also estimated the model for the Surveyed Countries sample, excluding India and Brazil. The rationale is that the job market for researchers and the scientific systems of these countries might differ from those of the other 13 countries in the surveyed sample. Results are reported in Appendix B, Table B1. The estimates of the restricted sample without India and Brazil show no significant differences from those reported in Table 5, with the one exception that the variable EXCHANGE_PROG is no longer significant.

We also run robustness checks to test whether the covariates used in our model remain significant once we split the sample between respondents who migrated for PhD training pre- and post-2000. These are presented in Table B3 of the Appendix. The results suggest that lifestyle considerations were more of a concern of Recent PhDs students

25 Marginal effects are computed at means of independent variables.

Table 5. Decision to take a PhD in the United States

Samples	Surveyed countries PhD		Recent PhD		Surveyed countries PhD	
Dependent variable	PhD United States = 1	PhD United States = 1	PhD United States = 1	PhD United States = 1	Second stage PhD United States = 1	Selection Eq. PhD abroad = 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						−1.313***
Country origin dummies	Yes	Yes	Yes	Yes	Yes	
Field dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1258	1258	1129	1129	1258	11,228
Wald Chi-square	284.9***	283.4***	283.6***	285.9***	117.232***	
Pseudo *R*-square	0.190	0.195	0.230	0.237		
Chi-sq LR independent eq.					2.82*	

Heteroskedasticity-robust standard errors in parenthesis. Significance levels: *90%,**95%,***99%.

Marginal effects for probit models on the subsample of Core Countries PhD (models I and II) and Recent PhD (models III and IV). Heckman probit sample selection model on the subsample of Core Country PhD (models V and VI).

and that contacts played a significant role only for this group—perhaps reflecting the important role that the Internet began to play in the 1990s. By way of contrast, career concerns played a significant role in the decisions of the earlier PhD recipients but not in the decisions of the later recipients.

The results are somewhat similar for the Recent PhD sample (models III and IV) as for the Surveyed Country sample. Prestige/research excellence is positively and significantly related to choosing the United States for study as is the unavailability of programs. Lifestyle factors and availability of exchange programs are negatively associated to students moving to the United States vs. going elsewhere for study. For this sample, but not for the Surveyed Country

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 United States 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, 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 models the probability that a student decides to go abroad for training and, having controlled for selection, proceeds 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 the Surveyed Countries, not for those from non-surveyed countries. Thus, we can only model selection for those in the Surveyed 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 United States as the training destination country vs. another country. The model follows a standard Heckman sample selection approach.[26] The variables used in the selection equation include a measure of 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 of origin for training abroad.

Estimates of the sample selection model are presented in Table 5, 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 choose the United States for PhD study than go elsewhere.

We find that even after controlling for selection into mobility for PhDs, time period dummies suggest that the relative US share of mobile PhDs has decreased over time. This can be seen in Figure 1 which reports the incidence of mobile PhDs by destination country and PhD completion year. The data are derived from the Surveyed Country sample.

Table 6 presents results from a multinomial logit model for the decision to attend a PhD program in the United States vs. attend a program in six other countries (Australia, Canada, France, Germany, Great Britain, and Switzerland), each of which accounts for 4% or more of the foreign-trained Surveyed Country sample. Collectively, these six countries plus the United States bestowed about 87%% of the PhDs to foreign-born students in the Surveyed Country PhD sample. In all equations, the baseline destination is the United States; the table reports relative risk ratios.[27] The coefficients on the variable PHD YEAR help in identifying which countries are taking the United States share of foreign-born PhD students.

The results suggest that students who report 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% level of significance for Canada and Australia) than come to the United States for study. Family reasons are reported to be associated with mobility toward Australia, Switzerland, and Germany (10% level) as opposed to mobility toward the United States 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% level) than come to the United States for study and more likely to go to Switzerland (10 % level). Career prospects are associated with the choice of PhD programs in the United States vs. Canada and France. Contacts are associated with the choice of PhD programs in the United States vs. Germany, Great Britain, and Switzerland (10 % level). The availability of financial support for study provided by the host

26 The model has been estimated with the Heckprob routine of the econometric software Stata 11.

27 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.

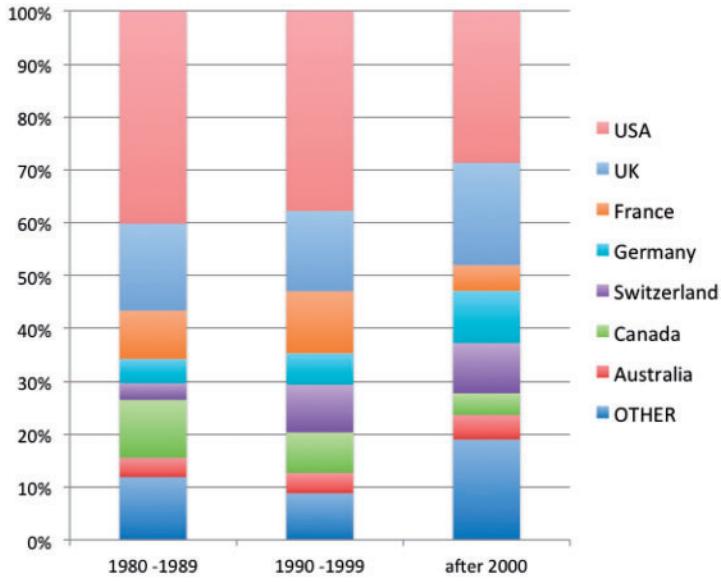

Figure 1. Share of mobile PhDs by destination country and time period

country is positively correlated with mobility toward Australia, Switzerland, and Canada (10 % level latter two) over the United States. The availability of exchange programs is positively associated with students attending programs in the EU and negatively associated with students attending programs in Switzerland (10% 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 among the surveyed countries have been nibbling on the US 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 US program and/or career prospects associated with training in the United States are positively associated with coming to the United States to study rather than going 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 when making their decisions regarding where to study.[28] The importance of cost factors is further underlined by the fact that exchange programs, which are widely available within the EU, are negatively associated with studying in the United States vs. going elsewhere for study. The US lifestyle is clearly negatively correlated with choosing the United States for study: 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 United States vs. go elsewhere for study. The effect is particularly strong for Recent PhDs, be they native of surveyed countries or natives of non-surveyed countries. Countries where lifestyle factors are positively associated with student flows are Australia, Canada, France, and Great Britain. Evidence from the Surveyed 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 surveyed countries that have been nibbling at the US share are Australia, Germany, and Switzerland.[29]

28 Its lack of significance in the Surveyed Country subsample may reflect the absence of individuals in the sample from countries such as China and South Korea, for whom financial assistance may be critical.

29 Several other surveyed countries have also been nibbling at the US share, as indicated in Figure 1, but the number of observations for each of these countries are sufficiently thin to limit our analysis of how factors contribute to this pattern.

Table 6. Decision to take a PhD. United States vs. six alternative destinations. Relative risk ratios reported

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	1098					
Wald Chi-square	926.5***					
LogLik	−1335.430					
Pseudo *R*-square	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.

5. Choice of postdoc location

We employ a similar strategy to that used in studying PhDs to estimate the probability that a postdoc who seeks training outside his or her country of origin comes to the United States vs. goes 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. Results for the Surveyed Country Postdoc sample are presented in columns I and II; those for the Recent Postdoc sample are presented in columns III and IV of Table 7. 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 Surveyed Country sample, we find RESEARCH_EXCELLENCE and RESEARCH_ENDOWMENT to be positively and significantly associated with coming to the United States as is the variable CAREER. Fringe benefits and working conditions provided for postdocs in the United States (BENEFIT) conversely are negatively and significantly associated with coming to the United States, consistent with the hypothesis that the relatively low level of fringe benefits and poor working conditions provided by US institutions to postdocs impose a cost on postdocs studying in the United States. The US lifestyle also is negatively correlated to choice of the United States for postdoc as are family issues. The opportunity to extend one's network is likewise negatively associated with the decision to train in the United States vs. elsewhere. This may reflect the dominance of individuals from EU countries in the Surveyed

Table 7. Decision to take a postdoc in the United States

Samples	Surveyed countries postdoc		Recent postdoc		Surveyed 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						−0.384***
						(0.096)
Country origin dummies	Yes	Yes	Yes	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5090	5090	1933	1933	5090	11,228
Wald Chi-square	561.0***	634.3***	326.7***	562.6***	596.5***	
LogLik	−3188.604	−3114.867	−1128.481	−1010.517	−10247.180	
Pseudo *R*-square	0.091	0.112	0.126	0.218		
LR Test independent eq.					6.12**	

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

Country sample and the attractiveness of working with researchers in other countries in close proximity, after study. We also find evidence that the probability of coming to the United States for postdoctoral work has declined over time. Concerning the magnitude of the effect of the analyzed variables, we find that at the sample mean in the baseline model I in Table 7, a one-standard deviation increase of BENEFIT leads to a 15.7% decrease (from 45% to 37.9%) in the likelihood of observing a mobility toward the United States for POSTDOC. The corresponding effect related to the variable RESERACH EXCELLENCE is +12.1% (from 45% to 50.4%). The dummy variable for those

who moved during the 80s generates a 24.5% increase in the likelihood of the United States being the destination country for a postdoc abroad.

We examine whether the results vary by the income status of the country, as we did above for location of PhD study, as the work of Sakellaris and Spilimbergo (1999) finds for tertiary students coming from a wide array of countries to the United States. To do so, and as an additional robustness check, we estimated the model for the Surveyed Countries sample, excluding India and Brazil. The rationale is that the job market for researchers and the scientific systems of these countries might differ from those of the other 13 countries in the Core Sample. Results are reported in Table B2. The estimates of the restricted sample without India and Brazil show no significant differences from those reported in Table 7.

We also run robustness checks to test whether the covariates used in our model remain significant once we split the Surveyed Country sample between respondents who obtained their PhD pre- and post-2000. These are presented in Table B4 of the Appendix. The results suggest that RES_EXCELLENCE and CAREER concerns are significant in both samples, as is the negative effect of BENEFITS. However, the results suggest that lifestyle considerations were more of a concern of recent postdoctoral trainees, as in the PhD case discussed above, while family and networks were associated with individuals prior to 2000 getting postdoctoral training outside the United States. The RESEARCH_ENDOW variable is positive and significant in the earlier years but not in the later years.

We find the results to be reasonably comparable between the Recent Postdoctoral sample and the Surveyed Country sample. Respondents report research excellence as playing a significant role in their decision to come for training in the United States, while BENEFITS and LIFESTYLE detracted from coming to the United States vs. going elsewhere.

As in the case for PhD study, one could argue that the decision to train outside one's country of origin is a two-stage process, where first one decides whether to train abroad and then one decides, conditional upon going abroad, where to go. To account for this selection process, we estimate a two-stage model, where in the first stage, we model the decision to do a postdoc abroad, and in the second stage, we model whether the destination country is the United States vs. all other countries. As above, we estimate the two-stage model only for the Surveyed 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 had already 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 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 8. 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 United States for training. Perhaps not surprisingly, there is evidence that the effects vary considerably by country. By way of example, RESEARCH ENDOWMENT correlates positively to going to Switzerland rather than the United States, but is also associated with postdocs choosing the United States over Australia, France, and Great Britain. RESEARCH EXCELLENCE is reported as associated with coming to the United States for postdoc work vs. going to Australia, Canada, or France. Career prospects correlate to the decision to come to the United States vs. go to Australia, France, Germany, and Switzerland. The possibility of enhancing one's network is associated with researchers going to Germany and Great Britain vs. coming to the United States, while the lifestyle is positively associated with going to Australia and Great Britain (10% level). Respondents rate benefits and working 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 are negatively associated with going to Canada and France vs. the United States, but not surprisingly, given the generous support provided, are positively associated with going 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, Table A3, we show the results for a multinomial logit model specification in which we also control for whether an individual had a PhD in the United States.

By way of summary, the empirical results, regardless of which of the two samples are used, support the hypothesis that research excellence is positively associated with individuals coming to the United States for postdoctoral training, while the level of fringe benefits, the quality of working conditions, and lifestyle are negatively associated with coming to the United States for postdoctoral training. When we restrict the sample to those living in one of the 16

Table 8. Decision to take a postdoc. United States vs. six alternative destinations. Relative risk ratios reported

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	4259					
Wald Chi-square	1432.3***					
LogLik	−5478.0					
Pseudo *R*-square	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.

core countries at age 18, we find that the research infrastructure and facilities and the availability of funds for research (RESEARCH_ENDOWMENT) also correlate positively and significantly to going to the United States for postdoctoral training, as does the opportunity to enhance one's career prospects. Family and the opportunity to extend one's network, however, are associated with individuals going elsewhere for training. Robustness checks suggest that these effects are restricted to those who received their PhD training before 2000. 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 US postdoc share.

7. Conclusion and discussion

The GlobSci data provide the most comprehensive view that currently exits of flows of scientists across the 16 countries for advanced training. The data also have the advantage that they include individuals from emerging countries such as India and Brazil as well as from the non-European and non-American countries of Australia and Japan. Moreover, the data provide insights into factors that play 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 16 surveyed countries, the selection process can be modeled and controlled for, in the sense of who among those who get a PhD or receive postdoctoral training choose to leave the country vs. stay in country for study or training.

The data are not without limitations. First, the sample is censored for natives of non-surveyed countries such as China, South Korea, and Russia since it only captures respondents from these countries who went abroad for training and stayed—not those who went abroad for training and subsequently returned to their native country, or a third, non-surveyed country. For this reason, we focus much of our analysis and discussion on results for the non-censored Survey Country sample. Second, 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. Third and related, the survey asks respondents to rate retrospectively the importance of a set of factors related to choosing a given foreign location for PhD and postdoc. In this regard, we do not know the degree to which respondents value *ex post* characteristics of the country where they trained more than they did *ex ante*. As such, the responses may be subject to reporting bias in the assessment of factors leading people to choose one country over another. In particular, given that respondents may not have trained in their country of first choice, responses may not reflect *a priori* preferences but instead reflect where they trained. Fourth, the survey 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, and the snapshot nature of our data means that we cannot infer causality between the various factors individuals give for study in a particular country and the actual choices trainees make. Finally, given the cross-sectional nature of our data and the self-reported metrics used as independent variables, our results should not be interpreted to indicate causality. For example, a positive association of prestige and choice of training in the United States may be due to perceived institutional prestige leading prospective PhDs to sign up for training in the United States, or it may be due to prestigious institutions being more likely to choose some (e.g. better trained) students rather than others.

Regardless of which sample we use, the empirical results support the hypothesis that prestige is positively associated with individuals coming to the United States for PhD study. For the more recent sample, the availability of financial assistance is also positively associated with coming. Its lack of significance in the non-censored sample, that covers a longer period of time, may reflect the absence of individuals in the Surveyed Country sample from countries such as China and South Korea for whom financial assistance may be critical.

Factors that are negatively associated with the foreign-born getting a PhD in the United States vs. another country are the perceived US lifestyle and the availability of exchange programs elsewhere. The results suggest that lifestyle issues play a role in the decisions of Recent PhDs—whether from a surveyed country or a non-surveyed country, to study in the United States. The evidence from the Surveyed Country 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 US 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 Surveyed Country sample, we find that the prestige of the host institution and the quality of faculty and colleagues are positively associated with individuals going to the United States for training. Career prospects associated with training in the United States are positively correlated with individuals from surveyed countries coming to train in the United States. The quality of the research infrastructure and facilities and the availability of funds for research are also positively correlated to individuals from Surveyed Countries doing postdoctoral work in the United States. The level of fringe benefits and the quality of working conditions available to postdoctoral scholars in the United States are negatively associated with doing postdoctoral work in the United States. The finding is robust across all samples. 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 United States for training. The results also suggest that lifestyle issues play a role in the decisions of recent PhDs not to take postdoctoral training in the United States—whether from a surveyed country or a non-surveyed country. 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.

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Appendix

A. Sample weights and alternative model specifications

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 surveyed country panel and we reestimate baseline model specification presented in Tables 5 and 7.

Table A1. Decision to take a PhD in the US probit model with probability weights

Dependent variables	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	1258

Significance levels: *90%, **95%, ***99%. Estimation based on Surveyed Country PhD sample. Equivalent to Table 5 column I.

Table A2. Probit model with probability weights. Decision to do a postdoc in the United States

Dependent variables	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)

(continued)

Table A2. Continued

Dependent variables	US postdoc = 1
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	5090

Significance levels: *90%, **95%, ***99%. Estimation based on Surveyed Country Postdoc sample. Equivalent to Table 7 column II.

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 United States 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)

(continued)

Table A3. Continued

Postdoc country	AUS	CAN	CHE	DEU	FRA	GBR
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	4259					
Chi-square	1559.417					
LogLik	−5414.483					
Pseudo *R*-square	0.126					

Significance levels: *90%, **95%, ***99%. Estimates based on the Surveyed Country Postdoc sample. Baseline outcome: USA. Relative risk ratios reported. Model specification with the inclusion of the US PHD dummy.

Relative risk ratios reported.

Appendix B. Robustness checks

Table B1. Decision to take a PhD in the United States

Dependent variable	PhD US =1
Models	II
PRESTIGE	0.048***
	(0.017)
CAREER	0.061***
	(0.019)
CONTACT	0.026**
	(0.012)
LIFESTYLE	−0.050***
	(0.015)
FAMILY	−0.020
	(0.013)
EXCHANGE_PROG	−0.015
	(0.015)
FELLOW_HOST	−0.005
	(0.013)
FELLOW_ORIGIN	−0.015
	(0.014)
PHD_70	0.143**
	(0.065)
PHD_80	0.109*
	(0.056)
PHD_90	0.107**
	(0.042)
FEMALE	0.002
	(0.041)
Country origin dummies	Yes
Field dummies	Yes
Observations	908
Pseudo *R*-square	0.190

Surveyed Countries PhD sample, excluding researchers from India and Brazil. Probit marginal effects reported.

Table B2. Decision to take a postDoc in the United States

Model	I
BENEFITS	−0.085***
	(0.012)
SALARY	0.010
	(0.010)
RESEARCH EXCELLENCE	0.074***
	(0.013)
RESEARCH ENDOWMENT	0.044***
	(0.013)
FAMILY	−0.021***
	(0.007)
LIFESTYLE	−0.017**
	(0.008)
CAREER	0.028**
	(0.012)
NETWORK	−0.018*
	(0.010)
PHD US	0.329***
	(0.035)
FEMALE	−0.028
	(0.020)
PHD_70	0.177***
	(0.027)
PHD_80	0.126***
	(0.024)
PHD_90	0.067***
	(0.020)
Country origin dummies	Yes
Field dummies	Yes
Observations	4420
Wald Chi-square	560.5***
LogLik	−2699.3
Pseudo *R*-square	0.112

Significance levels: *90%, **95%, ***99%.

Surveyed Countries POSTDOC sample, excluding researchers from India and Brazil. Probit marginal effects reported.

Table B3. Decision to take a PhD in the United States

Sample	Surveyed Countries PhD PhD year ≤ 2000	Surveyed Countries PhD PhD year > 2000
Dependent variable	PhD US = 1	PhD US = 1
Models	I	II
PRESTIGE	0.043**	0.051**
	(0.020)	(0.024)
CAREER	0.084***	0.029
	(0.023)	(0.026)
CONTACT	0.007	0.035**
	(0.014)	(0.016)
LIFESTYLE	−0.017	−0.062***
	(0.018)	(0.021)

(continued)

Table B3. Continued

Sample	Surveyed Countries PhD PhD year ≤ 2000	Surveyed Countries PhD PhD year > 2000
Dependent variable	PhD US = 1	PhD US = 1
Models	I	II
FAMILY	−0.015	−0.022
	(0.015)	(0.018)
EXCHANGE_PROG	−0.024	−0.033
	(0.017)	(0.020)
FELLOW_HOST	−0.025	0.026
	(0.016)	(0.016)
FELLOW_ORIGIN	−0.026	−0.001
	(0.016)	(0.020)
FEMALE	−0.004	0.028
	(0.052)	(0.051)
Country origin dummies	Yes	Yes
Time period dummies	Yes	No
Field dummies	Yes	Yes
Observations	747	511
Wald Chi-square	176.8***	120.3***
LogLik	−414.133	−234.604
Pseudo *R*-square	0.190	0.238

Significance levels: *90%, **95%, ***99%.

Surveyed Countries PhD sample split on the basis of PHD year. Probit marginal effects reported.

Table B4. Decision to take a postdoc in the United States

Samples	Surveyed Countries Postdoc PhD year ≤ 2000	Surveyed Countries Postdoc PhD year > 2000
Dependent variable	Postdoc US = 1	Postdoc US = 1
Models	I	II
BENEFITS	−0.069***	−0.111***
	(0.015)	(0.020)
SALARY	0.013	0.017
	(0.011)	(0.014)
RESEARCH EXCELLENCE	0.058***	0.102***
	(0.014)	(0.022)
RESEARCH ENDOWMENT	0.066***	−0.015
	(0.014)	(0.022)
FAMILY	−0.020**	−0.001
	(0.008)	(0.011)
LIFESTYLE	−0.009	−0.040***
	(0.009)	(0.014)
CAREER	0.031**	0.047**
	(0.012)	(0.022)
NETWORK	−0.034***	−0.023
	(0.011)	(0.018)
FEMALE	−0.033	0.010
	(0.023)	(0.032)
Country origin dummies	Yes	Yes
Time period dummies	Yes	No

(continued)

Table B4. Continued

Samples	Surveyed Countries Postdoc PhD year $\leq$ 2000	Surveyed Countries Postdoc PhD year $>$ 2000
Dependent variable	Postdoc US = 1	Postdoc US = 1
Models	I	II
Field dummies	Yes	Yes
Observations	3656	1434
Wald Chi-square	380.7***	206.2***
LogLik	−2318.6	−829.8
Pseudo *R*-square	0.085	0.118

Surveyed Countries POSTDOC sample split on the basis of PHD year. Probit marginal effects reported.