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*Abstract*¹

Many world regions, including Europe, have the perception that their best students and researchers leave to study and work in the United States. This phenomenon has been coined 'the elite brain drain'. With a sample of European students who obtain a PhD in economics in the US, we study whether the most promising among them are indeed less likely to return. We find that PhD recipients from top institutes, or with a highly cited advisor, or a pre-PhD publication or a higher impact factor on their first publication are more likely to stay in the US or Canada at a top institute. This indicates that the quality of the working environment is of crucial importance to top researchers, and that the attraction of the US consists in a big part in its many top economics departments. The location choice made for the first job strongly predicts the location of the current job. Once a top researcher has made the decision to stay, particularly at a top institute, the probability of his or her return becomes very small. This suggests that from the European perspective, there is indeed an 'elite brain drain', as its most talented researchers, once embedded in the North American research system, are not very likely to return.

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This version: January 15th 2012

¹ This paper was produced as part of the SCIFI-GLOW Collaborative Project supported by the European Commission's Seventh Framework Programme for Research and Technological Development, under the Socio-economic Sciences and Humanities theme (Contract no. SSH7-CT- 2008-217436).

1 Introduction

As more and more countries convert into knowledge-based economies, science and innovation are gaining importance as drivers of economic growth (Romer, 1990). Many countries and regions, however, recognize human capital as one of the major bottlenecks for their economic prosperity. Highly skilled labor - and specifically highly qualified researchers - is crucial both for the development of scientific breakthroughs and innovations as for their implementation.

The highly skilled are more likely to be internationally mobile compared to other layers of the population. In 2000, 34.6% of the immigrant stock in OECD countries had tertiary education, compared to only 11.3% of the world's labor force (Docquier and Marfouk, 2006). Many tertiary students, who go on to become the world's highly skilled labor force, are internationally mobile: in 2008, 6.7% of all tertiary students in the OECD were international students. In advanced research programs this proportion is even higher, at 18.2% (OECD, 2010).

The United States has been very successful at attracting foreign students and researchers. In 2008, the US attracted 18.7% of all foreign students in the OECD, making it the largest destination country. At the doctoral level, 1 in 3 PhDs in the US was awarded to students on temporary visas in 2007-2008 (National Science Foundation, 2010). Moreover, there are indications that the US not only attracts a large number of students and researchers, but specifically the best and brightest among them, a phenomenon that has been coined 'the elite brain drain' (Hunter et al., 2009; Maier et al., 2007; Laudel, 2003; Laudel, 2005).

Naturally, from the perspective of many sending countries, there is a fear of a substantial loss of human capital to the US. Whether this is indeed the case, depends to a large extent on whether the best foreign students who received their PhD in the US stay connected to their home country and eventually return. When surveyed by the NSF on their intentions to return home upon graduation, a large majority of foreign PhD recipients in the US, on average around 70%, indicate that they intend to stay in the US (National Science Foundation, 2010; Finn, 2010). Less is known, however, on their actual return rates at early and later stages in their research career, and which types of students are more or less likely to return, and more particularly whether the best students are more or less likely to return.

In this paper, we study whether it is the case that 'top' foreign PhD recipients are less likely to return home during their research career. Using a unique dataset with information on the careers of 375 European students who obtain a PhD in economics in the United States, we ask whether PhD holders with certain quality characteristics, such as having a PhD from a top institution, working with a highly cited advisor or obtaining an ISI publication prior to finishing the PhD are more likely to stay in the US for the first job and later jobs. We find that the labor market allocation process, where good students are more likely to obtain a job at top institute plays a crucial role: we observe that the best PhD recipients are most likely to work in the US *at a top institute* for their first job, but are also willing to return to Europe if they can work at a top European institution. Top PhD holders therefore do not seem necessarily more likely to stay in the US for their first job unless they can work at a top institute. The

prestige of the employing institute appears to play a more important role than its location, suggesting that the many top institutes in economics are among the most important attractive factors of the US for PhD holders in this field. The initial location decision does matter, however, for later jobs: Europeans who initially stayed in the US, be it at a top institute or not, are more likely to still be working in the US for their current job. However, those who initially stay to work at a top institute are even less likely to return compared to those who stay at a non-top institute, suggesting that there is indeed an 'elite brain drain' from Europe to the United States.

2 Conceptual framework and literature review

Several authors document and analyze the stay rates of foreign PhD students in the US. The US benefits from the presence of foreign PhD students and researchers (Chellaraj et al., 2005; Stephan and Levin, 2001), but has also become increasingly dependent on the inflow of foreign students and postdocs to fuel the expansion of research in certain fields (Black and Stephan, 2007), notably in the life sciences (Stephan, 2010). Therefore there is a lot of interest to know how many foreign students intend to stay, and what factors affect these stay rates. The National Science Foundation, in its Survey of Earned Doctorates, asks PhD recipients with temporary visas whether they have firm plans after their PhD, and whether they intend to stay in the US. In the period 2003-2009, 70.9% indicated an intention to stay. This stay rate varies strongly by country of origin: students from East and South Asia have a stay rate of 76.9%, compared to a stay rate of 68% for Europe and 54.6% for North and South America (NSF, 2011). Finn (2010) computes the stay rates of foreign PhD recipients using tax records, and finds a similar stay rate as the NSF: the one-year stay rate of PhD recipients from 2006 was 73%. There is also substantial variation by nationality: 94% of Chinese students are still in the US 1 year after graduation, compared to 61% of European students. Stay rates also vary strongly by discipline, with 78% of physicists and computer engineers staying in the first year after their PhD, but only 57% of agricultural scientists and 45% of economists.

Foreign students take many factors into account when they decide whether to return or not. Generally, professional considerations are found to be the major motive why students stay, while personal and societal considerations encourage them to return home (Alberts and Hazen, 2005; MORE, 2010). These findings provide a first indication why students who stay may be better than students who return, being more motivated by professional considerations relative to personal ones.

Several studies address the relationship between foreign students' ability and their probability to return more explicitly. Kahn and MacGarvie (2008) estimate the effect of return on foreign students' scientific productivity. Their prior is one of a negative selection of returnees: PhD recipients with less research talent may have a harder time obtaining a job in the US and may be more likely to return – and subsequently publish less not because they returned, but because they were less talented in the first place. To account for this unobserved heterogeneity, Kahn and MacGarvie instrument the return decision with grant and visa information, and match foreign PhD recipients with a particular grant tied to a J-1 visa - which forces students to return upon completion of their program irrespective of their

quality – to similar students without such grants. They find that return is indeed associated with a negative impact on scientific productivity, but only if students return to poorer countries. Gaulé studies the return patterns of foreign chemistry faculty in the US and finds that the 20% most productive professors are significantly less likely to return. Similarly, Black and Stephan (2007) find that PhD recipients from top 10 programs in their field are more likely to indicate an intention to stay for their first job. All these studies suggest that the most talented researchers are more likely to stay in the US. But what mechanism underlies this apparent quality selection?

For foreign PhD recipients, the workings of the academic job market imply that return may not always be the result of the preferences of the student alone. Some students may receive job offers from various institutes, in the US and at home, and choose their location according to their preferences. Other students, however, may not receive a job offer from a suitable institute in the US and are thus ‘forced’ to return home². Unfortunately, in our data we do not observe the job offers PhD holders receive, nor do we observe the reasons why certain PhD holders return. We only observe the final outcome of a complex matching process in the academic labor market.

With these caveats of our data in mind, we nevertheless expect to be able to analyse the patterns of where European students with a PhD from the US end up on the first and current jobs. We are particularly interested in how the quality of the PhD matters and the quality of the first and current job position.

In previous US studies, the prestige of the PhD granting institute has been found to have a strong and persistent effect on the prestige of the first and later jobs (Allison and Long, 1987, Burris, 2004; Smeets et al., 2006). We therefore expect that European PhD holders with a PhD from a prestigious US institute are more likely to receive an offer from a good US academic institute compared to Europeans who graduate from less prestigious US universities. In other words, PhD holders who can send a favorable signal to the market about their ability are more likely to have a choice in their location decision, whereas PhD holders without such a signal may be more likely to be ‘forced’ to return. PhD programs from prestigious institutions tend to be large, though, and within prestigious universities there may still be considerable heterogeneity in the quality of PhD recipients (Smeets et al., 2006). Other quality signals, such as having a good advisor or a publication in a good journal, may prove more important for PhD holders’ job market outcome.

Though PhD holders from prestigious US institutes, or with some other ‘quality signal’ to the job market, may be more likely to receive a job offer from a US institute, they may also attach greater importance to the quality of their work environment and less importance to its location. We therefore expect that top PhD holders are more likely to remain in the United States *at top institutes*, but we expect no higher likelihood to remain at lower-ranked institutes. Likewise, when top PhD holders return we also expect them to have a higher likelihood to return to a top institute in Europe. However, as the US hosts the majority of the highest ranked economics departments we expect the US to be the predominant location of the first job for top PhD holders.

² It is also possible that a foreign student receives an offer from a US institute but cannot get the appropriate work visa to stay in the US, and thus be forced to return because of immigration regulations.

Most studies of foreign students' return rates address immediate return upon completion of the PhD. Tracking researchers afterwards is tricky, because PhD holders can work in various sectors and often switch jobs a couple of times in their career. Finn (2010) manages to calculate long-term stay rates because of his unique methodology, using tax records linked to social security numbers of foreign students. He finds that stay rates only decrease slightly as time passes, and that the majority of students who return do so immediately after their PhD. Of those foreign students who received their PhD in 1997, 69% were still in the US 2 years after graduation, whereas 10 years later, this stay rate has only decreased to slightly under 66%. Although Finn points out that there is a certain amount of churning (some students who initially left return to the US and some who initially stay leave), the initial stay-or-return choice appears to be quite persistent into the future. This finding is corroborated by Gaulé (2010), who studies the return rates of foreign chemistry faculty in the US. He finds that only 9% of foreigners who held at least one faculty position in the US eventually return during their professional career, indicating that once foreign PhD holders become embedded in US academe, they are not very likely to return.

To summarize, we develop 4 hypotheses about the employment and location patterns of researchers which we expect to see in our data:

1. Top PhD holders are more likely to remain in the US compared to their peers with PhDs from lower ranked universities.
2. 'Quality signals' at the individual level, such as the reputation of the advisor or the quality of the first publication, may be stronger signals to the labor market about a PhD holders' ability, and thus have a stronger influence on employment outcome and location.
3. Top PhD holders are more likely to remain in the US insofar as they can work at a top institute; there is no higher probability to remain in the US at a non-top institute. Top PhDs are also more likely to return to Europe if they can work at top institute there.
4. Location choices are persistent: return mostly occurs immediately after the PhD, and researchers who initially stay are unlikely to return later in their professional career.

In the next section, we describe the data with which we test these hypotheses.

3 Data

We have compiled a unique dataset with information on the careers of 375 European researchers with a PhD in economics from the US or Canada. Although the analysis of researchers in a single discipline does not allow us to generalize our results to the entire population of academic researchers, it does provide us the advantage of keeping heterogeneity in labor market characteristics across different scientific disciplines constant, as well as other discipline specific characteristics, such as metrics for assessing research quality.

The starting point for our dataset is the ProQuest Dissertation database, which contains information on PhDs awarded at US institutions as well as some Canadian universities. We match the ProQuest

database to the Institution of Scientific Information (ISI)'s Social Science Citation Index (SSCI). For reasons of compatibility with the SSCI, only PhDs awarded as from 1992 are retained. Our focus is on PhD holders who opt for a research career, so we only keep those researchers with at least one publication in the SSCI. Given that our publication data were drawn at the end of 2008, and the most recently awarded PhDs in the version of ProQuest we obtained are from 2006, leaving enough time for most researchers in our sample to publish at least once. This leaves us with a set of 4,761 researchers with at least one ISI publication. From these we draw a stratified sample. More specifically, we sample 100% of those researchers with 2 or more publications (2,735 researchers), and 20% of those researchers with just one publication (405 researchers). All regression analyses will be weighted to account for the stratified sampling.

For the 3,140 researchers in our stratified sample, we collect information on their nationality, education and career by searching the web for faculty profile pages, personal web pages or curriculum vitae. From these web pages and CVs we collect the researchers' personal information (birth year, gender, nationality, marital status, etc.), education (institutions, graduation years and fields of undergraduate and graduate education) and career track (names, entry and exit years and positions occupied at various institutions).

Not all CVs provide equally detailed information, but generally education and career track are listed in adequate detail. Nationality is explicitly specified in roughly 30% of the cases; for the remaining 70% we derive nationality from the country where the BA degree was obtained.³ Ideally, we would have liked to study the return decisions of all foreign students who obtain a degree in the US or Canada.⁴ However, a comparison of our sample to the National Science Foundation's Survey of Earned Doctorates revealed that our sample is not representative of the population of foreign PhD students in economics with respect to their countries of origin. There is a specific bias against Asian PhD holders, presumably because the problem of homonyms is much more present for students of Asian origin than for students from other regions, which leads to problems with matching names to publication data and CV information. Therefore we focus only on the European students in our sample, which has the added benefit that Europe offers a relatively homogenous policy context in higher education and research.⁵

Researchers with a career in industry are excluded from the sample. Economics PhDs in industry are less likely to post a full CV online, and are thus automatically excluded from the sample. Moreover, in economics, one can argue that a career in industry is very different from a career in academia or government. Economists working in industry are much less likely to be doing 'academic-type' research compared to researchers in other fields. As we want to focus on researchers who are actively contributing to knowledge through publications in scientific journals, we decide to exclude the 17 PhD holders who opt for a career in industry. Most of these were either in private equity or in business

³ Gaughan (2007) and MacGarvie (2007) provide empirical evidence that the majority of students obtain their BA degree in their country of birth.

⁴ We consider the US and Canada as sufficiently homogeneous to regard them as a single higher education and research market, at least from the perspective of foreign students from outside North America.

⁵ We use a broad definition of Europe. Specifically, the countries included in our sample are those of the EU 27 plus Belarus, Croatia, Iceland, Israel, Norway, Russia, Serbia, Switzerland, Turkey and the Ukraine.

consulting. After excluding people with incomplete records, we are left with a sample of 375 Europeans who earned a PhD in the US or Canada between 1992 and 2006 and who have built a career in academia or in research departments of other institutions such as the Federal Reserve, the World Bank, the IMF, etc.

As we want to make a distinction between graduates from ‘top’ and ‘non top’ universities, and jobs at ‘top’ and ‘non top’ institutes, we need to define what universities are considered ‘top’. We compile a list of ‘top institutes’ using three rankings of economics departments: Tom Coupé’s ranking based on the productivity of the 20 most prolific scholars in a department (Coupé, 2003), the National Research Council’s 2010 regression-based ranking of economics PhD programs, and the 2010 REPEC ranking of economics departments. We define an institute as top if it features in the top 50 of all three rankings, which results in a list of 33 top institutions. Alternatively, we define a more narrow group of ‘supertop’ institutes, which are included in the top 15 of all three rankings; this list contains 11 institutes. For Europe, which compared to the US has fewer top institutes, we define a somewhat broader set of top institutes: an institute is considered as top if it is included in the top 100 of the REPEC ranking and the Coupé ranking (the NRC does not rank foreign universities). To summarize, we define 3 tiers of universities, which we call supertop, midtop and subtop. The first two are included in the definition of top institutes for the US, the latter two are included in the definition of top institutes for Europe. Table I lists the universities included in each tier by location⁶.

The prestige of a job candidate’s doctoral institutions may not be the only relevant signal of his or her ability. Top institutions often have large doctoral programs, and there may still be considerable heterogeneity among PhD recipients from those institutions. Therefore we use a set of alternative measures that may also signal a young researcher’s ability on the job market: having a highly cited advisor, having an advisor that co-authors on a publication at least once during the researcher’s career, whether the PhD holder has any ISI publications before graduation, and the impact factor of the first publication. A PhD recipient’s advisor may play an important role in a PhD holder’s job search by introducing the doctoral student to the right networks and through a ‘second-hand reputation effect’. However, highly reputed advisors may have a large number of PhD students, and devote relatively little time and effort to each. Therefore we also use an alternative advisor indicator, whether the advisor ever co-authored a publication with the student. Co-authoring (during the PhD, or after) signals a strong involvement of the advisor with the student’s research. Co-authoring with the advisor may also help a student to obtain a publication before graduating, which may be a strong signal of research ability to the academic labor market⁷. Similarly, having a publication in a good journal is an important asset for job candidates as the importance of research performance for hiring decisions and promotions increases. A caveat for this last measure is that only 55 researchers in the sample obtain their first publication before their PhD, so for those whose first publication is published afterwards the quality of the journal may be influenced by the prestige of the first job.

⁶ The list of subtop, midtop and supertop institutes does not vary over time, as few sources provide historical rankings. However, the composition of the top is quite stable over time (Burris, 2004).

⁷ Most job market papers are traditionally single authored. However, we can assume that an advisor only wants to actively co-author with the best students, so co-authoring could still be a signal of quality.

Finally, in the econometric models we control for a number of factors that may also affect European students' probability to stay. First, we include a measure of the quality of the research environment in a student's home country. This indicator is computed as the weighted sum of economics departments in the top 10% of the REPEC ranking divided by the home country's population to account for size. The resulting measure captures the 'density' of high quality economics departments where a researcher might consider working in the home country. The indicator is normalized so that the US has a score of 1. Arguably, researchers from countries with a higher density of high quality economics departments have more suitable employment opportunities at home and are therefore more likely to return. Second, we control for a researcher's gender and age at the time he or she starts the first job. Third, three dummy variables indicate whether a researcher received a fellowship or a grant, and from what source: the PhD granting institution (host institution), another US institution such as, for example, the Sloan foundation (other US institution) or the home country. Certain types of funding may be tied to a contractual obligation to return to the home country, or students who were financed by the home country may simply feel an obligation to return and contribute to their home country's economy. Grant selection may also entail a quality selection, so it is important to control for this in our regression models. Fourth, we control for the region of origin within Europe. We divide the home countries in our sample into 6 regions, i.e. Western Europe (the base region), Central Europe (including the countries that joined the EU in 2004 and 2007), Eastern Europe, Scandinavia, the Mediterranean countries and the Anglo-Saxon countries (Ireland and the UK). We include separate dummies for Turkey and Israel as well. Finally, cohort dummies are included to capture any other long-term time trends that influence European PhDs' stay rates. To save degrees of freedom, we use 5-year cohort dummies for the cohorts 1992-1996 and 1997-2001. The most recent cohort is the control group. Note that the cutoff point of the second cohort is 2001, which may be a pivotal year due to the events of 9/11 which made staying more difficult for foreign students. Ideally, we would also want to control for family characteristics, like whether the researcher is married or has children, which may affect the location decision as well. However, very few researchers indicate their marital status and/or children on their CV, and those who do all indicate that they are married and/or have children. We could assume that all researchers who do not mention marital status and children on their CV are single and childless. Using this definition, including these two variables into the analyses does not change our main findings, and neither was significant. However, as the quality of these variables is questionable, we omit them from further analyses.

Table II presents summary statistics for all explanatory variables. A sizable part of our sample obtains a PhD at a top institute in the US or Canada (66%), the majority of which obtain their PhD at one of the 11 'supertop' institutes (48%). This is partly due to the skew in our sample towards researchers with at least one or more publications⁸. However, it also illustrates that top economics departments tend to have large PhD programs, and that Europeans tend to be overrepresented at top departments compared to foreign students from other continents (Bound et al, 2009). The other quality indicators are more 'exclusive': 29% have a highly cited advisor, 25% have an advisor that co-authors with them at least once in their career and 15% have at least one ISI publication before they graduate. The average impact factor of the first publication is 0.97, although there is substantial variation ranging from 0.05 to

⁸ The descriptive statistics are not corrected for our stratified sampling, the regression analyses are.

4.41. The average researcher is 29 and a half years old when she takes up her first job after graduation, and 80% of PhD holders are male. Many receive fellowships or grants from various sources: 40% are financially supported by their host institute, 21% by another US institute and 22% by the home country. Italians are the most numerous in the sample, with 77 PhD holders, followed by Turkey with 53 and Germany with 37.

4 Results

In the first subsection, we analyze the stay rates for the first job, linking them to our various indicators of PhD holders' ability and analyzing how the quality selection process that takes place in the academic labor market interacts with location decisions. In the second subsection, we address how initial location decisions affect researchers' current location.

4.1 First job

Table III contains the number of researchers in our sample by home region (and the major home countries), and by location of their first job. Of the 375 Europeans in our sample, 264 stay in the US for their first job (70.4%). The remaining 111 return to Europe (29.6%), of which 70 to their home country and 41 to another European country⁹. The latter group fans out over several countries: the UK is the most popular destination with 14 researchers, but Spain (6), Belgium (5), France (5), Germany (3), the Netherlands (3), Israel (2), Denmark (1), Ireland (1) and Turkey (1) receive non-native European PhD holders as well. There are substantial differences in location patterns between nationalities: for example, 83% of Israeli PhD holders stay in the US or Canada, compared to only 53% of Spanish PhDs. However, as many nationalities are only represented by a few individuals, it is not possible to make any meaningful comparisons with this sample. Other sources, such as Finn (2010) and Black and Stephan (2007) are better suited to do this.

Is it the case that researchers with a PhD degree from a top institute, a highly cited advisor or a publication prior to graduation are more likely to stay? Table IV compares the stay rates and return rates of researchers with our various quality indicators. T-tests were done to check whether the stay rate of top students was significantly different from that of their peers. Those with a top or supertop PhD or with a highly cited advisor were not significantly more likely to stay. Having a co-authoring advisor is related to a significantly higher stay rate. However, co-authoring with one's advisor may be endogenous to staying: the probability of co-authoring after the PhD is probably higher for researchers who remain in the same country or area. If we only take into account advisors who co-authored on publications obtained before the PhD was completed, the difference becomes much less significant. This may also be due to the low number of observations which increases the standard error: only 26 researchers co-

⁹ A very small number of researchers leave the US to go to third countries outside of Europe, notably 4 researchers to Australia, one to China and one to Mexico, but these are excluded from the sample.

author with their advisor on a publication that appears before they obtain their PhD¹⁰. Only 55 researchers obtain an ISI publication prior to their PhD, but those who do are significantly more likely to stay. This suggests that having a publication at the time one enters the job market send a positive signal to US institutes, which may make it easier for a PhD recipient to stay.

A series of logit models, presented in table V, confirm that a pre-PhD publication is associated with a higher probability to stay for the first job (column 5), even when all ability indicators are controlled for together (column 7). None of the other ability indicators are significant when other factors are controlled for. However, having a pre-PhD publication may not necessarily be an indication of quality: the impact factor of pre-PhD publications is significantly lower than the impact factor of the other publications in our sample, and interacting the pre-PhD publication dummy with the impact factor of the first publication makes this variable insignificant.

The funding source for the PhD plays a significant role in European PhD holders' return rates: researchers financed by the host institute are significantly more likely to stay for the first job, whereas researchers financed by the home country are significantly more likely to return. Researchers from Eastern European countries are significantly more likely to stay in the US, perhaps indicating that these researchers have fewer job opportunities at home and are less inclined to move to another country within Europe. Finally, the earlier cohorts in our sample are less likely to stay for their first job, corroborating the observations of increasing stay rates by other authors (Finn, 2010; Black and Stephan, 2007).

All in all, the evidence for the hypothesis that more talented European PhD students are more likely to stay in the US appears meager. Although we expected that ability indicators at the individual level would be better predictors of the probability to stay than indicators based on a researcher's PhD institute, we find that only a pre-PhD publication is significantly associated with an increased probability to stay for the first job. This can also mean that none of our quality indicators capture a researcher's ability well, and that we should continue to look for better ways of measuring it.

In this stay/return analysis, we have so far disregarded at which specific institute a researcher works, and have only looked at the location of the first job. However, a top PhD holder may also attach more importance to the prestige and the quality of the specific institute where she works. The hypothesis that top PhD holders are more likely to stay in the US is based partly on the fact that the US harbors the majority of the top institutes in economics, which form an attractive environment for talented researchers to work in. However, top institutes are very selective in their recruitment procedures, and not all researchers will receive an offer from such an institute. Nevertheless, researchers with a top PhD are found to be more likely to get their first job at a top institute (Allison and Long, 1987; Burris, 2004; Smeets et al., 2006). Our quality indicators are also positively and significantly related to the probability of working at a top institute for the first job, with the exception of a co-authoring advisor and pre-PhD publications (see table VI).

¹⁰ As the number of observations for pre-PhD co-authoring advisor is so small, we do not include it in the regression analyses.

We therefore include the quality of the work environment into our analysis, and make a distinction between staying at a top institute and staying at a non-top institute, versus returning to a top institute and returning to a non-top institute. Table VII presents the quality indicators by location and prestige of the first job. 29.6% of the researchers in our sample stay at a top institute, whereas 40.8% stay at a non-top institute. 5.07% return to a top institute in the EU, compared to 24.53% who return to a non-top institute. Researchers with a top or a supertop PhD are significantly more likely to stay at a top institute and to return to a top institute, and significantly less likely to stay at a non-top institute, however. Those with a highly cited advisor are more likely to stay at a top institute and less likely to stay at a non-top institute, but not more likely to return to a top institute in Europe. Curiously, having a co-authoring advisor (be it during or after the PhD) is associated with a significantly higher probability of staying at a non-top institute. Having a pre-PhD publication is associated to a higher likelihood of staying at a top institute, and a lower probability of returning to a non-top institute in Europe. Finally, the impact factor of the first publication of those who stay at a top institute is significantly higher than that of their peers, while the reverse is true for those who work at a non-top institute in the US or in Europe.

To see how the different quality indicators are related to researchers' outcome in terms of the prestige and location of the first job, we run a series of multinomial logit models with 4 possible outcomes: stay at a top institute, stay at a non-top institute, return to a top institute, and return to a non-top institute. The last option is the base outcome. The results are reported in tables VIII and IX. The coefficients have been transformed into relative risk ratios, which can be interpreted as the factor increase in the likelihood of an outcome relative to the base outcome.

Having a top PhD or a supertop PhD (columns 1-3 and columns 4-6) significantly increases the likelihood to stay at a top institute, but also to return to a top institute: researchers with a top PhD are 7 times more likely to stay at a top institute, and 5.7 times more likely to return to a European top institute compared to their peers without a top PhD. This suggests that for top PhD holders, the prestige of the first job is more important than the location. The increases in probability for staying at a top institute are larger than the coefficients for returning to a top institute, indicating that the former option is the preferred one for researchers with a top PhD. A Wald test for combining outcomes rejects that these two categories should be combined, indicating that the location of a top institute is also a relevant parameter for European researchers.

A highly cited advisor almost doubles the probability to stay at a top institute, but has no significant effect on return to a top institute (columns 7-9). Having a co-authoring advisor has no significant effect on the likelihood of any of the options (columns 10-12). A publication prior to the PhD significantly increases the likelihood of staying at a top institute almost sevenfold, but also makes the likelihood of staying at a non-top institute 2.5 more likely (table IX, columns 1-3). This suggests that an early publication is a strong signal on the US academic labor market, but less so in Europe. Finally, the impact factor of the first publication is also positively and significantly associated to a higher likelihood of staying at a top institute (columns 4-6). Including all quality indicators together reveals that having a top PhD, an early publication and a high impact factor on the first publication are all significantly associated with a higher probability of staying at a top institute, whereas the other quality indicators lose significance when all quality indicators are controlled for (columns 7-9). None of the quality indicators

remain significant for return to a top institute. This suggests that the most promising students are indeed more likely to stay in the US, but only if employed at a top institute. Returning to a top institute in Europe seems to be a compelling alternative for some top students, but not all.

The source of funding for the PhD clearly has an impact on the location of the first job, but less so on the prestige of the employing institute. Researchers who were funded by their host institute are more likely to stay, whereas researchers funded by their home country are more likely to return. There are few consistent patterns in the home region dummies, but researchers from Anglo-Saxon origin are significantly more likely to stay in the US, perhaps due to cultural and linguistic similarities, as well as similarities in their higher education and research systems. However, in some of the models, researchers from Anglo-Saxon countries are also significantly more likely to return to top institutes in Europe. This is probably related to the fact that the UK hosts several of Europe's top institutes.

4.2 Current job

This section deals with the determinants of the prestige and location of the current job. Once researchers start working in a particular location, they may become more embedded in that particular research system over time, making mobility later in the career more costly. Moreover, factors that affect immediate return, such as the source of PhD funding and the quality of the PhD, should no longer immediately affect location decisions at later stages in the career.

For the majority of researchers in our sample, the location of the current job is the same as that of the first job. Table X contains the location of the current job cross-tabulated with the location of the first job. For the current job, the share of returnees has grown from 29.60% for the first job to 36.80%. Of those who returned to Europe for the first job, 81.98% are still in Europe for the current job. The other 18.02% have returned to the US for their current job. Of those who initially stayed, 82.2% are still working in the US or Canada, whereas the remaining 17.8% have returned to Europe in the meantime. Although there is still some mobility after the first job, it is clear that the location choice for the first job is rather persistent for the majority of researchers. A Pearson's Chi square test indeed rejects the hypothesis that the location of the first job and the current job are independent.

Given that location choices appear quite persistent, how does the location of the first job affect the probability of a researcher working in a specific location at a top or non-top institute now? Table XI divides the institutes where European PhD holders currently work into four categories: stay at a top institute, stay at a non-top institute, return to a top institute and return to a non-top institute. We examine what share of researchers in each category held their first job in the US or Canada, at a top or a non-top institute.

Of the 63.20% who hold their current job in the US or Canada, 28% are working at a top institute and 35.20% at a non-top institute. Among the returnees, 4.8% are working at a top institute in Europe, and 32% at a non-top institute. The share of returnees currently working at a non-top institute has increased

compared to the first job, when only 24.53% was working at a non-top institute. It appears that later return mostly happens by researchers who initially stayed in the US at a non-top institute, and who later return to a non-top institute in Europe. On average, however, researchers who initially stayed are significantly more likely to currently work in the US and significantly less likely to work in Europe, regardless of the prestige of the employing institute. More specifically, however, researchers who initially stayed at a top institute are significantly more likely to currently still work at a US top institute, but significantly less likely to work at a US non-top institute. Conversely, researchers who initially stayed at a non-top institute are significantly less likely to be working at a US top institute, and significantly more likely to be working at a US non-top institute, indicating that there is also strong persistence in the prestige of first and later jobs, as reported by other authors (Allison and Long, 1987; Burris, 2007).

In table XII, we run 3 multinomial logit models to test the descriptive findings in a multivariate framework. The multinomial logit models again have 4 possible outcomes: stay top, stay non-top, return top and return non-top, with the last option as the base outcome. The first model includes a dummy variable that indicates whether the researcher stayed in the US or Canada for the first job, along with all the control variables (columns 1-3). The second model splits this dummy variable into two dummies: one for staying at a top institute for the first job, and another for staying at a non-top institute (columns 4-6). In the last model, the dummies for staying for the first job and for staying at a top institute for the first job are included together, to check whether staying at a top institute has any additional effect on top of the stay dummy (columns 7-9). Instead of coefficients, again relative risk ratios are reported.

The first model confirms that researchers who stay for their first job are significantly more likely to still be in the US or Canada for the current job, both at top and non-top institutes. The relative risk ratios are very high, indicating a very strong effect: initial stayers are 15 times more likely to currently be working at a top US institute, and 26 times more likely to currently work at a non-top institute in the US. In the second model, we observe that those who initially stay at a top institute have a very strong likelihood of still working at a top institute, and a smaller, though strongly significant likelihood of currently staying at a non-top institute. Those who initially stay at a non-top institute are also significantly more likely to currently work at a top institute in the US or Canada, though the relative risk ratio is much smaller than for a first job at a top institute. The coefficient for currently staying at a non-top institute is, naturally, a lot larger. Finally, in the last model we observe that staying at a top institute indeed has an additional effect on top of the initial stay dummy, indicating that researchers who stay at a top institute are indeed more likely to stay than their peers who initially stay at a non-top institute, though only for the option of currently staying at a top institute as well.

None of the initial stayers display any significantly higher likelihood of returning to a top institute in Europe. This suggests that top institutes in Europe are not sufficiently attractive to draw top European researchers back once they have started to work in the US, especially at top institutes. From the European perspective, it appears that the most promising researchers are indeed attracted to stay in the US at top institutes, and once they decide to do so are not very likely to return to Europe. This suggests that there is indeed an 'elite brain drain' among European economics PhD holders who obtain their degree in the US or Canada.

5 Conclusion

Many world regions, including Europe, have the perception that their best students and researchers leave to study and work in the United States. This phenomenon has been coined ‘the elite brain drain’. With a sample of European students who obtain a PhD in economics in the US, we study whether the most promising among them are indeed less likely to return. We find that PhD recipients from top institutes, or with a highly cited advisor, or a pre-PhD publication or a higher impact factor on their first publication are more likely to stay in the US or Canada *at a top institute*. PhD holders with these quality indicators are not particularly more likely to stay at a non-top institute, but somewhat more likely to return to top institutes in Europe, although this last result is not very robust. This indicates that the quality of the working environment is of crucial importance to top researchers, and that the attraction of the US consists for a big part of its many top economics departments.

The location choice made for the first job strongly predicts the location of the current job: 82% of those who initially stayed in the US or Canada are still working there for the first job, while 18% of those who return to Europe for their first job revise that decision and are currently working in the US or Canada again. Researchers who initially stayed at a top institute are significantly more likely to still be working in the US or Canada, particularly at a top institute, compared to European researchers who initially stayed at a non-top institute. Once a top researcher has made the decision to stay, particularly at a top institute, the probability of his or her return becomes very small. This suggests that from the European perspective, there is indeed an ‘elite brain drain’, as its most talented researchers, once embedded in the North American research system, are not very likely to return.

Tables

Table I: Universities by tier and location

Tier	US + Canada	Europe	Definition of tier
Supertop	<ul style="list-style-type: none"> • Harvard University • MIT • University of Chicago • Princeton University • University of Pennsylvania • Stanford University • University of California, Berkeley • Northwestern University • Columbia University • New York University • University of Michigan 	/	In top 15 of all 3 rankings
Midtop	<ul style="list-style-type: none"> • Yale University • University of California, Los Angeles • University of California, San Diego • Duke University • University of Wisconsin - Madison • University of Maryland • University of California, Davis • University of Minnesota • Boston University • Brown University • University of British Columbia • Michigan State University • University of Washington • Queen's University 	<ul style="list-style-type: none"> • London School of Economics • University of Oxford • Tel Aviv University • University of Cambridge • University College London • University of Toulouse • Hebrew University 	In top 50 of all 3 rankings
Subtop	/	<ul style="list-style-type: none"> • University of Essex • University of Warwick • University of Amsterdam • University of York • Erasmus University Rotterdam • University of Nottingham • Universitat Pompeu Fabra • Stockholm School of Economics 	In top 100 of all 3 rankings

Table II: Summary statistics of the explanatory variables

	type	mean	std dev	min	max
top PhD institute	0/1	0.66	-	0	1
supertop PhD institute	0/1	0.48	-	0	1
highly cited advisor	0/1	0.29	-	0	1
co-authoring advisor	0/1	0.25	-	0	1
pre-PhD publication	0/1	0.15	-	0	1
impact factor first publication	continuous	0.97	0.83	0.048	4.412
age at first job	continuous	29.44	2.41	25	42
Female	0/1	0.20	-	0	1
top economics departments pc	continuous	0.29	0.36	0	1.46
funding source: host	0/1	0.40	-	0	1
funding source: other US institution	0/1	0.21	-	0	1
funding source: home	0/1	0.22	-	0	1
eastern Europe	0/1	0.06	-	0	1
central Europe	0/1	0.07	-	0	1
Mediterranean	0/1	0.06	-	0	1
Scandinavia	0/1	0.06	-	0	1
Anglo-Saxon countries	0/1	0.04	-	0	1
Turkey	0/1	0.14	-	0	1
Israel	0/1	0.06	-	0	1
cohort 1992-1996	0/1	0.29	-	0	1
cohort 1997-2001	0/1	0.50	-	0	1
cohort 2002-2006	0/1	0.21	-	0	1

Table III First job location by home region and home country

home region	stay	home	third	total
Mediterranean countries	61.36	24.24	14.40	133
Western Europe	71.08	13.25	15.67	83
Turkey	73.58	22.64	3.78	53
Central Europe	84.62	7.69	7.69	25
Israel	82.61	8.70	8.69	23
Eastern Europe	90.48	4.76	4.76	21
Scandinavian countries	61.90	28.57	9.53	21
Anglo-Saxon Europe	75.00	25.00	0.00	16
total	70.40	18.67	10.93	375

home country	stay	home	third	total
Italy	63.64	18.18	18.18	77
Turkey	73.58	22.64	3.78	53
Germany	72.97	16.22	10.81	37
Spain	52.94	41.18	5.88	34
Israel	82.61	8.70	8.69	23
France	68.42	15.79	15.79	19
Russia	86.67	6.67	6.66	15
Greece	73.33	13.33	13.34	15
UK	71.43	28.57	0.00	14
Denmark	80.00	10.00	10.00	10
Belgium	55.56	11.11	33.33	9
Hungary	62.50	12.50	25.00	8
Austria	71.43	14.29	14.28	7
Switzerland	85.71	0.00	14.29	7

Table IV: Quality indicators by stay/return for the first job

First job	return	stay	obs
all	111	264	375
%	29.6	70.4	100
Top PhD	71	174	245
%	28.98	71.02	100
Supertop PhD	51	127	178
%	28.65	71.35	100
Highly cited advisor	28	81	109
%	25.69	74.31	100
Co-authoring advisor	19	77	96
%	19.79	80.21**	100
Pre-PhD publications	8	47	55
%	14.55	85.45***	100
Pre-PhD co-authoring advisor	2	24	26
%	7.69	92.31*	100
Impact factor	0.85	1.06**	375

Table V: Logit models for the probability to stay (first job)

VARIABLES	(1) stay	(2) stay	(3) stay	(4) stay	(5) stay	(6) stay	(7) stay
PhD in a top institute	0.0825 (0.374)						0.0767 (0.413)
PhD in toptop institute		-0.0149 (0.315)					-0.167 (0.356)
highly cited advisor			0.0617 (0.249)				-0.0629 (0.260)
co-authoring advisor				0.330 (0.317)			0.266 (0.295)
Pre-PhD publication(s)					1.206** (0.468)		1.450*** (0.423)
impact factor of first publication						0.316 (0.217)	0.427* (0.238)
age at first job	-0.0543 (0.0498)	-0.0571 (0.0492)	-0.0561 (0.0488)	-0.0549 (0.0485)	-0.0763 (0.0500)	-0.0417 (0.0488)	-0.0630 (0.0523)
female	-0.203 (0.204)	-0.216 (0.208)	-0.208 (0.205)	-0.225 (0.193)	-0.224 (0.221)	-0.170 (0.205)	-0.209 (0.215)
top economics departments p/c relative to US	-0.229 (0.494)	-0.220 (0.492)	-0.217 (0.501)	-0.227 (0.477)	-0.422 (0.521)	-0.291 (0.501)	-0.579 (0.515)
funding source: host institution	0.608** (0.300)	0.614** (0.300)	0.609** (0.308)	0.627** (0.299)	0.716* (0.368)	0.608* (0.314)	0.767** (0.369)
funding source: other US institution	0.486 (0.398)	0.501 (0.392)	0.494 (0.413)	0.490 (0.402)	0.526 (0.409)	0.474 (0.404)	0.495 (0.409)
funding source: home country	-1.418** (0.574)	-1.408** (0.561)	-1.408** (0.555)	-1.412*** (0.547)	-1.495*** (0.571)	-1.430*** (0.549)	-1.543*** (0.572)
Eastern Europe - non EU	0.694** (0.322)	0.685** (0.307)	0.707** (0.347)	0.684** (0.314)	0.742** (0.318)	0.703** (0.302)	0.770** (0.337)
Central Europe - EU	0.828 (0.727)	0.811 (0.724)	0.833 (0.746)	0.798 (0.721)	0.765 (0.690)	0.823 (0.747)	0.721 (0.740)
Mediterranean countries	0.0792 (0.320)	0.0889 (0.322)	0.0933 (0.335)	0.0764 (0.320)	0.0560 (0.344)	0.0161 (0.326)	-0.0697 (0.347)
Scandinavian countries	0.430 (0.630)	0.448 (0.633)	0.448 (0.631)	0.414 (0.641)	0.413 (0.687)	0.477 (0.630)	0.448 (0.691)
Anglosaxon countries	0.615 (0.397)	0.606 (0.400)	0.628 (0.407)	0.522 (0.350)	0.577 (0.432)	0.711* (0.414)	0.596 (0.423)
Turkey	0.370 (0.315)	0.343 (0.328)	0.372 (0.333)	0.339 (0.289)	0.346 (0.313)	0.424 (0.285)	0.390 (0.336)
Israel	0.291 (0.360)	0.291 (0.361)	0.304 (0.357)	0.291 (0.343)	0.314 (0.380)	0.229 (0.355)	0.226 (0.346)
cohort 1992-1996	-1.542*** (0.311)	-1.540*** (0.321)	-1.542*** (0.314)	-1.482*** (0.312)	-1.419*** (0.307)	-1.521*** (0.285)	-1.312*** (0.267)
cohort 1997-2001	-0.883*** (0.222)	-0.882*** (0.229)	-0.888*** (0.226)	-0.862*** (0.220)	-0.758*** (0.218)	-0.927*** (0.205)	-0.758*** (0.215)
Constant	3.319** (1.501)	3.451** (1.449)	3.394** (1.426)	3.294** (1.404)	3.857*** (1.413)	2.753* (1.423)	3.098* (1.589)
Observations	375	375	375	375	375	375	375

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table VI: Logit models for the probability of a top first job

VARIABLES	(1) Top first job	(2) Top first job	(3) Top first job	(4) Top first job	(5) Top first job	(6) Top first job	(7) Top first job
PhD in a top institute	1.913*** (0.326)						1.213*** (0.397)
PhD in toptop institute		1.670*** (0.234)					0.945*** (0.272)
highly cited advisor			0.596** (0.275)				-0.0350 (0.274)
co-authoring advisor				-0.183 (0.340)			0.191 (0.405)
Pre-PhD publication(s)					0.627 (0.565)		0.491 (0.551)
impact factor of first publication						0.586*** (0.108)	0.592*** (0.126)
age at first job	-0.119* (0.0664)	-0.134* (0.0685)	-0.152** (0.0641)	-0.173*** (0.0654)	-0.181*** (0.0598)	-0.138** (0.0619)	-0.0980 (0.0654)
female	-0.824** (0.338)	-0.726** (0.296)	-0.957*** (0.293)	-0.976*** (0.307)	-0.975*** (0.297)	-0.938*** (0.303)	-0.698** (0.308)
top economics departments p/c relative to US	-0.0759 (0.568)	-0.119 (0.622)	-0.0413 (0.540)	-0.0658 (0.531)	-0.183 (0.560)	-0.219 (0.536)	-0.304 (0.621)
funding source: host institution	0.548** (0.262)	0.470* (0.264)	0.638** (0.260)	0.673** (0.273)	0.706** (0.288)	0.680** (0.319)	0.486 (0.307)
funding source: other US institution	0.292 (0.343)	0.323 (0.363)	0.461 (0.363)	0.576* (0.331)	0.548* (0.324)	0.531* (0.307)	0.180 (0.348)
funding source: home country	-0.150 (0.311)	-0.137 (0.346)	0.0423 (0.306)	0.00887 (0.294)	0.00246 (0.302)	-0.0407 (0.312)	-0.218 (0.367)
Eastern Europe - non EU	-0.565 (0.499)	-0.768 (0.491)	-0.583 (0.439)	-0.669 (0.441)	-0.635 (0.435)	-0.678 (0.455)	-0.494 (0.479)
Central Europe - EU	0.491 (0.777)	0.309 (0.710)	0.235 (0.714)	0.116 (0.742)	0.0440 (0.770)	0.0954 (0.706)	0.464 (0.730)
Mediterranean countries	-0.460 (0.464)	-0.370 (0.402)	-0.241 (0.409)	-0.262 (0.422)	-0.314 (0.418)	-0.481 (0.446)	-0.676 (0.432)
Scandinavian countries	0.174 (0.614)	0.196 (0.618)	0.546 (0.617)	0.547 (0.607)	0.487 (0.635)	0.620 (0.624)	0.199 (0.639)
Anglosaxon countries	0.296 (0.343)	0.514 (0.416)	0.377 (0.398)	0.231 (0.406)	0.110 (0.391)	0.359 (0.434)	0.543 (0.361)
Turkey	-0.798 (0.502)	-0.845* (0.452)	-0.936** (0.424)	-1.118** (0.474)	-1.182** (0.475)	-1.035** (0.494)	-0.702 (0.465)
Israel	-0.121 (0.376)	-0.195 (0.439)	0.0368 (0.384)	-0.0857 (0.387)	-0.0297 (0.391)	-0.236 (0.386)	-0.237 (0.389)
cohort 1992-1996	0.533* (0.289)	0.426 (0.279)	0.469* (0.255)	0.428 (0.264)	0.628** (0.284)	0.533* (0.277)	0.730* (0.402)
cohort 1997-2001	1.211*** (0.371)	1.093*** (0.371)	1.107*** (0.342)	1.124*** (0.339)	1.286*** (0.401)	1.068*** (0.337)	1.271*** (0.439)
Constant	0.465 (2.064)	1.450 (2.144)	2.537 (2.044)	3.395 (2.121)	3.420* (1.984)	1.851 (2.007)	-0.820 (2.154)
Observations	375	375	375	375	375	375	375

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table VII: Quality indicators by location and top/non-top first job

first job	stay top	stay non top	return top	return non top	total
all	111	153	19	92	375
%	29.60	40.80	5.07	24.53	100.00
Top PhD	99	75	17	54	245
%	40.41***	30.61***	6.94**	22.04	100.00
Supertop PhD	83	44	13	38	178
%	46.63***	24.72***	7.3*	21.35	100.00
Highly cited advisor	48	33	7	21	109
%	44.04***	30.28***	6.42	19.27	100.00
Co-authoring advisor	26	51	3	16	96
%	27.08	53.13***	3.13	16.67**	100.00
Pre-PhD publications	25	22	2	6	55
%	45.45***	40	3.64	10.91**	100.00
Pre-PhD co-authoring advisor	8	16	0	2	26
%	30.77	61.54***	0.00	7.69	100.00
impact factor	1.37***	0.84***	0.95	0.83**	375

note: t-tests comparing the probability of each outcome between researchers with and without that quality characteristic

t-test for impact factor for significant difference between outcomes

Table VIII: Multinomial logit model for the prestige and location of the first job

VARIABLES	(1) Stay top	(2) Stay non top	(3) Return top	(4) Stay top	(5) Stay non top	(6) Return top	(7) Stay top	(8) Stay non top	(9) Return top	(10) Stay top	(11) Stay non top	(12) Return top
PhD in a top institute	7.031*** (3.693)	0.700 (0.298)	5.732** (4.745)									
PhD in toptop institute				3.917*** (1.745)	0.557 (0.211)	3.168** (1.617)						
highly cited advisor							1.901* (0.664)	0.870 (0.269)	2.081 (1.039)			
co-authoring advisor										1.029 (0.376)	1.466 (0.618)	0.577 (0.487)
age at first job	0.900 (0.0634)	0.962 (0.0554)	0.964 (0.110)	0.886* (0.0641)	0.963 (0.0557)	0.948 (0.101)	0.870* (0.0631)	0.967 (0.0530)	0.941 (0.108)	0.854** (0.0628)	0.974 (0.0543)	0.930 (0.112)
female	0.461** (0.148)	1.095 (0.242)	0.875 (0.430)	0.495** (0.140)	1.028 (0.227)	0.942 (0.489)	0.411*** (0.102)	1.104 (0.241)	0.766 (0.393)	0.399*** (0.105)	1.106 (0.238)	0.782 (0.422)
funding source: host institution	2.615*** (0.930)	1.766* (0.523)	1.955 (1.127)	2.451*** (0.812)	1.851** (0.549)	1.845 (1.062)	2.802*** (0.938)	1.650 (0.521)	1.961 (1.171)	2.935*** (0.991)	1.673* (0.504)	1.937 (1.131)
funding source: other US institution	2.391* (1.232)	1.287 (0.471)	1.546 (1.024)	2.562* (1.327)	1.372 (0.508)	1.775 (1.153)	2.719* (1.453)	1.274 (0.527)	1.804 (1.157)	2.969** (1.496)	1.189 (0.494)	1.909 (1.190)
funding source: home country	0.289** (0.148)	0.192*** (0.122)	0.810 (0.646)	0.302** (0.155)	0.190*** (0.114)	0.871 (0.718)	0.347** (0.169)	0.186*** (0.111)	0.995 (0.823)	0.333** (0.158)	0.186*** (0.109)	0.992 (0.908)
cohort 1992-1996	0.498** (0.173)	0.179*** (0.0689)	2.501 (2.445)	0.461** (0.166)	0.185*** (0.0731)	2.479 (2.474)	0.445** (0.151)	0.185*** (0.0710)	2.597 (2.620)	0.441** (0.154)	0.198*** (0.0758)	2.327 (2.385)
cohort 1997-2001	1.246 (0.412)	0.311*** (0.0947)	4.240** (2.805)	1.127 (0.389)	0.332*** (0.101)	4.017** (2.773)	1.106 (0.334)	0.322*** (0.0969)	3.765* (2.683)	1.137 (0.348)	0.326*** (0.0992)	3.828* (2.681)
Eastern Europe - non EU	1.086 (0.520)	2.060*** (0.387)	4.27e- 07*** (5.60e- 07)	0.893 (0.502)	2.039*** (0.400)	1.18e- 07*** (1.58e- 07)	1.115 (0.547)	2.102*** (0.460)	5.11e- 07*** (6.29e- 07)	1.028 (0.448)	2.085*** (0.372)	1.46e- 07*** (1.95e- 07)
Central Europe - EU	2.531 (1.874)	1.791 (1.431)	5.92e- 07*** (6.83e- 07)	2.030 (1.287)	1.745 (1.417)	1.68e- 07*** (1.85e- 07)	2.021 (1.264)	1.942 (1.656)	5.74e- 07*** (5.93e- 07)	1.793 (1.071)	1.914 (1.624)	1.76e- 07*** (1.92e- 07)
Mediterranean countries	0.757 (0.190)	1.276 (0.263)	0.560 (0.464)	0.848 (0.245)	1.224 (0.239)	0.630 (0.506)	0.925 (0.200)	1.180 (0.263)	0.656 (0.510)	0.907 (0.187)	1.155 (0.253)	0.638 (0.533)
Scandinavian countries	1.173 (0.920)	1.175 (0.873)	0.324 (0.426)	1.247 (1.014)	1.173 (0.816)	0.338 (0.451)	1.667 (1.284)	0.956 (0.706)	0.403 (0.515)	1.639 (1.268)	0.901 (0.635)	0.393 (0.545)
Anglosaxon countries	2.364***	3.027**	3.785*	2.705***	2.714**	4.085**	2.696***	2.849**	4.162**	2.133***	2.644**	3.599*

Turkey	(0.747) 0.752	(1.389) 1.645***	(2.825) 4.01e-07***	(0.704) 0.680	(1.326) 1.506**	(2.869) 1.22e-07***	(0.673) 0.665*	(1.365) 1.607**	(2.929) 3.60e-07***	(0.553) 0.551**	(1.123) 1.629***	(2.590) 1.03e-07***
Israel	(0.187) 0.968	(0.282) 1.142	(4.80e-07) 0.367	(0.177) 0.865	(0.257) 1.093	(1.47e-07) 0.321	(0.145) 1.102	(0.313) 0.996	(4.34e-07) 0.404	(0.129) 0.952	(0.263) 1.019	(1.30e-07) 0.351
Constant	(0.225) 5.799	(0.238) 18.22*	(0.274) 0.0748	(0.207) 19.23	(0.221) 17.61*	(0.222) 0.233	(0.230) 52.37*	(0.196) 13.77*	(0.261) 0.406	(0.205) 115.4**	(0.186) 9.880	(0.251) 0.876
Observations	375	375	375	375	375	375	375	375	375	375	375	375

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table IX: Multinomial logit model for the prestige and location of the first job (continued)

VARIABLES	(1) Stay top	(2) Stay non top	(3) Return top	(4) Stay top	(5) Stay non top	(6) Return top	(7) Stay top	(8) Stay non top	(9) Return top
PhD in a top institute							4.625*** (2.587)	0.943 (0.428)	3.589 (3.754)
PhD in toptop institute							1.503 (0.693)	0.564 (0.229)	1.529 (0.949)
highly cited advisor							1.019 (0.331)	1.113 (0.387)	1.450 (0.638)
co-authoring advisor							1.327 (0.592)	1.323 (0.487)	0.886 (0.703)
Pre-PhD publication(s)	6.894*** (4.987)	2.581* (1.382)	2.286 (2.368)				7.703*** (5.314)	3.301** (1.690)	1.705 (1.954)
impact factor of first publication				1.955** (0.513)	0.960 (0.277)	1.048 (0.260)	2.269*** (0.659)	1.040 (0.319)	0.982 (0.299)
age at first job	0.821*** (0.0586)	0.957 (0.0552)	0.920 (0.105)	0.887 (0.0646)	0.971 (0.0531)	0.939 (0.108)	0.898 (0.0638)	0.939 (0.0577)	0.957 (0.110)
female	0.396*** (0.109)	1.080 (0.246)	0.721 (0.364)	0.417*** (0.0991)	1.102 (0.239)	0.740 (0.377)	0.500** (0.157)	0.988 (0.228)	0.996 (0.509)
funding source: host institution	3.381*** (1.425)	1.841* (0.680)	2.211 (1.274)	2.933*** (1.086)	1.690* (0.538)	2.010 (1.230)	2.913** (1.299)	2.159** (0.776)	1.904 (0.919)
funding source: other US institution	2.994** (1.560)	1.276 (0.533)	1.958 (1.261)	2.911** (1.422)	1.219 (0.501)	1.971 (1.283)	2.257 (1.206)	1.380 (0.546)	1.705 (1.136)
funding source: home country	0.293** (0.155)	0.168*** (0.104)	0.858 (0.769)	0.309** (0.145)	0.187*** (0.113)	0.908 (0.797)	0.236** (0.134)	0.169*** (0.107)	0.759 (0.629)
cohort 1992-1996	0.625* (0.177)	0.200*** (0.0780)	2.749 (2.879)	0.476** (0.171)	0.187*** (0.0722)	2.503 (2.543)	0.843 (0.317)	0.217*** (0.0762)	2.552 (2.691)
cohort 1997-2001	1.575 (0.566)	0.351*** (0.0978)	4.249** (3.064)	1.054 (0.308)	0.334*** (0.0944)	3.898** (2.663)	1.733 (0.622)	0.380*** (0.108)	4.114* (3.258)
Eastern Europe - non EU	1.331 (0.591)	2.307*** (0.473)	1.51e-07*** (1.96e-07)	1.139 (0.441)	2.184*** (0.404)	1.54e-07*** (2.00e-07)	1.868 (0.901)	2.573*** (0.657)	7.95e-07*** (9.89e-07)
Central Europe - EU	1.787 (1.045)	1.970 (1.567)	1.44e-07*** (1.49e-07)	1.938 (1.210)	1.966 (1.657)	1.67e-07*** (1.80e-07)	2.994 (2.292)	1.873 (1.460)	1.16e-06*** (1.31e-06)
Mediterranean countries	0.915 (0.237)	1.205 (0.280)	0.646 (0.539)	0.759 (0.161)	1.198 (0.246)	0.621 (0.500)	0.616 (0.199)	1.288 (0.291)	0.610 (0.442)
Scandinavian countries	1.478 (1.281)	0.931 (0.689)	0.376 (0.495)	1.809 (1.407)	0.974 (0.722)	0.393 (0.530)	1.196 (1.043)	1.106 (0.795)	0.291 (0.400)
Anglosaxon countries	1.682* (0.470)	2.824** (1.418)	3.017 (2.068)	2.454*** (0.696)	2.979** (1.426)	3.260 (2.424)	2.154* (0.879)	2.483* (1.355)	4.772* (3.817)
Turkey	0.581**	1.733***	9.06e-08***	0.665*	1.645***	9.96e-08***	1.041	1.745***	8.24e-07***

	(0.126)	(0.292)	(1.15e-07)	(0.151)	(0.274)	(1.29e-07)	(0.246)	(0.346)	(9.93e-07)
Israel	0.873	0.918	0.317*	0.736	1.018	0.323*	0.688	0.997	0.360*
	(0.207)	(0.211)	(0.210)	(0.160)	(0.194)	(0.217)	(0.186)	(0.318)	(0.194)
Constant	215.1**	15.85*	0.952	19.94	12.04	0.592	1.587	25.72*	0.0845
	(454.7)	(25.26)	(3.257)	(44.50)	(18.43)	(2.096)	(3.621)	(47.96)	(0.317)
Observations	375	375	375	375	375	375	375	375	375

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table X: Location of the current job by location of the first job

	Current EU	Current US	obs
Return for first job	91	20	111
%	<i>81.98</i>	<i>18.02</i>	<i>100.00</i>
Stay for first job	47	217	264
%	<i>17.80</i>	<i>82.20</i>	<i>100.00</i>
total	138	237	375
%	<i>36.80</i>	<i>63.20</i>	<i>100.00</i>

Pearson's Chi square test statistic: 138.3936 p-value: 0.000

Table XI: Location and prestige of the current job

	US top	US non top	EU top	EU non top	total
first job	111	153	19	92	375
%	<i>29.60</i>	<i>40.80</i>	<i>5.07</i>	<i>24.53</i>	<i>100.00</i>
current job	105	132	18	120	375
%	<i>28.00</i>	<i>35.20</i>	<i>4.80</i>	<i>32.00</i>	<i>100.00</i>
first job stay	94	123	7	40	264
%	<i>35.61***</i>	<i>123***</i>	<i>2.65***</i>	<i>15.15***</i>	<i>100.00</i>
first job stay top	83	15	3	10	111
%	<i>74.77***</i>	<i>13.51***</i>	<i>2.70</i>	<i>9.01***</i>	<i>100.00</i>
first job stay non top	11	108	4	30	153
%	<i>7.19***</i>	<i>70.59***</i>	<i>2.61</i>	<i>19.61***</i>	<i>100.00</i>

Table XII: Multinomial logit models for location and prestige of the current job

VARIABLES	(1) US top	(2) US non top	(3) EU top	(4) US top	(5) US non top	(6) EU top	(7) US top	(8) US non top	(8) EU top
first job stay	14.85*** (5.209)	26.27*** (13.23)	1.281 (0.568)				2.132* (0.914)	25.14*** (12.44)	0.830 (0.468)
stay top				120.8*** (80.87)	15.75*** (10.48)	2.947* (1.676)	56.67*** (42.46)	0.626 (0.271)	3.549 (2.848)
stay non top				2.132* (0.914)	25.14*** (12.44)	0.830 (0.468)			
age	0.879* (0.0611)	0.902 (0.0620)	0.887 (0.0719)	0.888* (0.0560)	0.891* (0.0586)	0.886 (0.0676)	0.888* (0.0560)	0.891* (0.0586)	0.886 (0.0676)
female	0.594 (0.409)	1.357 (0.974)	3.496*** (1.548)	0.783 (0.517)	1.297 (0.948)	3.718*** (1.621)	0.783 (0.517)	1.297 (0.948)	3.718*** (1.621)
funding source: host institution	0.654 (0.291)	0.606 (0.240)	0.762 (0.402)	0.333* (0.211)	0.686 (0.293)	0.688 (0.384)	0.333* (0.211)	0.686 (0.293)	0.688 (0.384)
funding source: other US institution	2.203 (1.134)	1.257 (0.479)	1.047 (0.726)	1.319 (0.925)	1.389 (0.554)	1.023 (0.740)	1.319 (0.925)	1.389 (0.554)	1.023 (0.740)
funding source: home country	0.474* (0.209)	0.248*** (0.0925)	1.294 (0.734)	0.373* (0.188)	0.263*** (0.113)	1.252 (0.678)	0.373* (0.188)	0.263*** (0.113)	1.252 (0.678)
cohort 1992-1996	0.161** (0.140)	0.120*** (0.0754)	0.599 (0.520)	0.0592*** (0.0460)	0.164*** (0.101)	0.528 (0.480)	0.0592*** (0.0460)	0.164*** (0.101)	0.528 (0.480)
cohort 1997-2001	0.263* (0.203)	0.223** (0.142)	0.297* (0.191)	0.0914** (0.0850)	0.339 (0.225)	0.254* (0.181)	0.0914** (0.0850)	0.339 (0.225)	0.254* (0.181)
Eastern Europe - non EU	0.309 (0.289)	1.510 (0.634)	7.71e-07*** (9.20e-07)	0.268 (0.265)	1.487 (0.645)	8.50e-07*** (1.00e-06)	0.268 (0.265)	1.487 (0.645)	8.50e-07*** (1.00e-06)
Central Europe - EU	0.661 (0.469)	1.547 (0.992)	1.21e-06*** (1.06e-06)	0.473 (0.343)	1.680 (1.088)	1.22e-06*** (1.11e-06)	0.473 (0.343)	1.680 (1.088)	1.22e-06*** (1.11e-06)
Mediterranean countries	0.741 (0.309)	1.390 (0.490)	0.832 (0.444)	0.714 (0.366)	1.333 (0.481)	0.790 (0.452)	0.714 (0.366)	1.333 (0.481)	0.790 (0.452)
Scandinavian countries	0.384 (0.441)	1.408 (0.840)	5.86e-07*** (3.50e-07)	0.110 (0.207)	1.798 (1.110)	4.90e-07*** (2.98e-07)	0.110 (0.207)	1.798 (1.110)	4.90e-07*** (2.98e-07)
Anglosaxon countries	4.783*** (1.455)	9.591*** (4.280)	6.059*** (3.386)	5.527*** (2.577)	9.613*** (4.260)	6.036*** (3.642)	5.527*** (2.577)	9.613*** (4.260)	6.036*** (3.642)
Turkey	0.0857*** (0.0304)	0.415*** (0.121)	0.198*** (0.0603)	0.0859*** (0.0380)	0.417** (0.146)	0.200*** (0.0625)	0.0859*** (0.0380)	0.417** (0.146)	0.200*** (0.0625)
Israel	0.574 (0.208)	3.565*** (1.019)	10.05*** (3.922)	0.288*** (0.117)	4.103*** (1.447)	8.691*** (3.281)	0.288*** (0.117)	4.103*** (1.447)	8.691*** (3.281)
Constant	209.5* (611.5)	43.73 (122.1)	27.31 (91.34)	434.1** (1,276)	52.22 (145.6)	34.20 (110.6)	434.1** (1,276)	52.22 (145.6)	34.20 (110.6)
Observations	375	375	375	375	375	375	375	375	375

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

References

Alberts, Heike C. and Helen D. Hazen, (2005), "There are always two voices...": International Students' Intentions to Stay in the United States or to Return to Their Home Countries, *International Migration*, vol.43, no.3, pp.131-145

Allison, Paul D. and J. Scott Long, (1987), Interuniversity Mobility of Academic Scientists, *American Sociological Review*, vol.52, no.5, pp.643-652

Black, Grant and Paula E. Stephan, (2007), The Importance of Foreign Ph.D. Students to U.S. Science, in *Science and The University*, edited by Paula E. Stephan and Ronald C. Ehrenberg, The University of Wisconsin Press

Bound, John, Sarah Turner and Patrick Walsh, (2009), Internationalization of U.S. Doctorate Education, in "Science and Engineering Careers in the United States, An Analysis of Markets and Employment", edited by Richard B. Freeman and Daniel L. Goroff, The University of Chicago Press

Burris, Val, (2004), The Academic Caste System: Prestige Hierarchies in PhD Exchange Networks, *American Sociological Review*, vol.69, no.2, pp.239-264

Chellaraj, Gnanaraj, Keith E. Maskus and Aaditya Mattoo, (2005), The Contribution of Skilled Immigration and International Graduate Students to U.S. Innovation, World Bank Policy Research Working Paper 3588

Coles, Peter, John Cawley, Philip B. Levine, Muriel Niederle, Alvin E. Roth and John J. Siegfried, (2010), The Job Market for New Economists: A Market Design Perspective, *Journal of Economic Perspectives*, vol.24, no.4, pp.187-206

Coupé, Tom, (2003), Revealed Performances: Worldwide Rankings of Economists and Economics Departments 1969-2000, *Journal of the European Economic Association*, vol.1, no.6, pp.1309-1345

Docquier, Frédéric and Abdeslam Marfouk, (2006), International Migration by Education Attainment (1990-2000) - Release 1.1, working paper

Finn, Michael G., (2010), Stay Rates of Foreign Doctorate Recipients from U.S. Universities, 2007, Oak Ridge Institute for Science and Education

Gaughan, Monica, (2007), Location of birth unknown: what we can learn by studying CV's, paper prepared for the NBER Conference 'Career patterns of Foreign-born scientists and engineers, trained and/or working in the US'

Gaulé, Patrick, (2010), Return Migration: Evidence from Academic Scientists, working paper presented at NBER productivity lunch seminar on November 16th, 2010, Boston, MA

Hunter, Rosalind S., Andrew J. Oswald and Bruce G. Charlton, (2009), The Elite Brain Drain, IZA working paper, forthcoming in Economic Journal

Kahn, Shulamit and Megan MacGarvie, (2008), How important is U.S. Location for Research in Science?, working paper

Laudel, Grit, (2005), Migration currents among the scientific elite, *Minerva*, vol.43, no.4, pp.377-395

MacGarvie, Megan, (2007), Using Published Dissertations to Identify Graduates' Country of Origin, paper prepared for the NBER Conference 'Career patterns of Foreign-born scientists and engineers, trained and/or working in the US'

Maier, Guther, Bernard Kurka and Michaela Trippel, (2007), Knowledge spillover agents and regional development - spatial distribution and mobility of star scientists, DYNREG Working Paper 17/2007

MORE, (2010), Study on mobility patterns and career paths of EU researchers, final technical report 3: Extra-EU mobility pilot study, Report prepared for the European Commission, Research Directorate-General

National Science Foundation, (2010), Doctorate Recipients from US Universities: Summary report 2007-2008, NSF 10-309

National Science Foundation, (2011), Doctorate Recipients from US Universities: 2009, NSF 11-306

OECD, (2010), Education at a Glance 2010: OECD indicators, OECD Publications, Paris, France

Romer, Paul M., (1990), Endogenous technological change, *Journal of Political Economy*, vol.98 no.5, pp.71-102

Siegfried, John J. and Wendy A. Stock, (2004), The Market for new Ph.D. Economists in 2002, *American Economic Review*, 2004, vol. 94, pp.272-285

Smeets, Valérie, Frédéric Warzynski and Tom Coupé, (2006), Does the Academic Labor Market Initially Allocate New Graduates Efficiently?, *Journal of Economic Perspectives*, vol.20, no.3, pp.161-172

Stephan, Paula E., (2010), The Biomedical Workforce in the US: An Example of Positive Feedbacks, ICER working paper no.11/2010

Stephan, Paula E. and Sharon G. Levin, (2001), Exceptional contributions to US science by the foreign-born and foreign-educated, *Population Research and Policy Review*, vol. 20, pp.59-79