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ABSTRACT

We investigate performance differentials associated with mobility for research active scientists residing in a broad spectrum of countries and working in a broad spectrum of fields using data from the GlobSci survey. We distinguish between two categories of mobile scientists: (1) those studying or working in a country other than that of origin and (2) those who have returned to their native country after a spell of study or work abroad. We compare the performance of these mobile scientists to natives who have never experienced a spell of mobility and are studying or working in their country of origin. We find evidence that mobile scientists perform better than those who have not experienced mobility. Among the mobile, we find some evidence that those who return perform better than the foreign born save in the United States, suggesting that positive selection is not at work in determining who remains outside the country. This is supported by the finding that for most countries the performance of returnees is no different than that of compatriots who remain abroad after controlling for other effects.

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1. Introduction

The circulation of the highly skilled workforce is a global phenomenon, especially characteristic of exceptionally talented individuals for whom productivity differentials –and respective differentials in wages--are higher (Gibson & McKenzie, 2012). Moreover, immigrant workers, especially high-skilled ones, have a higher propensity for mobility than natives, both because they are less tied to the latest location but also because they respond more rapidly to new windows of opportunities in a different location (Kerr, 2009a; Kerr, 2009b). It is thus not surprising that national science and innovation systems compete not only to attract the best and brightest, but also to retain national talent and to attract back those who have left to study or work abroad (Hunter, Oswald, & Charlton, 2009).

Empirical evidence on the correlation of mobility and performance in science, however, is inconclusive and often limited to the foreign-born in the US. Levin and Stephan (1999), for example, show that authors of exceptional contributions are disproportionately distributed among the foreign born and foreign educated in the United States, but they do not investigate more broadly representative samples nor do they investigate foreign-born differentials in countries other than the United States. Weinberg (2011) studies highly-cited scientists and finds that, although developing countries produce a considerable number of exceptional scientists, they are disproportionately located in high-income countries. Hunter, Oswald and Charlton (2009) study 138 highly-cited physicists. They show that migrants to the US perform similarly to native-US physicists; their performance is also no different from those who stay. Kahn and MacGarvie (2011) compare the performance of individuals who received Fulbright scholarships for study in the US to a control group and find no substantial difference in productivity in the top half of the Impact Factor distribution for those from richer countries. Finally, Borjas and Doran (2012) find evidence of displacement of US mathematicians after the wave of immigration of Russian mathematicians following the collapse of the Soviet Union and show that US mathematicians, particularly working in areas of research that overlapped with those of the Russian émigrés, experienced a decrease in productivity and a lower probability of producing exceptional contributions.

In sum, evidence concerning productivity differentials between immigrants and non-immigrants usually focuses on the high-end of the performance distribution and findings often diverge. Studies are usually limited to comparing immigrants with non-immigrants. Only the Kahn and MacGarvie paper investigates productivity differences between those who return and those who do not. Moreover, the

foreign born are usually compared to natives, without making the distinction between natives who have experienced mobility and returned vs. natives who have never experienced professional mobility.

Here we make use of a new large dataset on the mobility of 15421 academics (Franzoni, Scellato, & Stephan, 2012). We investigate the correlation of mobility to performance within a broad spectrum of destination countries, of which 14 (Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, UK and the US) are developed countries with varying levels of scientific and research excellence, and two (India and Brazil) are fast-growing economies. The richness of the data allow us to control for a large number of characteristics such as age, gender, and job position, as well as self-assessed characteristics of the sample paper. Our sample spans the four scientific fields of biology, chemistry, earth and environment and materials and is for research-active scientists publishing a survey article in one of the four quartiles of the Impact Factor distribution of journals for each of the four fields.

Information about country of origin and mobility is obtained through a webmail survey fielded in the 16 countries and available in seven languages in 2011. We assess performance by looking at two different measures related to the survey article: the Impact Factor (IF) of the journal in which it was published and Total Cites (TC) received in the first two years after publication.

Following the format and focus of the work of Hunter and colleagues (2009), our research attempts to answer questions such as the following (with answers provided in parentheses).

> Do foreign-born scientists perform at a higher level than scientists who have never experienced mobility? (Yes)
>
> Do returnees, i.e. nationals who have studied and/or worked abroad and subsequently returned home, perform at a higher level than home-grown nationals who have not been abroad? (Yes)
>
> Do returnees perform at a higher level than foreign born scientists working in the country? (The answer depends upon measure of performance).
>
> Do scientists who return after a period of mobility to their country of origin perform at a lower level than those who remain outside the country of origin? (No, although exceptions do exist).
>
> Do these patterns hold for the U.S? (Not always).

Given the cross-sectional nature of data, we are not able to infer causality; that is, we cannot tell whether our results imply that a better scientific base attracts and retains the best and brightest

internationally, or whether scientists perform better after they are exposed to a stronger scientific base, or both. But the results suggest that mobility is a plus for destination countries and that promoting international experiences can have positive returns for a country. Before presenting the results in section 5, we turn first to a discussion of the mobility of scientists in section 2, then present reasons as to why a relationship may exist between mobility and performance in section 3 and follow that with a discussion of the GlobSci survey and data in section 4.

2. The mobility of scientists

Scientists are a highly mobile class of skilled workers. Many scientists move for the prospect of better working opportunities and larger compensation to their skills (Hunter, Oswald, & Charlton, 2009). But scientists are not only motivated by salary. Scientists are known to respond to incentives in the form of recognition, intellectual curiosity and the freedom to perform research (Stephan & Levin, 1992; Sauermann & Roach, 2010). Selection in science is based in part on going to countries where one has the opportunity to be productive in terms of the resources and support for research. Many Argentinean scientists, for example, left the country after the financial crisis of 2002, when the devaluation of the currency made it impossible for them to even afford to attend international conferences (Dalton, 2008). Areas of expertise in science are also highly specialized, or require dedicated laboratories and special equipment that exists in very few settings (Stephan P. , 2012). Science is also more often than not a team effort. Mobility of scientists often occurs in order to begin or continue working with a network of scientists or pre-existing collaborators (Harvey, 2008). Because of either the specialties or the talents of others, a scientist may perform at a higher level in one setting rather than in another and this can influence migration decision (Gangiuli, 2012).

Among other reasons given for moving is the pursuit of an international lifestyle (Richardson & McKenna, 2003). Although family ties are known to be less important in driving the mobility of skilled as opposed to unskilled workers (Beine, Docquier , & Ozden, 2011) within the population of scientists family ties play a role in motivating return (Franzoni, Scellato, & Stephan, 2012). Migration waves have also been driven by political or social reasons. Consider, for example, the migration of German and Austrian scientists of Jewish origin in the first half of the last Century (Waldinger, 2010) or at the massive immigration of Soviet mathematicians to the US after 1992 (Borjas & Doran, 2012; Gangiuli, 2012).

Demand also plays a large role in migration decisions. In many countries academic job markets are strongly regulated, recruiting and promotion systems change only rarely and by acts of law (Franzoni,

Scellato, & Stephan, 2011). Some destination countries are also more or less willing to accept inward migration. For example, immigration policies are extremely restrictive in Japan for virtually any type of migrant. By way of contrast, several countries have policies for attracting high-skilled migrants that include easier visa procedures, fiscal benefits and special recruiting packages. Canada, for example, has an immigration system that assigns permits based on a point system. Skilled workers have a special visa program (the Federal Skilled Workers Visa), under which a PhD entitles the applicant to 25 points out of a total of 100, making it extremely likely that a visa will be granted. A similar system exists in Australia, where a PhD degree currently entitles the recipient to 20 points.

Other countries are less focused on attracting immigrants and more focused on convincing nationals who have migrated abroad to return to the motherland. India is discussing the creation of foreign-based contact points to encourage the recruitment of Indian scientists working abroad. Spain has an especially strong and large return policy for academics called "Ramón y Cajal". Between 2001 to 2010 the program supported 2500 postdoc positions for Spanish researchers who had worked abroad for at least two years (Adjunar, 2012). In a country of the size of Spain these numbers amount to approximately 4% of the entire population of academics.

3. Performance of the mobile scientists

In a context of large differentials in inward and outward migration, a question of considerable importance is whether mobile scientists are disproportionately distributed among the most talented. The standard theory of migration is based on Roy's selection model that posits workers make migration decisions based on the salary premium they would receive if they move, and on the cost of relocation (Roy, 1951). Training decisions, too, are sustained by the prospect of a skill-enhancement premium (Sjaastad, 1962), causing international students flows. With premium salaries that vary by level of skills and positive costs of relocation, provided skills are portable across countries (a condition likely satisfied in the academic workforce) sorting in out-migration will occur (Borjas, 1994; Grogger & Hanson, 2011).

When the source and destination country have dissimilar levels of earnings for a certain level of skill (small correlation of earning/skill level), high-skill people will migrate from the low to the high remuneration country. For example, wealthier countries, which offer the highest salary premium, would attract a greater proportion of highly talented individuals from lower-paying countries (Gibson & McKenzie, 2012). When the source and destination country have similar levels of return to skills, which may occur in some cases of mobility between wealthy countries, positive skill-selection will still occur toward those destination countries with a greater dispersion of return to skill (i.e. inequality ensures less

redistribution, hence relatively higher earnings to the higher-skilled). Conversely, negative skill-selection will occur toward destination countries that have less dispersion of return to skills (i.e. less inequality or more redistribution, means relatively higher earnings to the lower-skilled) (Grogger & Hanson, 2011). Return migration is seen as further accentuating the initial selection. Thus, if the best were those to leave in the first place, returnees will be the worst of the best, or conversely would be the best of the worst, in case the out-migrating were adversely selected in the first place.

Amid large salary differentials across countries, positive selection should result in observing a correlation of migration and performance, with the best-performing being disproportionately distributed among the internationally-mobile. It is less clear if a correlation should exist between performance and return and which direction it should go.

There are other reasons in addition to selection as to why mobility may be associated with performance. For example, there are private and collective gains in the form of spillovers from brain circulation (Saxenian, 2005). Knowledge that is highly tacit or otherwise difficult to circulate travels fasters when scientists are geographically mobile. Mobility of people facilitates mobility of knowledge and more knowledge from distant sources is associated with greater idea generation and creative attainments (Hargadon & Sutton, 1997; Fleming, 2001). It is possible that the advantages from richer knowledge sets accrue primarily to migrants who sit in positions of arbitrage. Physical mobility is also helpful in establishing effective networks. In a prior paper, we show that immigrants have a higher propensity to establish international links, collaborate with coauthors in a larger number of countries and perform at a higher level than international teams comprised of non-mobile scientists (Scellato, Franzoni, & Stephan, 2012).

But an academic environment that exposes scientists to richer knowledge sets may benefit the non-mobile host community. Likewise, it may benefit the native communities from which the mobile scientists have out-migrated. For example, long-distance collaborations between Indians abroad and their native communities in the motherland have been found to promote knowledge transfer from the host country to the country of origin (Agrawal, Kapur, McHale, & Oettl, 2011). They have also been found to enhance formal collaboration networks (Gangiuli, 2012), functioning as a balancing force that tends to level-off the performance of movers and stayers.

4. Sample and data

4.1 The GlobSci survey

We surveyed active researchers in the four scientific disciplines of biology, chemistry, earth and environmental sciences, and materials science during the period February-June 2011. In order to construct the sample, we selected all journals classified by ISI as belonging to one of the four disciplinary fields and sorted them by Impact Factor (IF) for all subfields in each of the four disciplines.[1] We then randomly picked a selection of four journals from each quartile of the Impact Factor distribution in each subfield of the four disciplines, thus obtaining four samples of journals by field stratified by Impact Factor. In aggregate, this process identified approximately 30% of all journals published in the four fields.

Starting from these four lists of journals, we then downloaded the full record of all scientific articles published therein in 2009. From the affiliation information of the articles, we retrieved the email address of the corresponding authors.[2] In case of multiple corresponding authors for a single article, we picked the first name in the list. We randomly selected one record in the case of corresponding authors appearing repeatedly in the corresponding author list.

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

We prepared 16 country panels. Surveyed countries are: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, India, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, United Kingdom, United States. This procedure produced a sample of 47,304 unique email addresses of scientists divided in 16 country panels (Table 1). Country panel sizes vary considerably, reflecting by construction the size of the country research-active population. The largest panel was the US, with 14059 observations; the smallest was Denmark with 513.

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

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

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

Table 1 reports a summary of the 19183 answers by country. Country responses reflect both the size of the underlying research-active population of scientists as well as variations in response rates across countries. The largest number of responses is for the US (5165 answers) and the smallest is Denmark (227). The overall response rate is 40.6 percent; the high is 69.0 percent for Italy, the low is 30.3 percent for Germany; 11 countries have a response rate of between 35.0 percent and 45.0 percent. Answers are further divided into complete answers and partial (usable) answers (answers from respondents who began the survey, but dropped-out before reaching the last question). The total dropout rate was 5 percent. The response rate, conditional on the respondent completing the survey, is 35.6 percent. Reported response rates do not take into account undelivered invitations due to such things as incorrect email address, retirement or death and consequently underestimate the response rate.[3]

[Table 1 about here]

4.2 Sample

For the purpose of this analysis, we selected the 15672 respondents who were working at universities, medical schools and government research agencies and residing in one of the 16 core countries at the time the survey was administered[4]. From these, we further drop 56 observations because the country of residency at 18 years of age was not known, 32 observations because foreign international experience

[3] Walsh, Cohen, and Cho (2007) find in a sample of US scientists that undelivered emails accounted for approximately 3.2 percent. Roach & Sauermann (2010) find that undelivered emails accounted for 6.3 percent in a sample of junior US scientists.
[4] Government research agencies were not sampled in the US.

was not known or incomplete. We dropped an additional 163 observations of people who stated that they were in a country different from that of origin at the time the survey was administered but in a different question stated that they had no international experience. These answers could either be from people on temporary leave at the time the survey was administered or from people who gave inconsistent replies. The final sample is thus composed of 15421 observations, unevenly split among the 16 countries.

Recall that during panel construction we randomly drew an equal proportion of source journals from each quartile of Impact Factor of the subfield category of the journals. Our panelists were therefore drawn from authors of articles in all levels of journal Impact Factor in equal proportions, short of any differences that might exist in the average size of the journals belonging to each group. In other words, the random pick of journals should mean that authors had equal probability of being included in our panel had they published an article in a journal with a very good, medium-high, medium-low or low Impact Factor. Similarly, if they published in more than one quartile, the probability that they would be chosen in one or another quartile would be random and in general not correlated to their prior international experience.

Random pick means that panelists would be a fair representation of the population, short of a random noise. Concerning the degree to which the sample of respondents is representative of the panel and consequently of the underlying populations, we perform a number of tests. These are reported in Section A1 of the Appendix and show, at worst, very modest evidence of bias. Moreover, to the extent that bias exists, the final data set may slightly over-represent corresponding authors of papers appearing in higher Impact Factor journals.

The international coverage of our survey has the advantage of providing information not only on the share of the foreign-born currently in a country, but also on the share of "native" scientists who currently live abroad in one of the other 15 core countries. Country of origin of the respondent was determined by asking in which country the person was living at the age of 18. We prefer this definition to country of birth, because we are interested in mobility decisions occurring for reasons of work or study of the respondents. Relocation events occurring before the age of 18 likely reflect parental decisions rather than choices of the respondent. Although we do not take country of birth as a reference, for simplicity, in the following description respondents residing in the same country as they did at age 18 are referred to as "natives;" those residing in a different country than where they lived at age 18 are referred to as "foreign born." Of the 15421 respondents, 13718 (89%) indicated an origin in one of the 16 core countries; the origin of the remaining 1703 was a non-core country.

Our survey is important because it is at present the largest and most successful effort to collect comparable data on the mobility of the academic workforce in a large number of countries. While micro-level data are available for migrants to the OECD countries, they are not specific to the academic workforce (Docquier & Rapoport, 2012). For the academic workforce, the sources of data until now have been very limited. Among these, three studies are worth noting. The first is a survey of Career of Doctorate Holders (known as CDH), conducted in seven countries by the OECD in collaboration with Eurostat and the UNESCO Institute for Statistics (UIS) (Auriol, 2007). The second (Ateş, Holländer, Koltcheva, Krstić, & Parada, 2010) is a pilot study of Eurostat in all domains of science and humanities, called "The Eurodoc Survey I of doctoral candidates" conducted in 2008-2009 in twelve European countries (Austria, Belgium, Croatia, Finland, France, Germany, the Netherlands, Norway, Portugal, Slovenia, Spain and Sweden). The third is a pilot study of EU-US mobility designed to be used in combination with the Eurostat project (IdeaConsult, 2010). Unfortunately, low response rates in the latter two studies (considerably below 10%) make these data unreliable for research purposes.

5. Performance of the internationally mobile

Based on the answers to the GlobSci survey, we partition the academic workforce of each of 16 countries into three statuses based on international background:

1) NATIVE NOT-MOBILE: natives of a country who declared no prior experience of work or study abroad at the time the survey was administered
2) RETURNEE: natives of a country who declared a prior experience of work or study abroad and were residing in country of origin at the time the survey was administered
3) FOREIGN BORN: immigrant scientists whose country of origin differs from the country in which they were working or studying at the time the survey was administered.

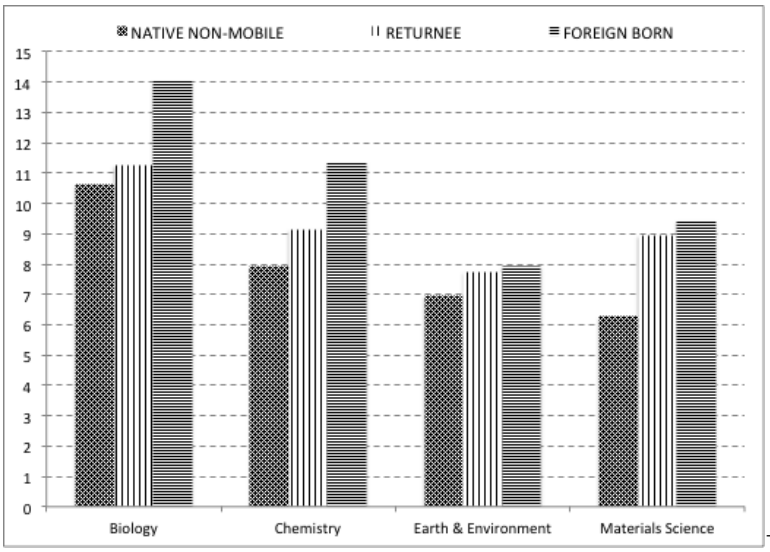
Status number one corresponds to non-mobile academics, trained in their country of origin, who have never taken a position outside their country. Categories two and three correspond to the internationally-mobile academics. These individuals share at least one experience of study or work away from their country of origin. The two groups differ, however, with respect to their current location. Individuals in group two have subsequently returned home; individuals in group three are either still

mobile or have permanently resettled away from their country of origin. Groups one and two combined represent the share of domestic scientists within the academic workforce of a core country.

Four types of international experience qualify for the status of internationally mobile: First, having an experience of non-PhD study outside the origin country (such as a BA, MA, laurea or equivalent); second, having either received a PhD degree or currently being enrolled in a PhD program (or doctorate education or equivalent) outside the country of origin; third, having taken a postdoc appointment or currently holding a postdoc position outside the country of origin; and fourth, having taken a job or currently holding a job outside the country of origin. For reasons of methodological conservativeness, stays of less than one year are not classified as an international experience.[5]

Here we compare the performance of the foreign born, returnees and native non-mobile researchers. Figure 1 shows the mean citation values for the survey article by field for the three groups. Figure 2 shows the mean IF. We see that regardless of field, mean citations of the foreign born are higher than those of native non-mobile researchers and also higher than returnees, although the differential is not usually as great and not statistically significant. In terms of IF, the sample paper for the foreign born outperforms that of native non-mobile and usually outperforms that of returnees.

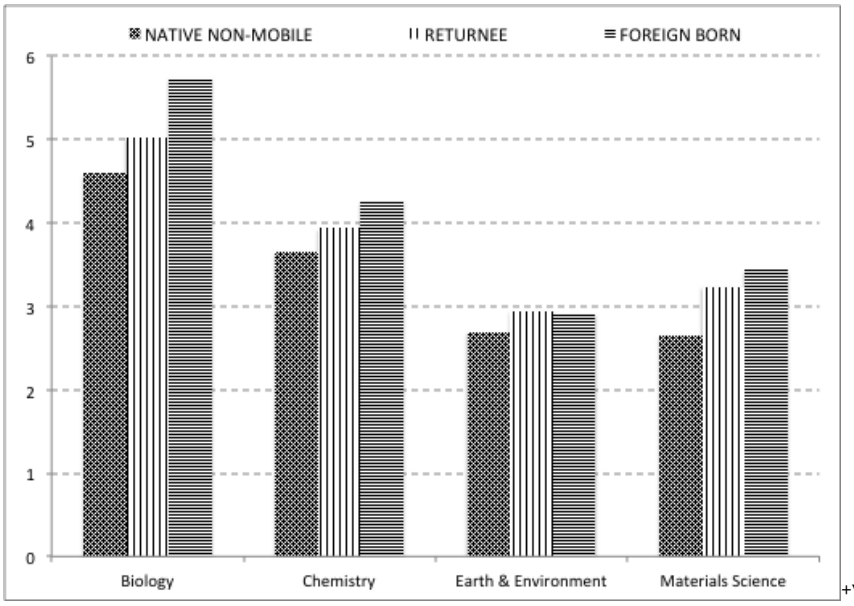
Figure 1 Mean total citations by STATUS and by subject



+Weighted by probability.

[5] Visiting periods of at least one year, such as PhD sandwich, which are quite common across EU member countries, and sabbaticals were coded and controlled for separately.

Figure 2 Mean Impact Factor by STATUS and by subject



+Weighted by probability.

Although these first results are suggestive, they control for no other characteristics that are related to performance. Thus, we resort to multivariate analyses to control for potentially confounding factors.

Our model for investigating the performance of the foreign-born and returnees compared to native non-mobile scientists takes the following general specification:

$$\Pi_i = \phi X_i + \delta A_i + \gamma I_i + \varepsilon_i$$

where:

Π_i is a performance indicator (either IF or TC)

X_i is a vector of individual characteristics such as age (entered in a quadratic form), gender, trainee status, location (country were currently working);

$\mathbf{A_i}$ is a vector of article characteristics that likely affect the rate of citation or visibility for reasons such as number of authors, international collaboration, interdisciplinary nature of the research or the article being in an emerging research topic[6];

$\mathbf{I_i}$ is a dummy variable taking the value of one if the scientists has a prior international mobility experience (i.e. is either foreign-born or a returnee, depending on the model) or zero if the scientist is a native of the country with no prior international mobility.

γ is a coefficient that captures the rate at which the international experience enhances performance relative to non-mobile scientists (in some models we will have split variables for international mobility and distinct γ_s);

ϕ,δ are vectors of coefficient estimates and ε_i is the error term.

We also initially controlled for prior visiting periods abroad, but the coefficient was not significant in any of the estimates and was omitted in the final estimations presented here.

Summary statistics for all variables used in the paper are provided in Table 4.

[Table 4 about here]

The results of the estimates of the general model are reported in Table 5. The left panel of the table shows results of the OLS estimate of the model in which the dependent variable of performance is the IF. The right panel shows results of the Negative Binomial estimate of the model in which the dependent variable of performance is the measure of TC. The performances of mobile individuals – both returnees and foreign born-- are estimated against the baseline of the performance of domestic scientists who were never mobile. All models control for field and country. All models were also estimated using probability weights. Results are consistent with those shown in Table 5 and are reported in the Appendix. In both cases, we computed heteroschedasticity-robust standard errors. The robustness of the estimates is discussed in section 6.

Regardless of which performance indicator is chosen, the estimates are largely consistent with the univariate analyses, pointing to positive performance differentials of scholars with either type of mobility experience. Moreover, in both instances, returnees have a performance advantage over those

[6] The latter three controls were included as dummy variables based on self-reported characteristics of the article. Characteristics were rated on a 1-5 scale and the variables were set to 1 if the rating was grater or equal to 4: zero if lower than 4.

who are foreign born; the difference is significant (at the 1 percent level) in the case of the Impact Factor measure of performance. This suggests that positive selection is not at work in determining who remains outside the country. This is supported by the finding, reported in the Appendix, that for most countries the performance of returnees is no different than that of compatriots who remain abroad after controlling for other effects. Exceptions, however, exist, as noted there. In particular, we find that returnees to India, Brazil, and Italy perform at a lower level compared to their fellow natives who have remained abroad.

In a second specification (Model 2, Table 5), we control separately for natives who did not study or hold working positions abroad, but nonetheless had been abroad for visiting periods of at least 12 months (e.g. sabbaticals). We find the correlation of visiting periods and IF to be negative and significant at the 5% confidence level and virtually non-existent and not significant in terms of TCs.

[Table 5 about here]

5.1 Performance of the foreign born

We continue our investigation, by focusing on the performance of the foreign born. We exclude the potentially confounding effect of having returnees in the baseline and run the estimates on 10719 observations.

Table 6 reports the results of two sets of estimates. The left panel has as the dependent variable the IF and the right panel has TCs as the dependent variable. As before, we treat IF estimations with standard OLS and TCs with negative binomial.

On average the superior performance of the foreign born residing in a country compared to natives of the same country who did not experience mobility is confirmed. Note that the estimates are net of location effects, with the baseline being the country where the current job is located. They are also net of controlling for the H-index of the country of origin, included here to capture average differentials in the quality of basic and secondary education that the scientist received (Model 1). The results indicate that, holding all else equal, the average foreign-born scientist outperforms a homegrown scientist by about 0.84 in IF (left panel) and by as much as 2.29 TCs (right panel).[7]

[7] The TC effect is calculated for changes in the conditional mean $E(y_i|\boldsymbol{X}_i)$ of the dependent variable y_i when the j-th independent variable x_{ij} changes from 0 to 1, based on the formula $\frac{\partial E(yi|\boldsymbol{X}i)}{\partial xij} = \beta_j e^{\boldsymbol{X}_i'\beta}$.

When we re-estimate the model using only the US observations (3772), the foreign-born performance premium is confirmed.[8]

[Table 6 about here]

Some of the foreign-born entered the country during graduate or PhD studies. Others entered after having completed their tertiary education to take a postdoc or job position. Those who entered during higher education should in principle be more homogeneous to the non-mobile natives, having shared to a greater extent the same academic environment beginning with the training years. To account for this potential source of variation, we split the foreign born based on the career stage at time of entry to the current country. The positive and significant effect holds, regardless of the stage of entry (Model 2), suggesting that foreign born outperform natives even when they were educated in the same country of the non-mobile natives. The performance premium varies by the stage of entry, ranging between a plus 0.66 in IF and plus 1.86 TCs for the average foreign born who entered during training to a plus 0.91 of IF score and 2.57 TCs for the average foreign born who entered after training. This effect holds invariant even after controlling for individuals who visited more than one country for postdoc training and job experience (results omitted for brevity).

In sum, foreign-born scientists on average show superior performance than natives who were never mobile. Moreover, the performance premium exists even after controlling for country of origin and is stronger for people who entered after training than for those who entered during training, although positive in both cases.

5.2 Performance of returnees

We move on to consider how the performance of returnees compares to that of fellow natives who have not been mobile. As stated above, the standard selection model postulates that returnees would be the worst of the best who migrated if initial outward migration was composed of positively-selected scholars (Borjas & Bratsberg, 1996).[9] We also noted that mobility might be associated with greater skills

[8] Omitted for brevity, but available upon request from the authors.

[9] In the Appendix we show that we find no compelling evidence of negative selection regarding return, when comparing natives with an experience of international mobility who have subsequently returned to natives who have remained abroad. In the simple mean-comparisons we see that returnees to India, Brazil and Italy perform at a lower level compared to their fellow natives who have remained abroad. However, this correlation does not hold for other countries. We find no significant difference between returnees and those who remained abroad after we control for the effect of current country and other potentially confounding factors when countries are pooled (see Appendix A-2).

that the scientist acquired while training or working in a richer environment (Sjaastad, 1962) as well as with a broader and better network established while abroad (Scellato, Franzoni, & Stephan, 2012).

We exclude from the model the foreign born and include in the model only the 11891 natives of the sixteen countries who are currently based in their country of origin. Table 7 reports the results of step-wise estimates for IF (left panel) and TCs (right panel).

The estimates of Model (1) confirm that, on average, returnees outperform natives with no prior experience of international mobility. The difference is sizable: holding all other things equal, returnees have on average a 0.63 higher IF than natives with no prior mobility and 1.69 higher TCs.

We noticed earlier in the univariate tests (Table 3) that the US exhibited a different pattern than the other countries, with no apparent difference in the average performance between returnees and non-mobile natives. When we run Model (1) for only the 2597 US observations, we find that this result holds for the IF measure of performance. However, we find that on average US returnees perform at a significantly higher level of TC than natives.[10]

In Model (2) we split the returnees into two groups: those who had a prior international experience in a country with a stronger science base than their country of origin and those who had a prior international experience in a country with a weaker science base than their country of origin. To measure movement we use the country ranking based on the country H-Index[11]. In case of multiple moves, we choose the highest ranked among the destination countries. As expected, the great majority (72.4%) of returnees was mobile towards countries with a better H-Index. However, both upward and downward mobility are associated with a positive performance differential. Based on the estimates of Model (2), returnees from a country with a stronger science base produce papers with a 0.81 larger IF. Mobility downwards is associated with a 0.26 larger IF. The two coefficients are statistically different from one another (Prob. F=0.000). Differentials in TCs (1.8 more citations for upward mobility and 1.6 for downward) are also found but are not statistically different from one another (Prob. Chi^2=0.487). Note that in all models we control for the incidence of internationally-coauthored papers. In sum, the results suggest that mobility of either kind is positively associated with performance.

[Table 7 about here]

[10] The estimates are omitted in the interest of brevity but are available upon request from the authors.

[11] H-Index is the number of papers that received as a minimum an equal number of citations. We use H-Index by country and by subject category, computed for all Scopus publications during the interval 1996-2010 by the Scimago Journal and Country Rank. Retrieved from http://www.scimagojr.com on April 18, 2012.

We move on to investigate whether the observed superior performance of returnees is associated with any international experience, or if it is exclusively the experience of work or education abroad that correlates to a performance differential. The literature on the mobility of skilled-human capital highlights that workers tend to move abroad in anticipation of a salary premium exceeding the cost of mobility. If salary is a function of personal skill-levels, movers are positively selected from their country of origin. In our case this implies that those who move to take job positions are positively selected among the top achievers in their country of origin. To the extent that PhD study is supported with financial assistance, we should also observe a similar positive selection. We know, however, that the amount of financial support available varies by country and largely dependent on government budgets (Bound, Turner, & Walsh, 2009), and quite inelastic to actual demand in a given year. As a result, we expect the positive selection effect to be less evident for those who leave for a PhD than for those who leave for work. In the extreme case, i.e. for bachelor and master degrees, where it is typically the student who pays to receive an education, we would expect the selection effect to be virtually nonexistent.

We examine these effects in Model (3) of Table 7, where dummy variables have been included which take the value of one depending upon whether the returnee had a mobility experience for pre-doctoral studies (*MA_BA*), doctoral studies (*phd*), postdoctoral study (*post-doc*) or job positions (*job*). Results indicate quite clearly that pre-doctoral education (Bachelor & Master or PhD) abroad is not associated with superior performance after returning. The same is true for the natives who went abroad to take a PhD or take a job. The superior performance effect holds only for returnees who went abroad to take a postdoc position. Although this result is not conclusive, it suggests ex-ante selection effect in explaining the differentials in performance. This conclusion is consistent with the findings in Model (4). Here, we have substituted the dummy-variables for the different types of experience abroad with variables that take a value of zero if the person did not move and take the value of the H-index of the country where the respondent experienced mobility. This model is meant to control for differentials in the strength of the science base of the destination country. Experience of a postdoc and job here are grouped into a single variable (*work_quality*) because we do not have the information on destination country of postdoc separately from that of job. In sum, after controlling for the relative strength of the country where the mobility experience occurred, it is only mobility for reasons of work (and we infer for reasons of a postdoc) that is associated with superior performance differentials of the returnees, compared with the non-mobile natives.

In sum, our data are consistent with the existence of long-term differentials in the performance of the natives with prior mobility experiences from the performance of natives without international

experience, although this is not the case in the United States. In general, the performance edge accrues to those who did a postdoc abroad. While the effect is consistent with a selection effect, it may also be due to the networks that returnees build while abroad and are able to maintain upon their return.

6. Robustness checks

As highlighted in the data section, the surveys were administered separately in the 16 countries. Consistently, the rate of response varies by country. Thus, when the data are pooled together to estimate the models, response rate differentials result in over-weighting the answers from scientists in countries whose response rate is above the average (Australia, Brazil, Canada, Denmark, Italy, Spain) and under-weighting the answers from scientists in countries whose response rate is below the average (Belgium, Germany, India, Japan, Netherlands, Sweden, Switzerland, UK, US). To neutralize this potential source of bias, all models were re-estimated by including probability weights. All results hold; see the Appendix.

Information on age and gender were asked at the end of the questionnaire. As a result, information on these variables is less complete than information on past mobility. Collectively, there are 988 responses for which the information of age or gender is missing, largely because the respondents dropped out before completing the survey. Given that gender and age are typically important control variables when exploring scholarly performance and have thus been included in our estimates, the missing items result in dropping observation when we run the multivariate estimates. Although we have shown in Section A1 of the Appendix that the evidence of potential biases caused by dropouts is very limited, nonetheless, the units dropped because of incomplete information in the control variables could potentially bias the estimates. In order to check the robustness of our estimates to these dropped observations, we imputed the age and gender of the respondent and re-estimate the models with the imputed values, using the multiple imputation method (Rubin, 1987) with 5 imputations for each variable with missing instances. The imputation models include both variables of observation (country, and foreign experience of higher education, PhD, postdoc, job and experience of visiting abroad) and auxiliary variables from our dataset (job position/tenured-untenured, affiliation type, existence of secondary affiliations, field of research). They also include probability weights. The imputation model generates imputed variables for age and gender in all but 6 cases. The variable of squared-age is produced as a passive imputation of age. Overall the imputation procedure yields a sample of 15415 from a possible 15421 observations. Model estimates that take into account observations with imputed values for gender, age and age-square are presented in the Appendix. The main findings remain after including these observations.

7. Discussion and conclusion

We find compelling and consistent evidence that mobile individuals perform at a higher level than non-mobile individuals, using several definitions of mobility and two measures of performance. These results are consistent with mobility being positively correlated with selection. They are, however, also consistent with treatment effects in the sense that mobility can enhance networks and lead individuals to work in environments that enhance their performance. The cross section nature of our data does not permit us to differentiate between the two types of explanations.

Our results suggest that on average foreign-born have a performance premium over natives who were not mobile of about 0.84 as measured by the Impact Factor of the survey article and 2.29 as measured by the total citations that the survey article received. The positive foreign-born premium holds for both those who were trained away from the host country but immigrate for a job as well as for those who were trained in the same country of the non-mobile natives.

We also find that domestic scientists who studied or worked abroad and subsequently return to work and live in their country of origin (the returnees) perform at a higher level than natives who were not mobile. Returnees have on average 0.63 higher IF than natives with no prior mobility and 1.69 higher TCs. The empirical results also suggest that not all mobility experiences are equal. To be more specific, the mobility experience that is systematically associated with a performance premium is that of a postdoc; other types of mobility experience are uncorrelated with the performance of returnees. An exception is the US, where returnees perform in general at the same level as natives who were not mobile. Experience of visiting alone is not a substitute for other types of mobility and is never associated with a performance premium.

When returnees are compared to fellow nationals who remained abroad, we find little evidence that they perform less well. Exceptions are returnees to India, Brazil and Italy. Regardless of country, we do, however, find evidence of decay in the number of citations received after one returns. The decay is modest and amounts to receiving approximately one fewer citations in the two years between publication and measurement for scientists who have been back in their native country for ten years.

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TABLES

Table 1 Response rate by country[12]

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

[12] Respondents were both academics and non-academics. In this paper we analyze the 15421 answers from academics.

Table 2 Status of the academic workforce by country and by field

	NATIVES NOT MOBILE		RETURNEES		FOREIGN-BORN	
	obs.	**%**	**obs.**	**%**	**obs.**	**%**
Italy (1664)	1171	70.0	451	27.2	42	2.7
Japan (1495)	838	56.1	589	39.4	68	4.5
USA (4107)	2212	54.0	385	9.4	1510	36.6
Brazil (657)	323	49.1	296	45.1	38	5.8
Belgium (226)	111	49.1	78	34.6	37	16.3
Netherlands (289)	133	46.1	80	27.6	76	26.3
Denmark (181)	77	42.6	71	39.4	33	18.1
Germany (1017)	419	41.6	370	36.6	228	21.8
India (452)	182	40.1	267	59.1	3	0.8
UK (1065)	412	38.9	312	29.5	341	31.6
France (1242)	462	37.2	564	45.5	216	17.4
Spain (1112)	408	37.0	634	56.7	70	6.4
Sweden (271)	85	31.4	87	32.1	99	36.5
Australia (550)	140	25.3	172	31.2	238	43.5
Canada (810)	183	22.6	258	31.8	369	45.6
Switzerland (283)	33	11.7	88	31.3	162	57.0
BIOLOGY (4757)$^{+}$	2177	45.4	1475	30.1	1105	24.5
CHEMISTRY (5124)$^{+}$	2228	42.7	1919	36.7	977	20.6
EARTH & ENVIRON. (3119)$^{+}$	1662	52.5	635	19.9	822	27.5
MATERIALS (2421)$^{+}$	1122	45.6	673	27.0	626	27.5
AVERAGE (15421)$^{+}$	**7189**	**46.0**	**4702**	**29.7**	**3530**	**24.3**

+Weighted by probability. Sample size in parenthesis.

Table 3 Mean performance by STATUS of the corresponding author

Observations: 15421 academic scientists in 16 countries

*.10≤**≤.05***≤0.01

CURRENT COUNTRY	NATIVES NOT MOBILE	RETURNEES	FOREIGN-BORN	NATIVES NOT MOBILE	RETURNEES	FOREIGN-BORN	NATIVES NOT MOBILE	RETURNEES	FOREIGN-BORN	DIFFERENCE: (RETURNEES - NOT-MOBILE)	DIFFERENCE: (FOREIGN-BORN-NOT MOBILE)	DIFFERENCE: (FOREIGN-BORN-RETURNEES)
	Impact Factor			Total cites			Rank-norm. Impact Factor			Rank norm. Impact Factor		
AUSTRALIA	3.067	4.083	3.543	8.863	10.943	9.526	0.671	0.772	0.733	0.100 (0.025)***	0.062 (0.025)**	-0.038 (0.022)*
BELGIUM	3.093	4.846	3.967	10.748	11.431	11.668	0.687	0.753	0.801	0.066 (0.034)*	0.113 (0.037)***	0.048 (0.040)
BRAZIL	1.794	2.185	2.246	3.876	4.994	5.991	0.479	0.566	0.614	0.089 (0.022)***	0.134 (0.042)***	0.047 (0.042)
CANADA	3.049	3.972	3.511	6.924	8.714	9.552	0.696	0.747	0.699	0.051 (0.022)**	0.002 (0.022)	-0.049 (0.018)***
DENMARK	3.316	4.275	3.026	8.974	13.647	10.807	0.668	0.755	0.753	0.087 (0.040)**	0.085 (0.042)**	-0.002 (0.042)
FRANCE	3.199	4.037	4.426	7.280	9.616	9.295	0.720	0.802	0.775	0.082 (0.012)***	0.054 (0.017)***	-0.028 (0.016)*
GERMANY	3.262	4.866	4.675	8.056	11.789	11.656	0.700	0.778	0.763	0.078 (0.016)***	0.062 (0.018)***	-0.015 (0.018)
INDIA	2.114	2.604	-	5.909	6.263	-	0.593	0.658	-	0.066 (0.022)***	-	-
ITALY	2.819	3.652	3.672	6.149	7.734	12.738	0.678	0.741	0.759	0.063 (0.012)***	0.081 (0.026)*	0.019 (0.036)
JAPAN	3.186	4.243	3.010	6.710	9.055	8.244	0.678	0.727	0.722	0.049 (0.012)***	0.044 (0.032)	-0.004 (0.027)
NETHELANDS	3.903	5.409	3.847	10.271	11.287	11.123	0.756	0.795	0.752	0.039 (0.028)	-0.00 (0.029)**	-0.074 (0.036)
SPAIN	2.569	3.546	3.735	6.319	7.768	8.973	0.640	0.749	0.709	0.109 (0.014)***	0.069 (0.033)***	-0.039 (0.029)
SWEDEN	3.374	4.946	4.754	8.141	12.715	11.828	0.689	0.782	0.796	0.093 (0.033)***	0.106 (0.050)	-0.013 (0.026)
SWITZERLAND	4.080	5.118	4.220	12.667	18.653	11.304	0.717	0.797	0.796	0.080 (0.053)	0.078 (0.017)***	0.001 (0.026)
UK	3.519	4.395	4.712	8.888	9.790	11.677	0.713	0.770	0.777	0.056 (0.017)***	0.064 (0.007)	0.008 (0.016)
USA	4.568	4.380	4.498	10.280	11.704	11.788	0.755	0.765	0.767	0.009 (0.013)	0.011 (0.007)	0.002 (0.013)
ALL (weighted)	3.567	4.046	4.271	8.280	9.600	11.071	0.703	0.747	0.758	0.044 (0.004)***	0.055 (0.004)	0.012 (0.005)**

Table 4 Summary of variables and description

Variable	Obs.	Mean	St.Dev.	Min	Max	Description
impact factor (IF)	15421	3.790	3.323	0	31.253	Impact Factor of survey article
total citations (TC)	15414	9.105	14.041	0	659	Total Cites to survey article after 2-years from publication
NATIVE_NOT_MOB.	15421	0.466	0.499	0	1	Natives of a country who declared no prior experience of work or study abroad at the time the survey was administered
RETURNEE	15421	0.305	0.460	0	1	Natives of a country with experience of work or study abroad who were residing in country of origin at the time the survey was administered
FOREIGN_A~18	15421	0.229	0.420	0	1	Immigrant scientists whose country of origin differs from the country in which they were working or studying at the time the survey was administered.
visiting_only	15421	0.995	0.299	0	1	Natives of a country who declared no prior experience of work or study abroad, but declared a visiting period of at least 12 months at the time the survey was administered
lowerH_country	15417	0.550	0.498	0	1	Dummy=1 if the scientist was a returnee from a country with a higher H-Index than that of origin; 0 otherwise
higherH_country	15417	0.277	0.447	0	1	Dummy=1 if the scientist was a returnee from a country with a lower H-Index than that of origin; 0 otherwise
BA_MA	15421	0.074	0.262	0	1	Dummy=1 if scientist reported international experience of study at bachelor, master or equivalent level.
phd	15421	0.172	0.377	0	1	Dummy=1 if scientist reported international experience of PhD level.
post	15421	0.440	0.496	0	1	Dummy=1 if scientist reported international experience of postdoc.
job	15421	0.286	0.452	0	1	Dummy=1 if scientist reported international experience of work.
MA_quality	15299	0.045	0.195	0	1.229	Interaction variable= *BA_MA**H-Index of country where mobility occurred
phd_quality	15404	0.140	0.339	0	1.229	Interaction variable= *phd* *H-Index of country where mobility occurred
work_quality	15133	0.444	0.513	0	1.229	Interaction variable=H-Index of country where mobility occurred if *post*=1 or *job*=1; 0 otherwise
entered_work	10719	0.195	0.396	0	1	Dummy=1 if the scientist was a foreign born who entered for postdoc or job
entered_edu	10719	0.133	0.340	0	1	Dummy=1 if the scientist was a foreign born who entered for BA, MA, PhD
hindex_origin/1000	10717	0.629	0.355	0.008	1.229	H-Index of origin country/1000
years_since_returned	6529	5.668	5.073	0	11	2011-year when returned to origin country after international mobility for study or work (first time returned was used if returned was reported more than once)
back_forth	6529	0.081	0.272	0	1	Dummy=1 if scientists reported having returned, out-migrated and returned one or multiple times
AGE	14611	48.114	10.840	25	88	2012-year of birth
SQ_AGE	14611	2432.5	1104.6	625	7744	Square of *AGE*
female	14541	0.237	0.426	0	1	Dummy=1 if gender is female; 0 if male
still_training	15421	0.025	0.157	0	1	Dummy=1 if respondent was a student at the time the survey was administered
emerging	15421	0.395	0.489	0	1	Dummy=1 if respondent agreed or strongly agreed to statement "this paper was in an emerging (new) area of research"; 0 otherwise
interdisc	15421	0.512	0.500	0	1	Dummy=1 if respondent agreed or strongly agreed to statement "this paper was in an interdisciplinary area of research"; 0 otherwise
inter_coop~d	15421	0.246	0.431	0	1	Dummy=1 if respondent indicated the survey paper included coauthors "in other institutions and different countries of affiliation"
n_author	15421	4.930	2.806	1	54	Number of authors of survey paper
COUNTRY_Australia	15421	0.036	0.185	0	1	Dummy=1 if scientist reported country of current job location is Australia
COUNTRY_Belgium	15421	0.015	0.120	0	1	Dummy=1 if scientist reported country of current job location is Belgium
COUNTRY_Brazil	15421	0.043	0.202	0	1	Dummy=1 if scientist reported country of current job location is Brazil
COUNTRY_Canada	15421	0.053	0.223	0	1	Dummy=1 if scientist reported country of current job location is Canada
COUNTRY_Denmark	15421	0.012	0.108	0	1	Dummy=1 if scientist reported country of current job location is Denmark

COUNTRY_France	15421	0.081	0.272	0	1	Dummy=1 if scientist reported country of current job location is France
COUNTRY_Germany	15421	0.066	0.248	0	1	Dummy=1 if scientist reported country of current job location is Germany
COUNTRY_India	15421	0.029	0.169	0	1	Dummy=1 if scientist reported country of current job location is India
COUNTRY_Italy	15421	0.108	0.310	0	1	Dummy=1 if scientist reported country of current job location is Italy
COUNTRY_Japan	15421	0.097	0.296	0	1	Dummy=1 if scientist reported country of current job location is Japan
COUNTRY_Netherlands	15421	0.019	0.136	0	1	Dummy=1 if scientist reported country of current job location is Netherlands
COUNTRY_Spain	15421	0.072	0.259	0	1	Dummy=1 if scientist reported country of current job location is Spain
COUNTRY_Sweden	15421	0.018	0.131	0	1	Dummy=1 if scientist reported country of current job location is Sweden
COUNTRY_Switzerland	15421	0.018	0.134	0	1	Dummy=1 if scientist reported country of current job location is Switzerland
COUNTRY_UK	15421	0.069	0.254	0	1	Dummy=1 if scientist reported country of current job location is UK
COUNTRY_USA	15421	0.266	0.442	0	1	Dummy=1 if scientist reported country of current job location is US
FIELD_biology	15421	0.308	0.462	0	1	Dummy=1 if focal article was in journal classified by ISI in Biology
FIELD_chemistry	15421	0.332	0.471	0	1	Dummy=1 if focal article was in journal classified by ISI in Chemistry
FIELD_earth&env	15421	0.202	0.402	0	1	Dummy=1 if focal article was in journal classified by ISI in Earth or Environmental sciences
FIELD_materials	15421	0.157	0.364	0	1	Dummy=1 if focal article was in journal classified by ISI in Materials science

Table 5 Performance of the internationally mobile

Robust OLS	-v1-	-v2-	Robust Neg.Bin.	-v1-	-v2-
RETURNEE	0.5700***	0.5308***	RETURNEE	0.2023***	0.2062***
	(0.058)	(0.061)		(0.025)	(0.027)
FOREIGN_AT_18	0.2591***	0.2285***	FOREIGN_AT_18	0.1560***	0.1590***
	(0.077)	(0.079)		(0.027)	(0.028)
visiting_only		-0.1712**	visiting_only		0.0171
		(0.070)			(0.035)
AGE	0.0564***	0.0560***	AGE	-0.0020	-0.0019
	(0.017)	(0.017)		(0.008)	(0.008)
SQ_AGE	-0.0007***	-0.0007***	SQ_AGE	-0.0001	-0.0001
	0.000	0.000		0.000	0.000
female	-0.2752***	-0.2789***	female	-0.1026***	-0.1024***
	(0.060)	(0.060)		(0.023)	(0.023)
emerging	0.8769***	0.8786***	emerging	0.3298***	0.3298***
	(0.057)	(0.057)		(0.021)	(0.021)
interdisc	0.0267	0.0258	interdisc	0.0218	0.0219
	(0.051)	(0.051)		(0.021)	(0.021)
inter_cooperated	0.0790	0.0851	inter_cooperated	0.0582**	0.0577**
	(0.062)	(0.063)		(0.023)	(0.023)
still_training	-0.4150***	-0.4228***	still_training	-0.1762***	-0.1753***
	(0.128)	(0.128)		(0.064)	(0.064)
n_author	0.2227***	0.2225***	n_author	0.0725***	0.0725***
	(0.015)	(0.014)		(0.004)	(0.004)
field dummies	yes	yes	field dummies	yes	yes
current country dummies	yes	yes	current country dummies	yes	yes
Constant	0.1283	0.1734	Constant	-0.1893***	1.9571***
	(0.461)	(0.461)		(0.017)	(0.304)
			Ln_alpha	-0.1893***	-0.1893***
				(0.017)	(0.017)
Dep. Variable	IF	IF	Dep. Variable	TC	TC
Observations	14,433	14,433	Observations	14,428	14,428
R-squared	0.1676	0.1679			
Adj. R-squared	0.1660	0.1662			
F stat	81.452	78.662			

*.10≤**≤.05***≤0.01 (Heteroschedasticity-robust st. errors in parenthesis). Baseline: NATIVES_NOT _MOBILE

Table 6 Performance of the FOREIGN BORN

Robust OLS	-v1-	-v2-	Robust Neg.Bin.	-v1-	-v2-
FOREIGN_AT_18	0.8438***		FOREIGN_AT_18	0.2706***	
	(0.096)			(0.036)	
entered_work		0.9124***	entered_work		0.2911***
		(0.105)			(0.038)
entered_edu		0.6579***	entered_edu		0.2131***
		(0.124)			(0.047)
hindex_origin	1.2132***	1.1395***	hindex_origin	0.2217***	0.1990***
	(0.150)	(0.154)		(0.052)	(0.054)
AGE	0.0825***	0.0825***	AGE	0.0050	0.0051
	(0.019)	(0.019)		(0.010)	(0.010)
SQ_AGE	-0.0010***	-0.0010***	SQ_AGE	-0.0001	-0.0001
	(0.000)	(0.000)		(0.000)	(0.000)
female	-0.2355***	-0.2338***	female	-0.0940***	-0.0939***
	(0.072)	(0.072)		(0.026)	(0.026)
emerging	0.8510***	0.8507***	emerging	0.3266***	0.3252***
	(0.067)	(0.067)		(0.025)	(0.025)
interdisc	0.0860	0.0885	interdisc	0.0367	0.0373
	(0.061)	(0.061)		(0.024)	(0.024)
inter_cooperated	-0.0103	-0.0139	inter_cooperated	0.0546**	0.0538*
	(0.073)	(0.073)		(0.028)	(0.028)
still_training	-0.2093	-0.1800	still_training	-0.1226*	-0.1145*
	(0.135)	(0.136)		(0.066)	(0.066)
n_author	0.2487***	0.2487***	n_author	0.0805***	0.0806***
	(0.017)	(0.017)		(0.004)	(0.004)
field dummies	yes	yes	field dummies	yes	yes
current country dummies	yes	yes	current country dummies	yes	yes
Constant	-1.3543**	-1.3160**	Constant	1.4202***	1.4328***
	(0.540)	(0.540)		(0.261)	(0.261)
			Ln_alpha	-0.1881***	-0.1886***
				(0.020)	(0.020)
Dep. Variable	IF	IF	Dep. Variable	TC	TC
Observations	10,046	10,046	Observations	10,043	10,043
R-squared	0.1867	0.1871			
Adj. R-sq	0.1844	0.1847			
F stat	56.6162	54.7404			

*.10≤**≤.05***≤0.01 (Heteroschedasticity-robust st. errors in parenthesis). Baseline: NATIVE_NOT_MOBILE

Table 7 Performance of RETURNEES

Robust OLS	-v1-	-v2-	-v3-	-v4-	Robust Neg. Bin.	-v1-	-v2-	-v3-	-v4-
RETURNEE	0.636***				RETURNEE	0.212***			
	(0.057)					(0.026)			
lowerH_country		0.270***			lowerH_country		0.194***		
		(0.096)					(0.043)		
higherH_country		0.808***			higherH_country		0.227***		
		(0.065)					(0.028)		
BA_MA			-0.171		BA_MA			0.162	
			(0.149)					(0.124)	
phd			0.1531		phd			0.0891	
			(0.122)					(0.064)	
post			0.742***		post			0.209***	
			(0.064)					(0.026)	
job			-0.1161		job			-0.051	
			(0.100)					(0.035)	
MA_quality				-0.236	MA_quality				0.243
				(0.213)					(0.178)
phd_quality				0.279*	phd_quality				0.125
				(0.167)					(0.082)
work_quality				0.752***	work_quality				0.180***
				(0.065)					(0.025)
AGE	0.048***	0.045**	0.045**	0.047**	AGE	-0.005	-0.005	-0.005	-0.004
	(0.019)	(0.019)	(0.019)	(0.019)		(0.009)	(0.009)	(0.009)	(0.009)
SQ_AGE	-0.001***	-0.001***	-0.001***	-0.001***	SQ_AGE	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
female	-0.335***	-0.330***	-0.328***	-0.324***	female	-0.099***	-0.098***	-0.097***	-0.094***
	(0.063)	(0.063)	(0.063)	(0.063)		(0.026)	(0.026)	(0.026)	(0.026)
emerging	0.937***	0.932***	0.936***	0.932***	emerging	0.339***	0.338***	0.339***	0.339***
	(0.063)	(0.063)	(0.063)	(0.063)		(0.024)	(0.024)	(0.024)	(0.024)
interdisc	0.0147	0.0139	0.0232	0.0213	interdisc	0.019	0.020	0.022	0.016
	(0.056)	(0.056)	(0.056)	(0.056)		(0.023)	(0.023)	(0.023)	(0.023)
inter_cooperated	0.150**	0.151**	0.161**	0.170**	inter_cooperated	0.101***	0.101***	0.105***	0.108***
	(0.070)	(0.070)	(0.070)	(0.071)		(0.027)	(0.027)	(0.027)	(0.027)
still_training	-0.195	-0.179	-0.167	-0.181	still_training	-0.1125	-0.1113	-0.1112	-0.1179
	(0.140)	(0.140)	(0.140)	(0.141)		(0.075)	(0.075)	(0.075)	(0.076)
n_author	0.189***	0.189***	0.189***	0.189***	n_author	0.066***	0.066***	0.066***	0.067***
	(0.016)	(0.016)	(0.016)	(0.016)		(0.005)	(0.005)	(0.005)	(0.005)
field dummies	yes	yes	yes	yes	field dummies	yes	yes	yes	yes
current country dummies	yes	yes	yes	yes	current country dummies	yes	yes	yes	yes
Constant	0.571	0.610	0.645	0.613	Constant	2.100***	2.100***	2.114***	2.111***
	(0.509)	(0.509)	(0.509)	(0.514)		(0.348)	(0.347)	(0.329)	(0.328)
					Ln_alpha	-0.206***	-0.207***	-0.206***	-0.204***
						(0.020)	(0.020)	(0.020)	(0.020)
Dependent variable	IF	IF	IF	IF	Dependent variable	TC	TC	TC	TC
Observations	11,227	11,227	11,227	11,072	Observations	11,223	11,223	11,223	11,068
R-squared	0.1691	0.1714	0.1709	0.1725					
Adj. R-sq	0.1671	0.1693	0.1686	0.1703					
F stat	67.685	65.636	61.495	62.022					

*.10≤**≤.05***≤0.01 (Heteroschedasticity-robust st. errors in parenthesis). Baseline: NATIVES-NOT MOBILE

APPENDIX

The appendix is composed of four sections:

A.1 Representativeness of sample

A.2 Who returns. Selection of returnees

A.3 Estimates weighted by probability of response

A.4 Imputation of missing control variables

A.1 Representativeness of sample

We performed three different checks concerning potential differences in scientific impact, as assessed by the journal impact factor of source articles. A final check is performed on a self-reported assessment of article representativeness.

Table A- 1 Two-groups comparisons of Impact Factor in 16 countries by 4 subject categories. T-Tests. Hypothesized difference (respondents – non-respondents)=0

COUNTRY	DIFFERENCE (RESPONDENTS - NON-RESPONDENTS)							
	Biology		Chemistry		Earth & Environment		Materials Science	
	mean	st.err.	mean	st.err	mean	st.err	mean	st.err
Australia	0.036	0.357	-0.350	0.211	-0.090	0.127	0.316	0.341
Belgium	-0.611	0.563	0.357	0.429	0.089	0.265	0.745	0.531
Brazil	0.224	0.115	0.092	0.103	-0.290	0.198	0.381	0.188*
Canada	0.535	0.320	0.287	0.182	-0.180	0.116	-0.118	0.280
Denmark	0.465	0.640	-0.213	0.357	-0.439	0.261	0.286	0.681
France	0.024	0.268	0.164	0.136	-0.085	0.107	0.065	0.149
Germany	0.185	0.320	0.135	0.180	0.172	0.108	-0.059	0.197
India	-0.196	0.186	0.060	0.133	0.073	0.180	-0.066	0.124
Italy	0.674	0.270*	0.080	0.142	-0.026	0.114	-0.067	0.217
Japan	-0.387	0.250	-0.045	0.122	0.229	0.120	0.040	0.125
Netherlands	0.366	0.369	0.009	0.402	0.185	0.194	-0.773	0.540
Spain	0.493	0.254	0.099	0.134	0.043	0.127	-0.433	0.188*
Sweden	-0.415	0.544	0.632	0.434	-0.035	0.233	0.107	0.486
Switzerland	0.452	0.662	-0.372	0.390	0.131	0.181	0.380	0.589
UK	0.589	0.283*	0.164	0.184	0.065	0.110	0.188	0.250
USA	1.111	0.187*	0.584	0.094*	-0.043	0.058	0.319	0.161*
OVERALL[+]	**0.705**	**0.088***	**0.315**	**0.046***	**0.041**	**0.032**	**0.209**	**0.062***

[+]Weighted by probability. *p<0.5

First, we asses potential bias due to unit-non response by comparing the Impact Factor of respondents in each of four subject categories and each of 16 countries, against those of non-respondents (Table A-1). Results indicate modest potential biases in the samples from Brazil (Materials science) Italy (Biology),

Spain (Materials Science) and US (Biology, Chemistry and Materials Science)[13]. Except for Spain, biases are in the direction of over-representing authors with higher-impact papers.

Second, we compare the impact factor of early respondents against those of late respondents. Late respondents are characterized as those who completed the questionnaire during the third (final) round, as opposed to those who completed the questionnaire during the first and second rounds (Table A- 2). This screening is useful to assess the potential existence of biases due to item non-response, but can also be helpful to assess the severity of bias for unit-non-response, if we expect that late-respondents would be more similar to non-respondents (or to those who would have responded if we had solicited the questionnaire one more round). T-test comparisons highlight modest biases concerning the Japan sample in Biology, and the Sweden and US samples in Earth & Environmental sciences, where authors of higher-impact contributions were disproportionately distributed among late respondents[14].

Table A- 2 Two-groups comparisons of Impact Factor in 16 countries by 4 subject categories. T-Tests. Hypothesized difference (early respondents – late respondents)=0

COUNTRY	DIFFERENCE IMPACT FACTOR (EARLY - LATE)							
	Biology		Chemistry		Earth & Environment		Materials Science	
	mean	st.err	mean	st.err	mean	st.err	mean	st.err
Australia	0.368	0.720	-0.206	0.429	-0.009	0.390	-0.754	0.692
Belgium	0.912	1.457	1.385	0.982	0.612	0.469	-1.007	0.734
Brazil	-0.427	0.240	0.316	0.218	0.093	0.402	-0.098	0.153
Canada	-0.986	0.585	-0.438	0.363	0.031	0.269	0.098	0.664
Denmark	1.820	1.524	-0.260	0.794	0.557	0.581	0.340	1.395
France	0.439	0.575	0.028	0.304	-0.137	0.264	-0.666	0.363
Germany	-0.576	0.721	-0.318	0.433	0.065	0.290	0.208	0.587
India	-0.238	0.413	-0.057	0.276	-0.049	0.391	0.338	0.288
Italy	-0.055	0.400	0.248	0.243	-0.426	0.233	-0.036	0.419
Japan	-2.060	0.856*	-0.212	0.365	-0.285	0.371	0.260	0.377
Netherlands	0.307	0.663	-1.503	0.980	-0.667	0.406	0.607	1.081
Spain	-1.431	0.473	-0.072	0.314	0.338	0.311	0.139	0.418
Sweden	-0.600	1.278	1.803	0.960	-1.525	0.727*	-0.703	1.232
Switzerland	-1.597	1.331	1.026	0.929	0.647	0.455	1.435	1.428
UK	0.099	0.612	0.334	0.473	0.374	0.244	0.374	0.474
USA	-0.167	0.369	-0.089	0.190	-0.257	0.123*	0.445	0.327
OVERALL[+]	**-0.414**	**0.120**	**-0.080**	**0.102**	**-0.145**	**0.075**	**0.061**	**0.133**

[+]Weighted by probability. *p<0.5

Third, we compare respondents who took the entire questionnaire against respondents who dropped-out before completing the survey (Table A- 3). This check is meant to assess potential biases due to item-non-response, for example caused by the fact that certain incomplete observations (like country of

13 Note that only that Bonferroni-adjusted p-value would indicate significant differences and only for the US sample.
14 Note that no difference would be significant if Bonferroni-adjusted p-values were used.

origin) made the response not-usable for our purposes. Moderate biases are highlighted for Belgium (biology), Germany and India (Chemistry), Japan and US (Earth & Environment), where authors of higher-impact papers were comparatively more likely to complete the questionnaire[15].

Table A- 3 Two-group comparisons of Impact Factor in 16 countries by 4 subject categories. T-Tests. Hypothesized difference (complete respondents – dropped-out respondents)=0

COUNTRY	DIFFERENCE IMPACT FACTOR (COMPLETE - DROPPED-OUT)							
	Biology		Chemistry		Earth & Environment		Materials Science	
	mean	st.err	mean	st.err	mean	st.err	mean	st.err
Australia	-0.926	0.934	-0.213	0.421	-0.245	0.428	0.693	0.732
Belgium	-3.043	1.025*	0.878	0.959	-0.044	0.404	1.085	0.846
Brazil	0.026	0.274	-0.157	0.283	-0.630	0.623	0.214	0.356
Canada	0.036	0.712	-0.167	0.404	-0.294	0.273	-0.152	0.633
Denmark	-2.309	1.549	-0.656	0.962	0.355	0.939	1.492	1.487
France	-0.128	0.574	0.354	0.251	-0.015	0.235	0.178	0.298
Germany	-0.384	0.709	0.904	0.407*	0.323	0.271	-0.338	0.482
India	0.539	0.335	0.519	0.209*	-0.261	0.271	0.046	0.206
Italy	0.263	0.528	0.068	0.271	0.081	0.268	-0.124	0.433
Japan	1.090	0.711	-0.246	0.301	0.630	0.307*	0.040	0.335
Netherlands	1.154	0.794	1.715	1.215	0.431	0.426	-1.746	1.270
Spain	0.930	0.524	0.388	0.266	0.136	0.243	0.023	0.439
Sweden	0.808	1.313	-0.267	0.924	-0.565	0.478	-0.002	0.782
Switzerland	-0.434	1.581	0.876	1.104	0.086	0.408	1.013	1.788
UK	0.120	0.629	-0.101	0.457	-0.263	0.252	0.531	0.533
USA	0.663	0.438	0.322	0.221	0.302	0.132*	-0.069	0.333
OVERALL[+]	**0.324**	**0.203**	**0.373**	**0.095***	**0.117**	**0.072**	**0.081**	**0.131**

[+]Weighted by probability. *p<0.5

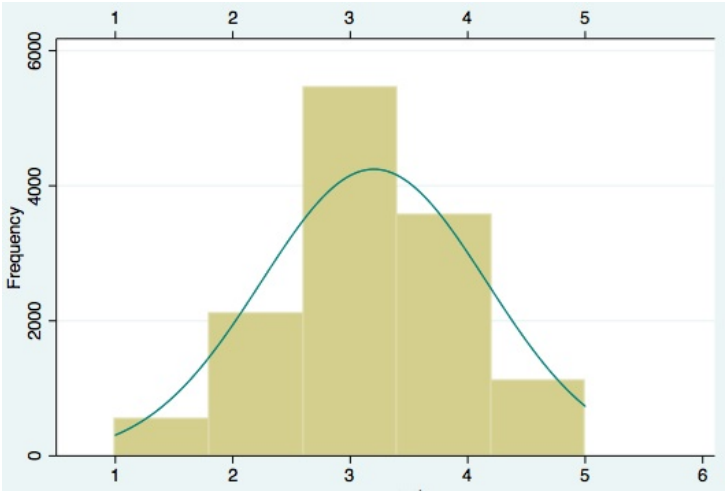
In sum, the controls performed on the set of information known ex-ante point to moderate evidence of bias. If biases exist, they seem to be more likely in the direction of slightly over-sampling correspondent authors of higher quality papers. A consistent picture is given by the last screening we performed, which, unlike the previous ones, is based on a self-reported assessment of representativeness. In particular, we asked the respondents the degree to which the selected paper represented their average production[16].

Figure A- 1 shows the histogram of the distribution of the answers. The distribution is overall well-behaved, with a slight right-skewness (mean 3.20; median 3.0).

[15] Note that Bonferroni-adjusted p-values would only indicate as significant the differences between samples in the Belgian sample in Biology.

[16] The question was formulated as asking the respondent to report on a 1-5 scale the agreement to the following statement: "This particular paper of yours is of a higher quality, with respect to my other papers".

Figure A- 1 Self-reported assessment of the representativeness of sample article (1-5 scale)



A.2 Selection of returnees

In addition to looking at the performance of returnees, it is interesting to examine evidence concerning selection effects in return migration. In other words, do academics who were mobile from a country and later decide to return exhibit comparable performance to their compatriots who have been mobile and remain abroad?

The standard selection models for return migration suggest that the direction of the initial selection, be it positive or negative, will be further strengthened by return migration (Borjas & Bratsberg, 1996). In other words, if migrants are positively selected, as our data suggest, those who return will be the worst of the best, those who remain are the best of the best. Thus, the foreign born remaining abroad would be survivors of a second selection process where only the brightest receive sufficiently good enough offers to convince them to stay and returnees would be those who did not receive such offers.

However, if the scientist is not or not primarily motivated by earnings in her decision to return, but, for example, motivated by family or personal reasons, the correlation may not be in the direction predicted. It turns out that in our data family or personal reasons is the most frequent factor given by respondents as being important or extremely important for returning to the origin country (64.3%). The second most frequently selected reason is quality of life (35.7%). A group of career and research-related factors follow. Least important among reasons given for returning are the pursuit of better working conditions and visa-related issues.

To shed light on the migration process, we compare the performance of individuals from the same origin country who were internationally mobile and subsequently returned to the performance of fellow natives who were mobile and remained abroad at the time the survey was administered. In this case, we restrict the sample by origin country and include only scientists who came from the 16 countries we have directly sampled and who had been mobile. There are 6529 observations in our sample that meet these criteria.

Average IF, TCs and Rank-normalized Impact Factors (RNIF) by country of origin and current residence in country of origin (returnees) vs. abroad are summarized in Table A-5. (The RNIF allows for comparing performance across discipline. It computes the journal rank in its field, based on the journal Impact Factor and normalized by the size of the subject category (Pudovkin and Garfield, 2004).

Table A- 4 Selection effect of RETURNEES

Observations: 6529 domestic scientists with international experience (Returnees and currently away from country of origin)

*.10≤**≤.05***≤0.01

COUNTRY OF ORIGIN	RETURNEES	CURRENTLY ABROAD	RETURNEES	CURRENTLY ABROAD	RETURNEES	CURRENTLY ABROAD	DIFFERENCE: (RETURNEES -CURRENTLY ABROAD)		
	Impact Factor		Total Cites		Rank-Norm. IF		Rank-Norm. IF		
AUSTRALIA	4.083	4.548	10.943	10.221	0.772	0.767	0.005	0.032	
BELGIUM	4.846	4.205	11.431	9.363	0.753	0.813	-0.060	0.036	*
BRAZIL	2.185	3.911	4.994	10.267	0.566	0.720	-0.154	0.042	***
CANADA	3.972	4.220	8.714	11.424	0.747	0.721	0.026	0.025	
DENMARK	4.275	4.581	13.647	14.587	0.755	0.818	-0.062	0.051	
FRANCE	4.037	4.075	9.616	11.618	0.802	0.787	0.015	0.019	
GERMANY	4.866	4.871	11.789	11.737	0.778	0.796	-0.019	0.016	
INDIA	2.604	3.824	6.263	9.447	0.658	0.726	-0.068	0.020	***
ITALY	3.652	5.346	7.734	13.403	0.741	0.800	-0.059	0.019	***
JAPAN	4.243	4.320	9.055	12.127	0.727	0.732	-0.006	0.036	
NETHELANDS	5.409	5.273	11.287	10.976	0.795	0.806	-0.011	0.031	
SPAIN	3.546	4.280	7.768	12.640	0.749	0.749	-0.001	0.026	
SWEDEN	4.946	4.284	12.715	10.460	0.782	0.802	-0.019	0.045	
SWITZERLAND	5.118	4.609	18.653	12.478	0.797	0.794	0.002	0.034	
UK	4.395	4.475	9.790	11.852	0.770	0.771	-0.002	0.018	
USA	4.380	4.390	11.704	10.835	0.765	0.799	-0.034	0.022	
ALL (weighted)	4.046	4.482	9.600	11.388	0.747	0.772	-0.026	0.005	***

The figures show that, in the majority of countries, mobile natives who have subsequently returned exhibit comparable performance to mobile natives who have remained abroad. Brazil, India and Italy are exceptions to the rule. In these countries, returnees on average do not perform as well as their fellow natives who have remained abroad. Belgium displays a similar pattern, but the difference is only significant at 90% confidence level. Results for these three countries are compatible with the world just described of positive selection among the stayers and, consequently, of adverse selection of those who return home. However, this result may also arise without adverse selection if, for example, the mobile scientist returns to a poorer research environment that constraints her subsequent capability to produce high-level research. This hypothesis is plausible considering that the three countries are among the lowest in our sample for percent of GDP spent on higher education.

To further investigate selection effects, we run a multivariate analysis (Table A-6). In addition to standard controls, in case the person returned, we add in two interaction variables (Model 2) that capture the years passed since the person returned, and those who have moved back and forth more than once during the ensuing years. The dummy variable tracking returnees takes a negative sign, but the standard error is too large to lead to statistically meaningful results. However, the coefficient of the control for the years passed since the person returned is negative and significant in the TC model, indicating that the longer a returnee has been back in her country of origin, the less likely she is to be cited, compared to her countrymen who remained abroad. The effect is moderate in magnitude: for each additional year spent in the home country after returning the average scientist receives 0.10 fewer citations. In other words, ten years after returning, scientists who are back in their country of origin receive about one fewer citations than fellow natives who have remained abroad. No such effect is found when we look at the Impact Factor.

In sum, we find no compelling evidence that returnees are on average adversely selected among the internationally mobile scientists. This may reflect that individuals report returning for family or life style reasons, not because of job-related issues. The lack of a performance differential also suggests that the premium associated with international experience survives return, despite the fact that many of the returnees work in a supposedly less favorable environment.

Table A- 5 Selection of the returnees

Robust OLS	-v1-	-v2-	Robust Neg. Bin.	-v1-	-v2-
RETURNEE	-0.1442	-0.1400	RETURNEE	-0.0184	0.0667
	(0.120)	(0.139)		(0.041)	(0.056)
years_since_ret		-0.0001	years_since_ret		-0.0109**
		(0.011)			(0.005)
back_forth		0.0150	back_forth		0.0255
		(0.162)			(0.063)
hindex_origin	0.4681**	0.4672**	hindex_origin	0.1591*	0.1524*
	(0.209)	(0.209)		(0.083)	(0.082)
AGE	0.0365	0.0365	AGE	-0.0048	0.0015
	(0.030)	(0.031)		(0.012)	(0.012)
SQ_AGE	-0.0005*	-0.0005*	SQ_AGE	-0.0001	-0.0001
	(0.000)	(0.000)		(0.000)	(0.000)
female	-0.3231***	-0.3229***	female	-0.1552***	-0.1521***
	(0.103)	(0.103)		(0.035)	(0.035)
emerging	0.8894***	0.8894***	emerging	0.3129***	0.3140***
	(0.092)	(0.093)		(0.032)	(0.032)
interdisc	-0.0711	-0.0708	interdisc	0.0031	0.0014
	(0.084)	(0.084)		(0.032)	(0.031)
inter_cooperated	0.1596	0.1593	inter_cooperated	0.0344	0.0334
	(0.099)	(0.099)		(0.033)	(0.033)
still_training	-0.8110**	-0.8104**	still_training	-0.3728*	-0.3627*
	(0.410)	(0.410)		(0.192)	(0.188)
n_author	0.2171***	0.2172***	n_author	0.0624***	0.0631***
	(0.023)	(0.023)		(0.006)	(0.006)
field dummies	yes	yes	field dummies		yes
current country dummies	yes	yes	current country dummies		yes
Constant	1.1240	1.1233	Constant	2.4084***	2.2072***
	(0.808)	(0.821)		(0.490)	(0.447)
			Ln_alpha	-0.1989***	-0.1996***
				(0.026)	(0.026)
Dependent variable	IF	IF	Dependent variable	TC	TC
Observations	6,082	6,082	Observations	6,079	6,079
R-squared	0.1504	0.1504			
Adj. R-sq	0.1465	0.1462			
F stat	34.1324	31.8652			

*.10≤**≤.05***≤0.01 (Heteroschedasticity-robust st. errors in parenthesis). Baseline: mobile natives currently abroad

A.3 Estimates weighted by probability of responding

Table A- 6 Performance of the internationally-mobile (probability weighted)

OLS	-v1-	-v2-	Neg. Bin.	-v1-	-v2-
RETURNEE	0.5769***	0.5342***	RETURNEE	0.2061***	0.2103***
	-0.063	-0.067		-0.026	-0.027
FOREIGN_AT_18	0.2527***	0.2192***	FOREIGN_AT_18	0.1504***	0.1537***
	-0.079	-0.082		-0.028	-0.028
visiting_only		-0.1956**	visiting_only		0.0193
		-0.077			-0.037
AGE	0.0579***	0.0577***	AGE	-0.0011	-0.001
	-0.018	-0.018		-0.008	-0.008
SQ_AGE	-0.0007***	-0.0007***	SQ_AGE	-0.0001	-0.0001
	0.000	0.000		0.000	0.000
female	-0.2790***	-0.2827***	female	-0.1019***	-0.1016***
	-0.066	-0.066		-0.023	-0.023
emerging	0.9164***	0.9178***	emerging	0.3361***	0.3361***
	-0.061	-0.061		-0.022	-0.022
interdisc	0.0266	0.0257	interdisc	0.0194	0.0195
	-0.055	-0.055		-0.021	-0.021
inter_cooperated	0.0411	0.0479	inter_cooperated	0.0479**	0.0473**
	-0.068	-0.068		-0.024	-0.024
still_training	-0.4172***	-0.4253***	still_training	-0.1947***	-0.1939***
	-0.134	-0.134		-0.065	-0.065
n_author	0.2317***	0.2316***	n_author	0.0760***	0.0760***
	-0.016	-0.016		-0.004	-0.004
field dummies	yes	yes	field dummies	yes	yes
current country dummies	yes	yes	current country dummies	yes	yes
Constant	0.0384	0.0842	Constant	1.9328***	1.9272***
	-0.486	-0.486		(0.306)	(0.307)
			Ln_alpha	-0.1780***	-0.1780***
				(0.017)	(0.017)
Dependent variable	IF	IF	Dependent variable	TC	TC
Observations	14,433	14,433	Observations	14,428	14,429
R-squared	0.1658	0.1658			

*.10≤**≤.05***≤0.01 (Standard errors in parentheses). Baseline: NATIVE_NOT_MOBILE

Table A- 7 Performance of FOREIGN-BORN (probability weighted)

OLS	-v1-	-v2-	Neg. Bin.	-v1-	-v2-
FOREIGN	0.8704***			0.2676***	
	(0.099)			(0.036)	
entered_work		0.9326***	entered_work		0.2858***
		(0.108)			(0.039)
entered_edu		0.6976***	entered_edu		0.2162***
		(0.130)			(0.048)
hindex_origin	1.2436***	1.1743***	hindex_origin	0.2239***	0.2037***
	(0.153)	(0.158)		(0.052)	(0.054)
AGE	0.0817***	0.0815***	AGE	0.0056	0.0056
	(0.020)	(0.020)		(0.010)	(0.010)
SQ_AGE	-0.0010***	-0.0010***	SQ_AGE	-0.0001	-0.0001
	(0.000)	(0.000)		(0.000)	(0.000)
female	-0.2350***	-0.2332***	female	-0.0900***	-0.0897***
	(0.079)	(0.079)		(0.027)	(0.027)
emerging	0.8872***	0.8865***	emerging	0.3319***	0.3304***
	(0.072)	(0.072)		(0.026)	(0.026)
interdisc	0.0917	0.0941	interdisc	0.0365	0.0372
	(0.065)	(0.065)		(0.025)	(0.025)
inter_cooperated	-0.0485	-0.0519	inter_cooperated	0.0457	0.0450
	(0.079)	(0.079)		(0.029)	(0.029)
still_training	-0.2190	-0.1918	still_training	-0.1464**	-0.1393**
	(0.142)	(0.142)		(0.067)	(0.066)
n_author	0.2588***	0.2588***	n_author	0.0831***	0.0832***
	(0.018)	(0.018)		(0.005)	(0.005)
field dummies	yes	yes	field dummies	yes	yes
current country dummies	yes	yes	current country dummies	yes	yes
Constant	-1.4030**	-1.3602**	Constant	1.4018***	1.4151***
	(0.568)	(0.568)		(0.263)	(0.263)
			Ln_alpha	-0.1810***	-0.1814***
				(0.020)	(0.020)
Dep. Variable	IF	IF	Dep. Variable	TC	TC
Observations	10,046	10,046	Observations	10,043	10,043
R-squared	0.1840	0.1843			

*≤.10;**≤.05;***≤.01. (Standard errors in parentheses). Baseline: NATIVE-NOT-MOBILE

Table A- 8 Performance of RETURNEES (probability-weighted)

OLS	-v1-	-v2-	-v3-	-v4-
RETURNEE	0.648***			
	(0.062)			
lowerH_country		0.271***		
		(0.101)		
higherH_country		0.845***		
		(0.072)		
BA_MA			-0.176	
			(0.162)	
phd			0.168	
			(0.139)	
post			0.760***	
			(0.070)	
job			-0.140	
			(0.106)	
MA_quality				-0.259
				(0.228)
phd_quality				0.298
				(0.190)
work_quality				0.768***
				(0.071)
AGE	0.050**	0.047**	0.047**	0.048**
	(0.020)	(0.020)	(0.020)	(0.020)
SQ_AGE	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
female	-0.356***	-0.352***	-0.347***	-0.345***
	(0.070)	(0.070)	(0.070)	(0.071)
emerging	0.989***	0.985***	0.988***	0.983***
	(0.068)	(0.068)	(0.068)	(0.069)
interdisc	0.0091	0.0082	0.0173	0.0165
	(0.061)	(0.061)	(0.061)	(0.061)
inter_cooperated	0.1103	0.1130	0.1212	0.1292*
	(0.077)	(0.077)	(0.077)	(0.078)
still_training	-0.1916	-0.1746	-0.1645	-0.1798
	(0.147)	(0.147)	(0.147)	(0.148)
n_author	0.198***	0.197***	0.197***	0.197***
	(0.018)	(0.018)	(0.018)	(0.018)
field dummies	yes	yes	yes	yes
current country dummies	yes	yes	yes	yes
Constant	0.4523	0.4943	0.5420	0.5243
	(0.541)	(0.540)	(0.541)	(0.546)
Dependent variable	IF	IF	IF	IF
Observations	11,227	11,227	11,227	11,072
R-squared	0.166	0.169	0.168	0.170

Neg. Bin.	-v1-	-v2-	-v3-	-v4-
RETURNEE	0.208***			
	(0.029)			
lowerH_country		0.196***		
		(0.044)		
higherH_country		0.234***		
		(0.030)		
BA_MA			0.136	
			(0.121)	
phd			0.091	
			(0.073)	
post			0.215***	
			(0.027)	
job			-0.050	
			(0.037)	
MA_quality				0.205
				(0.174)
phd_quality				0.129
				(0.096)
work_quality				0.186***
				(0.026)
AGE	0.005	-0.003	-0.003	-0.003
	(0.010)	(0.009)	(0.009)	(0.009)
SQ_AGE	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
female	-0.096***	-0.096***	-0.095***	-0.092***
	(0.027)	(0.027)	(0.027)	(0.027)
emerging	0.365***	0.347***	0.348***	0.347***
	(0.027)	(0.025)	(0.025)	(0.025)
interdisc	0.0594**	0.0165	0.0185	0.0122
	(0.025)	(0.024)	(0.024)	(0.024)
inter_cooperated	0.224***	0.090***	0.093***	0.0970***
	(0.031)	(0.028)	(0.028)	(0.028)
still_training	-0.0898	-0.1249	-0.1247	-0.1335*
	(0.088)	(0.076)	(0.077)	(0.078)
n_author		0.070***	0.070***	0.071***
		(0.005)	(0.005)	(0.005)
field dummies	yes	yes	yes	yes
current country dummies	yes	yes	yes	yes
Constant	2.051***	2.045***	2.073***	2.089***
	(0.356)	(0.352)	(0.340)	(0.338)
Ln_alpha	-0.147***	-0.192***	-0.192***	-0.190***
	(0.021)	(0.020)	(0.020)	(0.020)
Dependent variable	TC	TC	TC	TC
Observations	11,223	11,223	11,223	11,068

*≤.10;**≤.05;***≤.01. Baseline: NATIVE-NOT-MOBILE

A.4 Imputation of missing control variables

Table A- 9 Imputation estimates

IMP. Age (OLS)	Model	IMP. Female (Logit)	Model
INST_TYPE2	3.0034***	INST_TYPE1	0.1147*
	-0.241		-0.067
affil	-1.6019***	affil	0.0901
	-0.264		-0.067
POSITION1	3.5271***	POSITION1	-1.0473***
	-0.855		-0.153
POSITION2	-3.5516***	POSITION2	-0.4626***
	-0.855		-0.156
POSITION3	-14.2016***	POSITION3	-0.1599
	-0.905		-0.191
POSITION4	-11.8718***	POSITION4	-0.3105*
	-0.863		-0.168
POSITION5	-18.1810***	POSITION5	-0.4882
	-2.304		-0.784
POSITION6	-4.5089***	POSITION6	-0.3391*
	-0.92		-0.176
FIELD_bio	2.0171***	FIELD_bio	0.5794***
	-0.229		-0.067
FIELD_chem	1.6362***	FIELD_chem	-0.0093
	-0.241		-0.069
FIELD_mat	-0.0426	FIELD_earth	0.0987
	-0.275		-0.073
COUNTRY_Australia	1.3322	COUNTRY_Australia	-0.0627
	-0.827		-0.116
COUNTRY_Belgium	-2.5902***	COUNTRY_Belgium	-0.0436
	-0.922		-0.175
COUNTRY_Brazil	0.2032	COUNTRY_Brazil	0.7863***
	-0.815		-0.095
COUNTRY_Canada	2.1772***	COUNTRY_Canada	-0.1289
	-0.796		-0.103
COUNTRY_France	-0.0669	COUNTRY_Denmark	-0.0284
	-0.768		-0.189
COUNTRY_Germany	1.2818*	COUNTRY_France	0.2927***
	-0.77		-0.089
COUNTRY_India	-0.1391	COUNTRY_Germany	-0.1492
	-0.822		-0.093
COUNTRY_Italy	1.7563**	COUNTRY_India	-0.1799
	-0.748		-0.145
COUNTRY_Japan	0.7022	COUNTRY_Italy	0.6952***
	-0.758		-0.073
COUNTRY_Netherlands	-0.376	COUNTRY_Japan	-1.4954***
	-0.882		-0.125
COUNTRY_Spain	-1.3852*	COUNTRY_Netherlands	-0.2869*
	-0.759		-0.159
COUNTRY_Sweden	1.117	COUNTRY_Spain	0.7724***
	-0.871		-0.084
COUNTRY_Switzerland	2.0512**	COUNTRY_Sweden	0.3232**
	-0.876		-0.15
COUNTRY_UK	0.2339	COUNTRY_Switzerland	-0.4605***
	-0.771		-0.173
COUNTRY_USA	1.7456**	COUNTRY_UK	-0.2332**
	-0.734		-0.092
HE	0.3361	HE	0.0987
	-0.339		-0.087
phd	-1.3545***	phd	-0.0144
	-0.249		-0.067
post	-0.4054**	post	-0.2602***
	-0.195		-0.051
job	-0.3176	job	0.1328**
	-0.234		-0.059
q37rvisiting	-3.2491***	q37rvisiting	0.2554***
	-0.189		-0.049
Constant	52.5582***	Constant	-1.2127***
	-1.179		-0.202
Observations	14,563	Observations	14,493
R-squared	0.262	Pseudo R-squared	0.0727

Table A- 10 Performance of the internationally-mobile (weighted, with imputations)

OLS			Neg.Bin.		
RETURNEE	0.5815***	0.5393***	RETURNEE	0.2072***	0.2108***
	(0.063)	(0.066)		(0.026)	(0.027)
FOREIGN_AT_18	0.2521***	0.2191***	FOREIGN_AT_18	0.1472***	0.1501***
	(0.078)	(0.081)		(0.027)	(0.028)
visiting_only		-0.1923**	visiting_only		0.0165
		(0.076)			(0.037)
AGE	0.0581***	0.0578***	AGE	-0.0035	-0.0035
	(0.017)	(0.017)		(0.008)	(0.008)
SQ_AGE	-0.0007***	-0.0007***	SQ_AGE	-0.0001	-0.0001
	(0.000)	(0.000)		(0.000)	(0.000)
female	-0.2771***	-0.2808***	female	-0.0999***	-0.0997***
	(0.066)	(0.066)		(0.023)	(0.023)
emerging	0.9072***	0.9085***	emerging	0.3314***	0.3315***
	(0.060)	(0.061)		(0.022)	(0.022)
interdisc	0.0297	0.0288	interdisc	0.0203	0.0204
	(0.055)	(0.055)		(0.021)	(0.021)
inter_cooperated	0.0362	0.0426	inter_cooperated	0.0477**	0.0473**
	(0.067)	(0.067)		(0.024)	(0.024)
still_training	-0.3985***	-0.4063***	still_training	-0.1934***	-0.1926***
	(0.135)	(0.135)		(0.065)	(0.065)
n_author	0.2345***	0.2343***	n_author	0.0773***	0.0773***
	(0.016)	(0.016)		(0.004)	(0.004)
field dummies	yes	yes	field dummies	yes	yes
current country dummies	yes	yes	current country dummies	yes	yes
Constant	0.0176	0.0624	Constant	1.9842***	1.9795***
	(0.480)	(0.480)		(0.305)	(0.306)
			Ln_alpha	-0.1785***	-0.1785***
				-0.017	(0.017)
Dep. Variable	IF	IF	Dep. Variable	TC	TC
Observations	14,611	14,611	Observations	14,605	14,605
F stat	77.62				

*.10≤**≤.05***≤0.01 (Standard errors in parenthesis). Baseline: NATIVE_NOT_MOBILE

Table A- 11 Performance of the Foreign-born (weighted, with imputations)

OLS	-v1-	-v2-	Neg.Bin.	-v1-	-v2-
FOREIGN_AT_18	0.8805***		FOREIGN_AT_18	0.2687***	
	(0.098)			(0.036)	
entered_work		0.9444***	entered_work		0.2875***
		(0.107)			(0.039)
entered_edu		0.7047***	entered_edu		0.2163***
		(0.128)			(0.048)
hindex_origin	1.2634***	1.1935***	hindex_origin	0.2334***	0.2129***
	(0.151)	(0.156)		(0.052)	(0.054)
AGE	0.0794***	0.0791***	AGE	0.0026	0.0025
	(0.020)	(0.020)		(0.010)	(0.010)
SQ_AGE	-0.0009***	-0.0009***	SQ_AGE	-0.0001	-0.0001
	(0.000)	(0.000)		(0.000)	(0.000)
female	-0.2322***	-0.2305***	female	-0.0907***	-0.0904***
	(0.079)	(0.079)		(0.027)	(0.027)
emerging	0.8848***	0.8842***	emerging	0.3307***	0.3293***
	(0.071)	(0.071)		(0.025)	(0.025)
interdisc	0.0919	0.0947	interdisc	0.0370	0.0377
	(0.065)	(0.065)		(0.025)	(0.025)
inter_cooperated	-0.0577	-0.0612	inter_cooperated	0.0415	0.0407
	(0.078)	(0.078)		(0.028)	(0.028)
still_training	-0.2021	-0.1743	still_training	-0.1460**	-0.1385**
	(0.142)	(0.143)		(0.066)	(0.066)
n_author	0.2601***	0.2601***	n_author	0.0837***	0.0838***
	(0.018)	(0.018)		(0.005)	(0.004)
field dummies	yes	yes	field dummies	yes	yes
current country dummies	yes	yes	current country dummies	yes	yes
Constant	-1.3674**	-1.3221**	Constant	1.4714***	1.4860***
	(0.559)	(0.559)		(0.258)	(0.258)
			Ln_alpha	-0.1833***	-0.1837***
				(0.020)	(0.020)
Dep. Variable	IF	IF	Dep. Variable	TC	TC
Observations	10174	10174	Observations	10170	10170

*≤.10;**≤.05;***≤.01. (Standard errors in parenthesis). Baseline: NATIVE-NOT-MOBILE

Table A- 12 Performance of RETURNEES (weighted, with imputations)

Robust OLS	-v1-	-v2-	-v3-	-v4-
RETURNEE	0.652***			
	(0.062)			
lowerH_country		0.263***		
		(0.100)		
higherH_country		0.857***		
		(0.072)		
BA_MA			-0.094	
			(0.177)	
phd			0.132	
			(0.139)	
post			0.754***	
			(0.070)	
job			-0.1422	
			(0.106)	
MA_quality				-0.045
				(0.289)
phd_quality				0.235
				(0.190)
work_quality				0.763***
				(0.071)
AGE	0.052***	0.048**	0.049**	0.051***
	(0.019)	(0.019)	(0.019)	(0.020)
SQ_AGE	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
female	-0.357***	-0.352***	-0.349***	-0.345***
	(0.070)	(0.070)	(0.070)	(0.070)
emerging	0.978***	0.974***	0.977***	0.971***
	(0.068)	(0.068)	(0.068)	(0.068)
interdisc	0.013	0.012	0.021	0.020
	(0.060)	(0.060)	(0.060)	(0.061)
inter_cooperated	0.112	0.114	0.125	0.133*
	(0.077)	(0.076)	(0.077)	(0.077)
still_training	-0.194	-0.177	-0.170	-0.185
	(0.147)	(0.146)	(0.146)	(0.147)
n_author	0.201***	0.200***	0.201***	0.200***
	(0.018)	(0.018)	(0.018)	(0.018)
field dummies	yes	yes	yes	yes
Curr. country dummies	yes	yes	yes	yes
Constant	0.394	0.437	0.473	0.454
	(0.534)	(0.533)	(0.535)	(0.539)
Dependent variable	IF	IF	IF	IF
Observations	11359	11359	11359	11203

Robust Neg. Bin.	-v1-	-v2-	-v3-	-v4-
RETURNEE	0.218***			
	(0.027)			
lowerH_country		0.190***		
		(0.044)		
higherH_country		0.237***		
		(0.030)		
BA_MA			0.167	
			(0.118)	
phd			0.095	
			(0.073)	
post			0.207***	
			(0.027)	
job			-0.048	
			(0.037)	
MA_quality				0.282*
				(0.166)
phd_quality				0.127
				(0.094)
work_quality				0.181***
				(0.026)
AGE	-0.004	-0.005	-0.004	-0.004
	(0.009)	(0.009)	(0.009)	(0.009)
SQ_AGE	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
female	-0.096***	-0.095***	-0.094***	-0.091***
	(0.027)	(0.027)	(0.027)	(0.027)
emerging	0.344***	0.343***	0.344***	0.344***
	(0.025)	(0.025)	(0.025)	(0.025)
interdisc	0.017	0.018	0.020	0.014
	(0.024)	(0.024)	(0.024)	(0.024)
inter_cooperated	0.092***	0.092***	0.096***	0.099***
	(0.028)	(0.028)	(0.028)	(0.028)
still_training	-0.133*	-0.132*	-0.134*	-0.142*
	(0.076)	(0.076)	(0.076)	(0.077)
n_author	0.072***	0.072***	0.072***	0.072***
	(0.005)	(0.005)	(0.005)	(0.005)
field dummies	yes	yes	yes	yes
Curr. country dummies	yes	yes	yes	yes
Constant	2.062***	2.062***	2.082***	2.093***
	(0.352)	(0.350)	(0.337)	(0.334)
Ln_alpha	-0.192***	-0.193***	-0.191***	-0.190***
	(0.020)	(0.020)	(0.020)	(0.020)
Dependent variable	TC	TC	TC	TC
Observations	11354	11354	11354	11198

*≤.10;**≤.05;***≤.01. (Standard errors in parenthesis). Baseline: NATIVE-NOT-MOBILE