Working Paper
Economic Series 17-18
Febrero 2019
ISSN 2340-5031

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"SPATIAL MOBILITY IN ELITE ACADEMIC INSTITUTIONS IN ECONOMICS. THE CASE OF SPAIN"

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Abstract

Using a dataset of 3,540 economists working in 2007 in 125 of the best academic centers in 22 countries, this paper presents some evidence on spatial mobility patterns in Spain and other countries conditional on some personal, department, and country characteristics. There are productivity and other reasons for designing a scientific policy with the aims of attracting foreign talent (*brain gain*), minimizing the elite *brain drain*, and recovering nationals who have earned a Ph.D. or have spent some time abroad (*brain circulation*). Our main result is that Spain has more brain gain, more brain circulation and less brain drain than comparable large, continental European countries, i.e. Germany, France, and Italy, where economists have similar opportunities for publishing their research in English or in their own languages. We suggest that these results can be mostly explained by the governance changes introduced in a number of Spanish institutions in 1975-1990 by a sizable contingent of Spanish economists coming back home after attending graduate school abroad. These initiatives were also favored by the availability of resources to finance certain research related activities, including international Ph.D. programs.

Key words: governance; economics institutions; brain drain; brain circulation; brain gain
JEL Code: J61

Acknowledgements. This is the fourth version of a Working Paper in this series with the title "Governance, brain drain, and brain gain in elite academic institutions in economics. The case of Spain", published in December 2017. Carrasco and Ruiz-Castillo acknowledge financial support from the Spanish MEC (*Ministerio de Economía y Competitividad*) through grants No. ECO2015-65204-P and ECO2014-55953-P, respectively, as well as grants MDM 2014-0431 from the MEC, and MadEco-CM (S2015/HUM-3444) from the *Comunidad Autónoma de Madrid* to their economics department. Research Assistantships by Fernando Gutierrez del Arroyo, Pedro Henrique Sant'Anna, Ana Moreno, and Carlos Berganza are deeply appreciated. Comments from Pedro Albarrán, César Alonso, Salvador Barberá, Olympia Bover, Marco Celentani, Jesús Fernández-Huertas, Jesús Gonzalo, and Matthias Kredler are gratefully acknowledged. All remaining shortcomings are the authors' sole responsibility.

1. Introduction

Using large bibliographic databases with information about the characteristics of documents appearing in the periodical literature, it has been established that, in all sciences, there is a heavy concentration of the most productive and influential researchers in top U.S. research institutions.[1] However, part of the success achieved by U.S. institutions must be attributed to scholars born or having obtained a first college degree in other countries, giving rise to what Hunter *et al.* (2009) call the *elite brain drain*.[2]

This observation leads toward the subject matter of this paper, namely, the role of geographic mobility in the organization of science. Specifically, we study the partition of researchers working in any country into three groups: (i) foreigners, or what we call *brain gain*; (ii) nationals who study and/or work abroad followed by a return to the home country, a phenomenon known as *brain circulation*, and (iii) nationals who study and work in their country of origin, or *stayers*.[3] Yet, since the individual information on the country of origin and the place where one has studied or worked abroad is hard to collect, there is virtually no data that allow for consistent comparisons of mobility patterns across countries among the Ph.D. trained. In this paper, we study the spatial mobility of 3,540 economists working in 2007 in 125 economics departments and research centers in 22 countries. These 125 centers are selected among the best in each country according to the Econphd (2004) ranking of institutions and other considerations (see Section 2.1 on the selection of sample countries and departments).

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[1] See *inter alia* Batty (2003), Dossi *et al.* (2006), Albarrán *et al.* (2010, 2011), Herranz and Ruiz-Castillo (2013), Rodriguez-Navarro (2016), Bonaccorsi *et al.* (2017a), Rodriguez-Navarro and Narin (2018), and Rodriguez-Navarro and Brito (2018). Yearly rankings using the volume and citation impact of publications can be obtained, among others, from the following two sources: the *Leiden Ranking* (www.leidenranking.com), a bibliometric ranking of universities based on the Web of Science, presently distributed by Clarivate Analytics, and the *SCImago Institutions Rankings* (SIR; www.scimagoir.com), a bibliometric ranking of research institutions based on the Scopus database, distributed by Elsevier.

[2] For the economics of immigration, see Borjas (1999) and Stark (2005), McDowell & Singell, (2000), Franzoni *et al.* (2014, 2015), and for a survey of four decades of economics research on the brain drain, see Doquier & Rapoport (2012). Specifically, for the importance of foreigners in U.S. science, see Section 2 in Doquier & Rapoport (2012), and chapter 8 in Stephan (2012); for the elite brain drain, see Stephan & Levin (2001), Laudel (2003, 2005), Basu (2006), Bauwens *et al.* (2008), Parker *et al.* (2010), Parey *et al.* (2017), and Albarrán *et al.* (2017a, b).

[3] Just as immigrants are said to be brain drained from the point of view of sending countries, in this paper immigrants are said to be brain gained from the point of view of receiving countries. This use is at variance with the "new economics of brain drain" (see *inter alia* Stark, 2005), where brain gain refers to the idea that the prospect of migration provides incentives to individuals in the sending countries to build the greatest possible stock in human capital.

The following three characteristics should be emphasized at the outset. Firstly, 51.8% of the sample consists of movers (34.4% of brain gain, and 27.4% of brain circulation). Secondly, more than three quarters of all immigrants are concentrated in a few countries: 53.4% in the U.S., and 26% in what we call *open* countries (Canada, the U.K., Australia, and Switzerland). Thirdly, a number of continental European countries, which we call *closed* countries, are characterized by a small percentage of brain gain and a large percentage of stayers (Germany, France, Italy, Netherlands, Belgium, Sweden, and Denmark).[4] In this scenario, we focus on a comparison of Spain and Germany, France, and Italy. These are four large, demographically comparable continental members of the European Union, and non-English speaking countries where economists have similar opportunities for publishing their research in English or in their own languages.

It turns out that Spain has more brain gain, more brain circulation and less brain drain than Germany, France, and Italy. However, this unconditional evidence must be subject to as many controls as possible. The reason, of course, is that the probability that an individual becomes an immigrant may depend on her individual characteristics, the relative attractiveness of the department where she works, as well as the characteristics of the countries of origin and destination. Our main finding is that our descriptive results are maintained after controlling for demographic variables, Ph.D. education, a measure of individual productivity, average department productivity, and *per capita* GDP. This is important because, in the context of increased global competition for skilled workers (OECD, 2008, Freeman, 2010, Jacob and Meek, 2013, and Geuna, 2015), any country has reasons for designing a scientific policy with the aims of attracting foreign talent (*brain gain*), minimizing the elite *brain drain*, and recovering nationals who have earned a Ph.D. or have spent some time abroad (*brain circulation*).

[4] This features are not exclusive for economics. In particular, the partition into the U.S., open, closed, and other countries is similar to the one in the largest dataset in the literature (Franzoni *et al.*, 2015), consisting of 17,182 researchers in biology, chemistry, materials science, and earth and environmental science working in 2011 in 16 'core' countries, 14 of which coincide with some of our 22 countries. The importance of mobility and the concentration of brain drain in a few countries in these sciences are of a similar order of magnitude as what we found in economics (for the details of these comparisons, see Section 3.3 below).

A relevant aspect is whether the productivity of brain gain and those who return from abroad to work in their country of origin differs from the productivity of those who study and work in the country in question. As is well known, an answer to these questions should consider that the unobservable ability of individuals is correlated both to migration and to performance. The results of the literature and the correlations observed in our sample indicate that the productivity of foreigners is greater than or equal to the productivity of stayers (McDowell & Singell, 2000, Stephan and Levin, 2001, Hunter *et al.*, 2009, Franzoni *et al.*, 2014, and Albarrán *et al.*, 2017b). Moreover, among the nationals from any country, the productivity of scientists that have been brain drained in the top U.S. departments is generally greater than the productivity of those in brain circulation, while the productivity of the latter is greater than the productivity of stayers (see Section 4). In addition, from the point of view of the sending countries, there are other reasons for concern about the consequences of the brain drain. As Laudel (2005) has emphasized for narrowly defined specialties, the consequences for any country from losing elite members typically means that the national specialty becomes uncoupled from frontier science; quality standards might no longer be enforced nationally; the country may no longer be able to recruit or train the best young scientists in the field (a country needs elites to generate elites), and an important channel of communicating societal interests to those who govern the specialty is lost.

On the other hand, it can be argued that geographic mobility is beneficial to receiving countries because (i) mobile scientists place themselves in settings where they can be more productive due to specialized skills or equipment that exists only in specific locations (Jones, 2008, Stephan, 2012), (ii) both foreign-born scientists and returnees have larger international research networks than do native researchers who lack an international background (Scellato *et al.*, 2015), and (iii) a more diverse knowledge or ethnic mix boosts the creative outcomes (Freeman and Huang, 2015). Finally, as pointed out by Velema (2012), scientists in brain circulation can contribute to the national science system in several ways, such as facilitating access to foreign resources, improving the reputation and international profile of their country of origin, contributing to the international orientation of colleagues or students in the local scientific community, and contributing to the creation of an institutional environment in which science and research can prosper.

It should be noted that, in comparison with other sciences, the ability of Spanish institutions in economics to attract immigrants constitutes an exception: the percentage of brain gain in Spain is 31.1% in our sample but only 7.3% in the four sciences studied by Franzoni *et al.* (2015). Thus, the question addressed in this paper is how to explain the differences in this respect between Spain and other comparable European countries. Given the set of individual, departmental, and country characteristics we control for, a significant difference between the effect of Spain and other countries on the probability of becoming an immigrant must be attributed to uncontrolled variables. In our suggested interpretation, the most important uncontrolled variables refer to governance. Our reasoning is the following. Higher education in the four large European countries emphasized in this paper are dominated by an old public system repeatedly critized in the literature for being relatively closed to foreign competition and because research does not necessarily hold a predominant place (see *inter alia* Portes, 1987, Frey & Eichenberg, 1993, and Bonaccorsi, 2007). However, the Spanish situation in economics has changed dramatically during the sample period. Since the mid-1970s, a sizable contingent of brain circulation economists has made compatible a number of drastic changes in the Spanish centers in our dataset with the rules for becoming a public servant in the official system. These governance changes include: (i) the introduction of meritocratic hiring and promotion rules with the aim of fomenting quality research; (ii) a strong international Ph.D. program, and (iii) the use of English as the working language. Instead, with few exceptions, the governance of the institutions in the other countries has remained largely unchanged during the period. Thus, we mainly attribute our results on country effects to the unobservable governance changes in Spain. A second unobservable factor that may have a role in the results, is the increase of resources for research related activities in Spain since the mid-

1980s coming from two sources: public higher education budgets, and Spanish and European Union competitive grants.[5]

In order to understand the policy implications of our analysis, consider the following two points. Firstly, the increase in resources for research facilities in Spain benefited all sciences. However, differences in mobility patterns between Spain and comparable European countries have only taken place in economics. Secondly, the government changes emphasized in our interpretation are not the consequences of a new policy at the national or university levels, but the result of decisions taken by a self-selected number of institutions in economics. Thus, in the context of a rigid system of higher education in continental Europe that does not have at his core the promotion of quality research, our results indicate that initiatives at a local level in a given science can have measurable consequences in international mobility patterns.

The remainder of this article is organized as follows. Section 2 describes the data, Section 3 presents descriptive statistics, including a useful partition of the 22 sample countries into five types, while Section 4 discusses our correlations on productivity comparisons. Section 5 presents the empirical model and the estimation results on the probability that an individual becomes an immigrant, Section 6 discusses them, and Section 7 concludes. In order to facilitate the reading of the text, a Supplementary Material document contains some additional information on the construction of the dataset, other descriptive statistics, and some empirical results.

2. The dataset

2.1. The selection of sample countries and departments

It must be recognized that, beyond the first 50 or 70 positions, any international ranking becomes very much open to debate. Nevertheless, any acceptable ranking may be safely used for the mere

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[5] The improvement of Spanish economics institutions in international research rankings during the same period, which has been documented elsewhere (Drèze and Estevan, 2007, and Ruiz-Castillo, 2008), has been also attributed to these governance changes in elite Spanish centers and the availability of increased resources for research.

selection of a representative sample of the best institutions in any country, regardless of whether the exact rank received by a given institution actually represents its true place in the world. In our case, research excellence is generally assessed in terms of the Econphd (2004) ranking.[6]

We select countries and departments in four steps.[7] We begin with a dataset used in previous contributions (Carrasco and Ruiz-Castillo, 2014, and Albarrán *et al.*, 2017a, b), consisting of the top 81 Economics departments worldwide according to the Econphd (2004) ranking. We aim to select a minimum of five or six departments for large European countries and important cases, such as Canada, and a minimum of two departments for any other country. With this criterion, we find that the following five countries are well represented in the original sample (with the number of departments in brackets): the U.S. (52), the UK (8), the Netherlands (4), Sweden (2), and Israel (2). In the second step, in the remaining seven countries with at least one department in the original list, we add seventeen institutions as follows (with the total number in brackets): five in Germany (6), four in France (5), three in Spain (6), two in Belgium (3), and one in Canada (5), Denmark (2), and China (2). In the third step, we use information on the institutions between the 81 and the 125th position in the Econphd (2004) ranking. Among the new countries with at least one department in this interval, we include the following three (with the number of departments in brackets): Italy (5), whose Università Bocconi occupies the 101 position; Australia (2), whose first three universities are ranked in this interval, and Switzerland (2), whose University of Zürich occupies the 99th position. Finally, for the sake of completeness, we add the following seven countries whose best departments do not appear within the first 125 positions in the Econphd (2004) ranking: Greece (2) and Portugal (2) are included to complete the vision offered by other small members of the European Union that are considerably more affluent; we also include Turkey (4), a country geographically close to the European Union but with a different culture and with a number

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[6] This ranking takes into account the publications in the period 1993-2003 in the top 63 economics journals in the Kalaitzidakis *et al.* (2003) weighted journal ranking, where the weights reflect journal citation counts adjusted for factors such as the annual number of pages and the age of the journal (for further methodological details, see Econphd, 2004).

[7] To save space, details and some exceptions are discussed in Section SM1 in the Supplementary Material.

of prominent nationals among the elite in economics; finally, we find it interesting to include four countries in Central and South America: three Spanish speaking countries –Mexico (4), Argentina (2), and Chile (2)– plus Brazil (3). As we will see, the inclusion of these countries with 19 departments has been worthwhile.

The final dataset includes 125 university departments and research centers in 22 countries. The list of institutions in each country, ordered by their Econphd rank, is in Table A in Section SM1 in the Supplementary Material. In spite of the difficulties and shortcomings recognized in that section, we have constructed a sound sample of the most productive institutions in 2007 in an interesting list of countries.

2.2. Collecting individual information, and the distribution of researchers by institutions in each country

In most centers, we searched for individual researchers in the departmental web pages in 2007. The minimum information we require for each individual includes the nationality, the university where a Ph.D. is obtained, the age, the gender, and the publications in the periodical literature up to 2007. There are 3,540 individuals in the dataset with at least one publication and with complete information on education, and age. The distribution of the these individuals by institutions in each country is presented in Table A in Section SM1 in the Supplementary Material. Details on how we collected individual information, as well as the distribution of institutions by size in each country are discussed in Section SM2 in the Supplementary Material. As we conclude in that section, the greatest difficulty might relate to the quality of our information on stayers, and hence on the total number of economists working in 2007 or originating in a given country. For example, if we are unable to include all junior stayers in German institutions, then our estimate of the percentage of brain gain, brain drain, and net gain over the sum of brain circulation and stayers in Germany will be biased upwards. The opposite will be the case if we have too many stayers in some French or Italian universities.

2.3. The measurement of individual productivity

Because of budgetary restrictions, our information on productivity suffers from two limitations: we make no distinction between single and multiple-authorship in each publication, and we do not consider the citation impact achieved by every article. What we do is to construct a quality index that weights differently the publications each individual has over her academic career up to 2007 in four journal classes.[8] We believe that, to stress the difference between top and local journals, it is desirable to value class A journals very highly. We should also recognize the role of excellent field journals. Thus, the four classes are assigned weights equal to 40, 15, 7, and 1 point, respectively. The resulting quality index is denoted by Q.[9] The mean Q for all centers is presented in Table A in Section SM1 in the Supplementary Material.

3. Descriptive statistics on spatial mobility

3.1. Mobility variables

Our information concerning mobility patterns is limited but interesting. We only know the country where individuals earn a B.A. or a Ph.D., and the country where they work in 2007. Therefore, any move that takes place during the period between obtaining a Ph.D. and 2007 is ignored. This means that we cannot separate permanent migration from temporary mobility. Nevertheless, among the 3,540 economists working in 2007 in any of the 22 sample countries, we can distinguish between: (i) those who have completed all their studies in the country in question (*stayers*); (ii) those who study their Ph.D. abroad but come back to the country of origin (*brain circulation*), and (iii) those born in any other country in the world (*brain gain*). In turn, the 3,253 economists born in the 22 countries in the dataset can be

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[8] Classes A, B, and C consist of 5, 34, and 47 journals, while class D consists of any other journal. Class A includes the *American Economic Review*, *Econometrica*, *Journal of Political Economy*, *Quarterly Journal of Economics*, and *Review of Economic Studies*. By way of example, the following 12 journals are in class B: *Economic Journal*, *Games and Economic Behavior*, *International Economic Review*, *Journal of Econometrics*, *Journal of Economic Growth*, *Journal of Economic Theory*, *Journal of Finance*, *Journal of Labor Economics*, *Journal of Monetary Economics*, *Journal of Public Economics*, *Rand Journal of Economics*, and *Review of Economics and Statistics*. See Appendix II in Albarrán *et al.* (2014) for the listing of all journals in classes B and C.

[9] This index has been used in our previous publications (Albarrán *et al.*, 2017a, b, as well as Carrasco and Ruiz-Castillo, 2014). To save space, for further details concerning this construction see Section SM3 in the Supplementary Material.

partitioned into stayers, brain circulation, and those who work in 2007 in a different country than the one where they originate (*brain drain*). Note that there are 3,540 – 3,253 = 287 economists born outside our sample countries that are part of the brain gain in these 22 countries. The quality of our information on mobility variables is defended in Section SM4 in the Supplementary Material.

3.2. Country types

As we will presently see, it is convenient to classify the 22 sample countries into five well defined types. For that purpose, Figure 1 illustrates the partition of the economists working in 2007 in any country into brain gain, brain circulation, and stayers (the numerical information is in Table B in Section SM4 in the Supplementary Material).

Figure 1 around here

We begin by noting that the 14 countries in the right-hand side of Figure 1 have below average percentages of brain gain (in red). These countries can be partitioned into two types. Firstly, Netherlands, Belgium, Sweden, Denmark, Germany, and France are also characterized by a relatively low percentage of brain circulation and, therefore, a large proportion of stayers (in blue), ranging from 59.4% of the total number working in Sweden to 76.6% in France. Italy, with the lowest percentage of brain gain, has also a high percentage of stayers. Consequently, we refer to these seven European countries as *closed* countries. Secondly, many of the best B.A. graduates in a number of countries with weak graduate schools choose to earn a Ph.D. abroad, mainly in the U.S. After this investment in human capital, these foreign Ph.Ds. are welcome back home to work in the best economics departments. In our dataset, Greece, Portugal, Turkey, Brazil, Argentina, Chile, and Israel, with a very high proportion of brain circulation (in green) and a below average proportion of stayers, are referred to as *brain circulation* countries.

The remaining eight countries in the left-hand side of Figure 1, all of which have a relatively large proportion of brain gain, will be classified into three types. Firstly, the U.S., with a negligible proportion of brain circulation and a proportion of stayers around the sample average, constitutes a special case better treated separately. Secondly, in the UK, Canada, Australia, and Switzerland, with the highest proportion of brain gain, the number of foreigners is greater than the number of nationals working there. Thus, we refer to them as *open* countries. Finally, Mexico, Spain, and China form a *mixed* type. Their proportion of brain gain, around the sample average, places them close to the open countries and away from brain circulation and closed countries. But their proportion of brain circulation, well above average, makes them quite different from open and closed countries.

The following two points should be emphasized. Firstly, the fact that 79.3% of all brain drained economists work either on the U.S. or the four open countries clearly indicates that it is very hard to attract foreigners away from the U.S., the other three Anglo-Saxon countries, and Switzerland. Thus, only 13.9% of the brain gain total works in the fourteen closed and brain circulation countries. The remaining 6.8% immigrants work in Spain, Mexico, and China. Secondly, judging from its brain circulation percentage, Spain and Italy are closer to Portugal and Greece than to the remaining six continental members of the European Union in our sample. Thus, descriptive statistics seem to indicate that these four Southern European countries could be classified as brain circulation countries. More recently, however, whereas Italy has become a closed country with a large percentage of stayers, Spain has surprisingly become an open country. Mexico and China seem to have traversed a similar route from brain circulation to open countries.

It is also interesting to consider the partition of the economists born in each of the sample countries into brain drain, brain circulation, and stayers. As can be observed in Table C in Section SM4 in the Supplementary Material, the proportion of brain drain does not generally follow a regular pattern by country type. In spite of this variability, it is worthwhile to compare the size of the brain gain and brain drain flows in each country. Of course, the number of individuals born in a country need not be equal to the number of economists working there in 2007. However, we can compare the flows of brain gain and brain drain as a percentage of the nationals working in each country, that is, the sum of brain circulation and stayers in each country. We define the *percentage of net gain* as the difference between the percentages of brain gain and brain drain over this denominator (Table D in Section SM3 in the Supplementary Material). The situation is illustrated in Figure 2. The results are very eloquent. Firstly, except Netherlands, all closed and brain circulation countries have a negative percentage of net gain. Secondly, the U.S., open and mixed countries, except China, with a large percentage of brain drain, have a positive percentage of net gain.

Figure 2 around here

3.3. A comparison with other sciences

It is interesting to compare the above descriptive statistics with the corresponding information for other sciences. Unfortunately, the study of geographic mobility using large datasets is limited at present to a definition of mobile researchers as those who change affiliations during a reduced time period. However, we know of two other contributions comparable to our own. For space reasons, we report briefly about the most important one due to Franzoni *et al.* (2015) (for a detailed discussion, see Section SM5 in the Supplementary Material).

These authors collect information –albeit in a roundabout way– for 17,182 researchers in four scientific fields: biology, chemistry, materials science, and earth and environmental sciences. Geographic mobility patterns in these sciences are similar to our own in two respects. Firstly, as indicated in note 4, the partition into the U.S., open, closed, and other countries among 16 'core' countries, 14 of which coincide with some of our 22 countries, is similar to the one in economics. The only difference is that, together with the U.K., Canada, Australia, and Switzerland, Sweden is included among the open countries. Secondly, out of the total number of researchers, 53.4% are movers –24.0% foreign-born, and 29.4% returnees– a percentage comparable with the 49.4% in our sample. Similarly, there is a concentration of immigrants into a few countries of the same order of magnitude that our own: 42.0% work or study in the

U.S., and 34.4% in open countries.[10]

However, there is a key difference worth emphasizing: while the percentage of brain gain in Spain is 31.1% in our sample, it is only 7.3% in Franzoni *et al.* (2015). The conclusion is that, in comparison with other European countries, the Spanish case in economics constitutes an exception in need of an explanation.

4. Productivity comparisons

We are concerned with the following two issues.

1. Which is the contribution of immigrants to the average productivity of the country where they work? To answer this question, we compare the average productivity of foreigners, brain circulation, and stayers in each country.

2. Among all researchers born in a given country, we would like to investigate whether those brain drained are more productive than stayers. For completeness, we are also interested in comparing the productivity of brain circulation and brain drained economists.

For answering these questions, we use regressions of individual productivity on a number of mobility, individual, and department characteristics. Among personal control variables, we have information on years of academic experience, gender, and the university where individuals earn their first college degree and where they attend graduate school. In previous research, we have documented the importance of department effects in the sense that when we partition departments into several categories according to their prestige –say, top, intermediate, and bottom categories–, the average productivity of economists working in each category is hierarchically ordered (Albarrán *et al.*, 2017b). Using the Econphd (2004) department ranking, we distinguish between five categories. The 52 U.S. departments are partitioned into the *Top 25* and the *Next 27*. The 73 non-U.S. departments are partitioned into the *Top*

[10] In the only additional dataset we know of, consisting of the 317 highly cited mathematicians studied in Panaretos and Malesios (2012), the importance of movers and the concentration of brain gain in the U.S. are of a similar order of magnitude.

15, the *Bottom 43,* and the *Last 15* belonging to the brain circulation countries except Israel.[11]

It should be emphasized at the outset that, since we do not have information for dealing with the endogeneity of mobility choices, we can only report correlations. Nevertheless, our correlation results will describe the productivity characteristics of our sample. To save space, we relegate the regression analysis to Section SM6 in the Supplementary Material. Here, we merely report the key results.

1. The results in the literature concerning the existence of productivity differences between immigrants and nationals are mixed. Our results indicate that, controlling for personal characteristics and fixed department effects, foreigners are more productive than brain circulation, and the latter are more productive than stayers (Table H in Section SM6).[12] However, when we make productivity comparisons between immigrants and stayers *within* department categories, the situation is different in top and bottom institutions. Results are summarized in panel A in Table 1 (from Table I in SM6). We also study the effect of these mobility variables in each country (or aggregates of countries when required by data limitations). Results are summarized in panel B in Table 1 (from Table J in SM6).

Table 1 around here

Two points are in order. Firstly, in the U.S. we confirm that, as in Albarrán *et al.* (2017b), the productivity of foreigners and stayers is indistinguishable at the top, while foreigners are more productive than stayers at the bottom. The novelty in Panel A is that this situation is essentially reproduced outside the U.S.: foreigners and stayers in the *Top 15* departments are equally productive, whereas immigrants are more productive than stayers both in the *Bottom 43* and the *Last 15* departments. In Panel B, the situation at the top is represented by the *Top 25* U.S. departments, the U.K., Canada, and Israel. Except in Netherlands, in all other countries foreigners are more productive than stayers. Note that the stayers in our sample of top institutions are presumably more productive than the rest of stayers in any country.

[11] Of course, which departments are at any moment in the "top 25" or "bottom 27" in the U.S., or the "top 15", "bottom 43", and the last 15 outside the U.S. is open to debate. Moreover, even if this classification is appropriate for the period 2004-2007, individual departments are likely to have changed positions over the period of this study prior to 2007. Therefore, it is advisable to take this partition as representative of "top" or "bottom" departments in general.

[12] P-values for these and the remaining productivity comparisons in this Section are available on request.

Therefore, suppose that the brain gain in any country is reduced in half. Since the replacement must come from the pool of country stayers, the result will surely be detrimental for the country in question.

Secondly, the situation of brain circulation economists is remarkable: except in Mexico, they are as productive or even more productive than foreigners. Thus, except at the top department and countries where foreigners, brain circulation, and stayers are indistinguishable, the productivity of brain circulation is greater than the productivity of stayers.

2. Ideally, for all economists born in a given country, we would like to compare the average productivity of three types of individuals: brain drain, brain circulation, and stayers. If possible, we would like to differentiate between brain drained economists in different department categories. Because of data limitations, we can separate brain drained individuals at most into two groups: those working in *Top 25* U.S. departments, and those working in what we call *All other* departments, namely, the sum of the *Next 27* U.S. departments plus the 73 non-U.S. departments. Results are summarized in Table 2 (from Table K in SM6).

Table 2 around here

Unsurprisingly, in 16 countries the productivity of brained drained economists is greater than the productivity of stayers, while there are three countries for which the productivity of stayers is so high that it is indistinguishable with the productivity of those brain drained even in the *Top 25* U.S. departments: Israel, Canada, and Netherlands.[13] Finally, the U.S. constitute an exception in which brain drain economists appear to be negatively selected relative to stayers in the *Top 25* U.S. departments.[14] Thus, in most cases brain drained economists –particularly those working in the *Top 25* U.S. departments– are more productive than stayers. On the other hand, the productivity of brain circulation is generally smaller than the productiviuty of those who remain abroad (see the details in Section SM6).

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[13] Since Mexican brain circulation and stayers are treated together and there are no Chinese stayers, this issue does not apply to these countries.

[14] However, it can be shown that, under certain values of the parameters capturing the utility of being abroad, the cost of moving, and the premium received for remaining in the U.S., this is a prediction in an extension of the Hunter *et al.* (2009) model.

Thus, as anticipated in the Introduction, these facts justify a scientific policy for attracting foreign talent, minimizing the elite brain drain, and recovering nationals who have earned a Ph.D. or have spent some time abroad. Note that a defense of such a policy is independent of whether brain drained and brain circulation scientists are positively selected relative to stayers, and whether brain circulation researchers are negatively selected relative to the nationals that remain working abroad.

To finish this section, recall that, except the U.S., most countries in our dataset are represented by a reduced number of departments. Thus, our data does not allow for a proper country ranking in productivity terms. Nevertheless, a complete description of our sample should include a comparison of the average productivity of those working in any country. In particular, we are interested in learning which countries are equally, more, or less productive than Spain.

The answer is that, after controlling for personal characteristics, the marginal effect of working in Spain is indistinguishable from the effect of working in Australia, France, Belgium, Denmark, and China, and greater than the effect of working in Italy, Mexico, and the brain circulation countries except Israel. However, the effect of working in Spain is smaller than the effect of working in the remaining countries, namely, the U.S., the U.K., Canada, Switzerland, Israel, Germany, Sweden, and Netherlands (Table L in SM6). We conclude that a good performance in geographic mobility patterns is neither a necessary nor a sufficient condition for an excellent research performance according to world standards.

5. Empirical results

Our empirical strategy can be summarized as follows. We first estimate the probability that an individual selected at random becomes an immigrant as a function of all control variables and a set of 22 country dummies that take the value one for all individuals who work in 2007 in each country and zero otherwise. We then estimate the average probability that individuals working in a given country become immigrants, i.e. the average probability of brain gain in that country. Next, we estimate the probability that an individual selected at random becomes an immigrant as a function of all control variables and a set of 22 country dummies that take the value one for all nationals in each country and zero otherwise. We estimate the average probability that individuals born in a given country become immigrants, i.e. the average probability of brain drain. The *net average probability for each country* is defined as the difference between the above two average probabilities.

But the key question is the comparison between the marginal effects of working, or being born, in different countries on the probability that an individual becomes an immigrant holding constant the value of other control variables. The former captures the *effect of working in 2007 in that country on the probability of becoming an immigrant, i.e. of becoming brain gained*, whereas the latter captures the *effect of being born in that country on the probability of becoming an immigrant, i.e. of becoming brain drained*. Since we are also interested in which of the two effects is greater, we define the *net effect of a country* as the difference between the two previous country dummy effects.

5.1. The model

Let m_i be a dummy variable taking the value 1 if the individual *i* is an immigrant, that is, if s/he works in a different country from where s/he was born, and 0 otherwise. We specify two binary choice models.

Firstly, a model in which the probability that an individual *i* becomes brain gained, is a function of a set of controls, X_i, and a set of working country dummy variables where, for each country *j*, WC_{ji} takes the value 1 if the individual *i* works in country *j* and 0 otherwise. This can be expressed as follows:

$$Pr(m_i = 1 \mid X_i, WC_{1i}, \dots, WC_{22i}) = F(\beta_0 + \gamma' X_i + \sum_{j=1}^{21} \alpha_j WC_{ji}), \qquad (1)$$

where F is the standard normal cumulative distribution function.

Secondly, a model in which the probability that an individual becomes brain drained, is a function of the same set of controls and a set of country of origin dummy variables where, for each country *j*,

OC_{ji} takes the value 1 if the individual *i* is born in country *j* and 0 otherwise. This can be expressed as follows:

$$Pr(m_i = 1 \mid X_i, OC_{1i}, \ldots, OC_{22i}) = F(\delta_0 + \mu' X_i + \sum_{j=1}^{21} \lambda_j OC_{ji}). \qquad (2)$$

We estimate these models by Maximum Likelihood, and report three types of results. Firstly, we discuss the impact of control variables in terms of the sign and statistical significance of their estimated coefficients. Secondly, we assess the quantitative significance of the effects of country dummies in terms of their marginal effects, evaluated at the mean value of the continuous explanatory variables and at the value 0 of the binary explanatory variables, denoted by $\overline{X}$. In particular, the marginal *effect of working in country s on the probability that an individual becomes brain gained* is:

$$\tau_s = F(\beta_0 + \gamma' \overline{X} + \alpha_s) - F(\beta_0 + \gamma' \overline{X}). \qquad (3)$$

Thus, the probability that an individual working in country *s* is an immigrant changes in $\tau_s \times 100$ percentage points with respect to the probability of being an immigrant in the countries in the constant. Similarly, the marginal *effect of being born in country s on the probability that an individual becomes brain drained* is:

$$\eta_s = F(\delta_0 + \mu' \overline{X} + \lambda_s) - F(\delta_0 + \mu' \overline{X}). \qquad (4)$$

Thus, the probability that an individual being born in country *s* is an immigrant changes in $\eta_s \times 100$ percentage points with respect to the probability of being an immigrant in the countries in the constant. Since we are interested in which of the two effects is larger, we define the *net effect of country s* as the difference between (6) and (7):

$$\nu_s = \tau_s - \eta_s. \qquad (5)$$

We order all countries in terms of τ_s, η_s, and ν_s, *s* = 1,…, 22, and report in each case whether the differences between the marginal effects for Spain and for the other 21 countries are statistically significant.

Finally, we compute the *average probability of brain gain for each country s,* defined as:

$$\Omega_s = \frac{1}{Ns}\sum_{i=1}^{Ns} F(\beta_0 + \gamma' X_i + \alpha_s), \tag{6}$$

where *Ns* is the number of individuals working in country *s*. Similarly, the *average probability of brain drain for each country s* is defined as:

$$\varphi_s = \frac{1}{Ms}\sum_{i=1}^{Ms} F(\delta_0 + \mu' X_i + \lambda_s), \tag{7}$$

where *Ms* is the number of individuals born in country *s*. As indicated in Section 3.2, in general, *Ns* will be different from *Ms*. Since we are interested in which of the two average probabilities is larger, we define the *net average probability in country s* is the difference between (6) and (7):

$$\Delta_s = \Omega_s - \varphi_s. \tag{8}$$

The average estimated probabilities in expressions (6), (7), and (8) are comparable with the unconditional percentages of brain gain, brain drain, and net gain reviewed in Section 3. We order all countries in terms of Ω_s, φ_s, and Δ_s, $s = 1,\ldots, 22$, and report in each case whether the differences between the Spanish values and the values of these magnitudes for the other 21 countries are statistically significant.

5.2. Control variables

There are three types of control variables: personal, departmental, and country characteristics. Among personal characteristics, we have information on demographics, the university where individuals attend graduate school, and individual productivity. Among the demographic variables we consider the individuals' age or academic experience, denoted by *Exp*. To capture non-linear effects, we use the variables *Exp* and $(Exp)^2$. We also introduce the dummy variable *Female* that takes the value one if the individual is female. Graduate education is measured by seven dummy variables. Finally, individual productivity is measured by the individual *Q* index. Given its high skewness, we use the log of this variable.

We control for department effects by the department mean *Q* index. Finally, Lepori *et al.* (2015) emphasize that although academics value primarily the quality of prospective institutions, they are also likely to consider the characteristics of the hosting country. Since we expect that the probability that an individual becomes an immigrant is related to the attractiveness of the country of destination, we include the *relative* GDP *per capita*, that is, the ratio of the log GDP *per capita* of the country of destination over the log GDP *per capita* of the country of origin.

5.3. Estimation results

Table M in the Appendix in the Supplementary Material presents the estimation results without controls. As expected, these unconditional results reproduce the descriptive statistics previously shown. Then, we add a set of controls to analyze to what extent the unconditional results still hold once we account for some individual, departmental and country characteristics. In other words, we estimate the two models in expressions (1) and (2), one for the 3,540 individuals working in 2007 in the 22 sample countries, and another one for the 3,253 nationals from these countries. The main purpose of this exercise is to obtain the probability of being brain gained or brain drained for individuals with the same value of those characteristics but working or being born in different countries, and to see how the set of country dummy "gaps" change as we add the controls.

We are aware of the potential endogeneity of some of these variables, such as the individual and departmental productivity, but we prefer to condition also on them given that we do not focus on the causal effect of productivity. So, in this sense the potential endogeneity problem is less worrisome. Mean values for all controls in both cases are in Table N in the Appendix in the Supplementary Material. Country mean values for *Female*, Ph.D. dummy variables, and GDP *per capita* for the two subsets are in Tables O and P in the Appendix in the Supplementary Material, while the mean *Q* for all departments in each country is in Table A in Section SM1 in the Supplementary Material.

The estimated coefficients for the two models are presented in Table 3, where the regression constant refers to researchers working in the following brain circulation countries: Greece, Portugal, Turkey, Brazil, Argentina, and Chile. We note that the pseudo-R^2 for the two samples are 0.29 and 0.30, whereas the pseudo-R^2 for the probability of becoming brain gained or brain drained depending exclusively on the working country dummy variables are 0.10 in both cases (detailed results are available on request).

Table 3 around here

As far as the effect of control variables is concerned, in both cases older individuals have a smaller probability of becoming immigrants and at an increasing rate, but gender has no effect. As expected, the probability of attracting a foreigner increases with the individual productivity, the department mean productivity, and the relative GDP *per capita* of the destination country. It is harder to attract a foreigner who has obtained a Ph.D. from Harvard or MIT, presumably because she becomes brain drained into the U.S. or returns home as brain circulation, whereas an individual who has obtained a Ph.D. from a U.S. department rather than elsewhere is more likely to become brain drained into the U.S. or any of the other sample countries.

The key question is how Spain fairs relative to other countries in both models. We begin by considering marginal effects with respect to the countries in the constant, evaluated at the mean value of the continuous control variables and at the value 0 of the binary control variables, i.e. expressions (3) and (4).[15] The results for the probability of becoming brain gained are in Table 4. Countries are ordered by the size of country dummy effects in column 1, while column 2 shows the difference between the marginal effect of the corresponding country dummy and the marginal effect of the dummy for Spain, 0.150; thus, for instance, since the marginal effect for China is 0.501, the difference with respect to

[15] To save space, results on average probabilities are presented in Section SM7 in the Supplementary Material.

Spain is 0.350. Column 3 presents the *p*-value associated to the null hypothesis that such differences are statistically equal to 0. It is a Wald type test and the *p*-values are based on the delta method.

Table 4 around here

The following two points should be emphasized. Firstly, the effect of working in Spain in 2007 on the probability of being an immigrant is significantly smaller than the effect of working in the four open countries, China, and Mexico. In particular, the probability of being a foreigner if working in China or Mexico is 35 or 27 percentage points greater than if working in Spain. It should be noted that in terms of productivity at the individual and department level as well as graduate education, China is a high performing country but Mexico is not. On the other hand, the high ranking of Mexico and China is achieved in spite of having a GDP *per capita* smaller than the one in Spain (Table O in the Appendix in the Supplementary Material). Secondly, among the four-large continental European countries, the effect of working in Spain on the probability of becoming brain gained is indistinguishable from the effect of working in Germany, but greater than the effect of working in France and Italy (by 21 and 36 percentage points greater, respectively).

The results for the probability of becoming brain drained are in Table 5. As before, countries are ordered by the size of country dummy effects in column 1, column 2 presents the effect of each country dummy with respect to the dummy for Spain, whereas the *p*-values for such comparison are in column 3. The following three points should be noted. Firstly, the effect of being born in Spain on the probability of becoming brain drained is only greater than the effect of being born in the U.S.; in particular, 24 percentage points greater as indicated in column 2. Secondly, the only countries for which regression coefficients are significantly positive are the four open countries, plus Germany and Italy. Consequently, the effect on the probability of becoming brain drained of being born in these countries, together with Sweden, is significantly greater (around 27 percentage points) than the effect of being born in Spain, which is negative. Thirdly, the effect of being born in Spain on this probability is indistinguishable from the effect of the remaining 13 countries, including France.

Table 5 around here

Finally, the main magnitude of interest is the net effect defined in expression (5). The ranking is in Table 6, and the situation can be summarized as follows. Only China and Mexico are above Spain, whereas only the U.S., Canada, the UK and Australia are indistinguishable from this country. Thus, Spain is above the remaining nine countries, including Germany, France, and Italy. We find that the net effect is 27.8, 36.5, and 63.5 percentage points greater for Spain than for Germany, France, and Italy, respectively.

Table 6 around here

To sum up, descriptive statistics indicate that by 2007 Spain has become an open country (Figure 1) with a percentage of net gain greater than any other European member in the closed country club (Figure 2). This has been confirmed after introducing a limited but interesting set of control variables. Country rankings in terms of marginal effects and the net average probability place Spain only below the U.S., and above other large and small European countries. Mexico and China also exhibit remarkable performances.[16]

6. Discussion

How should we interpret these results? If we had all relevant information on the determinants of spatial mobility, country-dummy regression coefficients in equations (1) and (2) would not be significant, and country dummy effects in Tables 2, 3, and 4 would be indistinguishable. The probability of becoming brain gained or brain drained would be fully explained by the complete set of control variables.

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[16] For completeness, we also estimate the probability of an individual in brain circulation. Results are briefly discussed in Section SM8 in the Supplementary Material.

As we have seen in Section 5.3, our list of explanatory variables is playing an important control role.[17] However, our results indicate that there are still significant marginal country effects that should be attributed to unobserved factors. In what follows, we limit our discussion to the Spanish case (some brief remarks on Mexico and China are relegated to Section SM10 in the Supplementary Material).

6.1. Unobserved factors

There are three possibilities concerning how unobserved variables may affect our results.

A. Unobserved personal characteristics

The control of personal characteristics –academic age, gender, graduate education, and individual productivity in terms of a weighted index of publications in four journal classes– may have been insufficient. For example, it could be argued that Spaniards are ranked lower than nationals from other countries in terms of unobservable characteristics such as the citation impact of their publications or the sub-fields to which they belong, so that they are relatively less demanded abroad and must be content working in Spain. In this case, the effect of being born in Spain on the probability of becoming brain drained and the Spanish average probability of brain drain may have been underestimated, and hence the net marginal effect and the net average probability for Spain may have been biased upwards. This is, indeed, a possibility. However, compared to unobserved department characteristics, we believe that these omissions may at most cause a limited impact.

B. Unobserved country characteristics

There are two cases to be analyzed. We begin with the European closed countries. There are two types of considerations. Firstly, among the variables in Lepori *et al.* (2015), in this paper we have only controlled for relative GDP *per capita* because we do not have information for the entire sample on other country variables such as the salary and the percentage of people with a higher education, the percentage of GDP devoted to R & D, or the citation impact of the country's scientific publications. However,

[17] A dramatic example on the brain drain performance in China and Spain before and after introducing control variables is discussed in Section SM9 in the Supplementary Material.

Spain does not have an advantage in this respect relative to other European countries that might explain their differences in net effects (details are available on request). Secondly, there are amenities that should be taken into account. For example, it can be argued that the cities where Spanish elite centers are located –Alicante, Barcelona, and Madrid–, as well as Spain as a whole, have favorable weather, a lively culture, and good quality of life.[18] In addition, Spanish is a language worth learning because is widely spoken around the world. Naturally, these unobserved amenities make Spain attractive to foreign scholars in all sciences. However, as discussed in Section 3.4, the unconditional results in Franzoni *et al.* (2015) indicates that this effect is not present in four scientific fields: biology, chemistry, materials science, and earth and environmental sciences. Therefore, the differences in mobility patterns in economics between Spain and other European countries constitutes an exception that requires and *ad hoc* explanation.

Next, consider the brain circulation countries. In this case, Spain is wealthier than these countries and, among the amenities, it should be emphasized that belonging to the European Union is an important factor contributing to the attractiveness of Spain relative to all non-member countries in this group. Thus, country unobservables might be favoring the situation of Spain relative to the countries with equally remarkable brain gain performances, such as Mexico and China, or the remaining ones capable of attracting mostly brain circulation nationals. This could be particularly the case for Central and South American natives who (except Brazilians) speak Spanish. However, in comparison with other open countries or the Central and South American sample countries (México, Argentina, Chile, and Brazil), the number of Central and South American economists working in Spain is not unduly large. The percentage of these economists relative to the total of foreigners is 8.8% in Spain; 7.9% in the U.S., Canada, and the U.K., and 44% in the Central and South American countries.[19]

[18] For the role of factors such as "appeal of the lifestyle or international experience" and "better quality of life", see Franzoni *et al.* (2015, Table 3 and Figure 1).

[19] Of the 92 Central and South American economists brain drained in any of the sample countries, 72 work in the U.S., Canada, or the U.K., 11 in Central or South American countries, five in Spain, and four in any of the 14 remaining countries.

C. Unobserved department characteristics

Although department effects have been partially controlled for by means of the department of destination's average productivity, Spanish centers may be relatively more attractive to both foreigners and natives in unobserved dimensions. In this respect there is a valuable literature arguing that the research gap between the U.S. and the rest of the world in any science can be explained by differences in governance and resources (Ali *et al.*, 2007, Aghion *et al.*, 2007, 2010, Bauwens *et al.*, 2008, Veugelers and Van der Ploeg, 2008 and, in economics, Drèze and Estevan, 2004).

C.1. Governance

Before 1970, only a handful of Spaniards held a foreign Ph.D. and/or had ever written a paper in a peer reviewed international journal. Since then, an increasing number of Spaniards went abroad to obtain a Ph.D. Out of 164 Spanish economists in our dataset, 41.5% earned a Ph.D. in the U.S., 14.0% in the UK, and 9.1% in the rest of the world. Since the mid-1970s, a continuous string of these foreign Ph.Ds. came back to work in Spain. Since the mid 1970s, these "cultural hybrids –nationals socialized in a foreign setting" (Pérez-Díaz, 2005)– dominated the economics department at the UAB (Universitat Autònoma of Barcelona), and imposed research excellence as the main aim of academic activity for the first time in Spanish history. This example was followed by the University of Alicante since the mid 1980s. Soon afterwards, brain circulation Spaniards led two new research institutions: the IAE (Institut d'Anàlisi Econòmica) and CEMFI (Centro de Estudios Monetarios y Financieros), founded in 1985 and 1987. However, Spanish graduate programs continued to serve the role of preparing students for pursuing a Ph.D. at stronger graduate schools abroad. In brief, from 1970 and 1990, Spain clearly belonged to the brain circulation country group.[20] The creation of two entirely new university

[20] Of the 54 economists working in Spain in 1990, the percentage of stayers, brain circulation, and brain gain is 38.9%, 55.5%, and 5.5%. A distribution very close, for example, to the one in Brazil in 2007 (41.3%, 54.3%, and 4.2%), and very different

economics departments in 1990, Carlos III in Madrid and Pompeu Fabra in Barcelona, marks the consolidation of a governance model in the six Spanish institutions in our dataset. This model can be summarized in the following three points.

1. Personnel policies were fundamentally oriented to promoting quality research. Two characteristics stand out (Ruiz-Castillo, 2008). Firstly, by avoiding the hiring of graduates from their own doctoral programs, the traditional endogamy characterizing the Spanish university system was drastically reduced.[21] The recruitment of new faculty was carried out by means of a rigorous selection system open to interested candidates from any other university.[22] Secondly, the academic staff hired in this way, whose performance is evaluated every two years, had a maximum period of six years to become tenured faculty members. Among good practices for tenure and promotion decisions, we emphasize the following: minimum research and teaching excellence standards were clearly established beforehand; letters of recommendation from outside experts were required; merits were evaluated in written reports by *ad hoc* committees, and final decisions were taken by tenured faculty members in a department vote.

It should be noted that, except for CEMFI, the rest of Spanish institutions in the dataset are public, and their tenured faculty are civil servants. To become a tenured associate or full professor, a candidate must pass a competitive public examination contest –*oposiciones*– similar to the system followed in other European countries. Thus, there was a dual system at work: the public system for the country as a whole, and the system described above that operates exclusively within the economics centers in the

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from the one that obtains in Spain at that date: 28.4%, 40.4%, and 31.2% (Table B in Section SM4 in the Supplementary Material and Figure 1).

[21] As observed in Section SM11 in the Supplementary Material, the proportion of inbreeding in Spain in 2007 is smaller than in 14 sample countries: the U.S., the four open countries, the seven closed countries, Portugal, and Israel (Table R).

[22] The steps included: publishing job vacancies on the Internet; first round candidate selection by an *ad hoc* committee; interviews with those selected in the job market, which had been held since the mid-1990s at the annual meeting of the Spanish Economic Association and, at least in the case of Carlos III and Pompeu Fabra, in the job market held at the Winter meetings of the American Economic Association; Seminar presentations and, upon hearing department members' opinions, extension of job offers.

dataset. However, since the tenure and promotion standards in the latter were much more demanding than in the rest of the system, whenever there was an official vacancy the "internal" candidate had no difficulty filling it against potential rivals; if there were a better candidate willing to work in any of these centers, she would have already been hired there.

2. The four university departments in our dataset had strong Ph.D. programs consisting of two years of course study and around three years for the writing of a dissertation. Students, all of whom receive financial support during the entire program, were recruited internationally among hundreds of applicants, and the Ph.D. programs in the UAB and the University of Alicante were part of European networks.[23] Finally, the commitment not to hire their own Ph.Ds. provided incentives to these departments for organizing the best possible program in order to facilitate the placement of their graduate students elsewhere.

3. The use of English as a working language was established for the first time in continental Europe in 1966 at CORE (Center for Operations Research and Econometrics) in Leuven, Belgium. Spanish centers followed suit during the 1990s. Seminars and graduate programs in all centers, as well as many disciplines in undergraduate programs at UAB, Carlos III and Pompeu Fabra, were conducted in this language.

C.2. Resources

Three points should be noted. Firstly, recall that wages have not been controlled for in this study. Anecdotal information suggests that, in purchasing power terms, Spanish salaries for tenured faculty in public institutions in the dataset were equal or below German, French, and Italian ones.[24] Secondly, in

[23] ENTER in 1993 originally included the UAB, Toulouse University, University College London, Tilburg University and Mannheim University; afterwards, the Université Libre de Bruxelles, Stockholm University, and Carlos III University joined the network in 1995, 2003, and 2006, respectively. On the other hand, QED included the University of Alicante, the University of Amsterdam, the University of Bielefeld, the University of Copenhagen, the University Nova of Lisbon, the University Paris I, the University of Venice, and the University of Vienna.

[24] Consider, for example, the information on average salaries in academia in U.S. dollars by level of seniority in selected countries and geographical areas in *IONOMICS Salary Report 2018* (Graph 5, inomics.com). Relative to Spain, the ratios for junior faculty in Germany, France, and Italy are 1.54, 1.04, and 0.95. For senior faculty, the ratios are 1.31, 1.31, and 1.05.

the Spanish case there are two qualifications. (i) There was some leeway concerning what can be paid to young tenure-track candidates. (ii) Contingent on the research (and teaching) trajectory of each faculty member, there were internal incentive systems to assign the teaching load and/or to complement –in a moderate way– the civil servant salaries in public institutions. Having some wage autonomy during the tenure-track period, as well as the annual recognition of research merits were valuable policy options. Thirdly, the increase in public resources for higher education in Spain since the mid-1980s in regular university budgets, as well as through competitive national and European Union research grants, made possible to finance, not only Ph.D. programs, but other important academic-related activities, such as travel expenditures, computing facilities, and a rich network of weekly seminars. Sabbaticals, and visiting faculty for undergraduate and graduate teaching were also funded.

6.2. Other factors at work

To understand how these unobservables at the department level actually affected people's behavior, we must take into account the following two factors. Firstly, in Spain, as in Germany, France, or Italy, for example, academic labor markets in our period of study are fragmented, scarcely mobile and transparent, and dominated by linguistic considerations (Ehrenberg, 2003, Avveduto, 2005, Musselin, 2004, 2005). Recruitment in what Bonaccorsi *et al.* (2017b) call the Continental Europe model "*makes it difficult for universities to enforce a consistent strategy of excellent quality, due to the centralization of main decisions regarding academic staff in terms of legislative and administrative regulation, and the lack of substantive autonomy of departments*" (p. 443). Thus, the aggressive recruitment strategy, the meritocratic policy, the minimum degree of inbreeding, the research incentives, the existence of an international Ph.D. program, and the role of English in daily professional life in our sample Spanish institutions constituted an exception relative to the mass of public centers both in economics and other sciences in Spain and other

Interestingly, these ratios for Central and South America are 1.34 for juniors and 1.01 for seniors. According to this source, average salaries for faculty members in the U.S., the U.K., or North America and Western Europe are considerably greater than in Spain. We expect these 2018 ratios to be of the same order of magnitude during our sample period.

comparable European countries. The exceptional nature of this experience contributed to its international visibility from its inception.

Secondly, since 1990, the six Spanish centers formed an informal network within which they competed and cooperated. They competed for the best faculty and graduate student talent, as well as for available grants, both within and outside Spain. Thus, they directed their hiring and promotion policy, and they strived to place their Ph.D. students as well as possible, with the aim of improving their reputation –their main weapon in this competitive process. In Aghion *et al.* (2010), autonomy and competition *combined* increase universities' productivity. In our case, the virtuous circle of (partial) autonomy and competition improved the performance and the attractiveness of the Spanish centers. At the same time, these centers cooperated in certain dimensions: they shared information, and copied organizational solutions adopted by another network member. At any rate, the fact that several centers were able to develop together in a single country reinforced the credibility of the entire experience.

Although nothing like this had taken place in other European countries, it must be recognized that there were very similar experiences in some continental European centers, such as the University of Toulouse that, together with the London School of Economics, has been at the top of all European rankings since 1990. Similarly, human resources policies at the University of Bocconi were based on pursuing research excellence. However, in other German, French or Italian elite centers, reformist economists had only been able to influence, but not dominate, hiring and promotion policy. Thus, contrary to the Spanish case, good practices in other European countries remain rather isolated in a handful of institutions immersed in a traditional public-sector system controlled by a relatively large contingent of stayers not particularly interested in meritocratic governance rules.

In this context, Spanish economists with an entrance opportunity into the best Spanish departments easily appreciated the advantages of the new system. This may explain the relatively high proportion of brain circulation in these departments, as well as the relatively low proportion of brain drain among Spanish economists. In turn, foreign faculty members and, above all, new Ph.Ds. from top international graduate programs quickly understood that the Spanish way to implement the Anglo-Saxon department model in a Latin country was credible. Thus, since the early 1990s a considerable number of foreigners decided that, in spite of relatively low wages, working in certain Spanish institutions constituted a good investment in human capital.[25]

To finish this discussion, it must be emphasized that not all was well in Spain. Many of the best foreigners spent only a limited period at Spanish centers before migrating again, or going back to their countries of origin, to profit from better economic and academic conditions. Even some excellent brain circulation Spaniards decided to migrate abroad. Lack of resources has conditioned the ability of Spanish centers to retain much of the best talent that they were able to attract at the beginning of their careers.[26] Consequently, as observed in Table S in the Appendix in the Supplementary Material, the percentage of immigrants with less than seven years of experience in Spain is the third largest among the 16 countries with a percentage of brain gain above 14%.

6.3. After the crisis

One may wonder how the mobility patterns studied in this paper have been affected by the severity of the 2008 economic recession in Spain. A proper answer requires another paper. Here, we will simply review the faculty composition of the six Spanish centers in the 2018-19 academic year. As we can see in Table 7, the total number of individuals has grown from 183 in 2007 to 222 in 2018. The percentage of foreigners in Spain is now 41.3%, well above the 28.4% in 2007. These percentages vary from 23% in the UAB and Alicante, to more than 50% in IAE and Pompeu Fabra.

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[25] Recall that the number of foreigners in Spain went from 3 in 1990 to 57 in 2007, with an increase in the percentage of brain gain from 5.5% to 31.1% (note 20). For the role of non-pecuniary factors for the decisions of migrant scientists on coming to work in their current country of residence, see Stephan and Levin (1992), Sauerman and Roach (2010), Franzoni *et al.* (2015), Van Bouwel and Veugelers (2014), Lepori *et al.* (2015), Stephan *et al.* (2015), Veugelers and Van Bouwel (2015).

[26] This coincides with the findings showing that high-skilled workers who have experienced mobility in the past have a higher propensity to move than natives who have never experienced mobility (Kerr and Lincoln, 2010), and the findings in Musselin (2004) showing that most post-docs in nuclear physics and biology in France, Germany and the UK conceive of their foreign experience as a way of improving their chances for recruitment in their own country.

Table 7 around here

The following comments are in order. Firstly, the retirement of most of the 15 Spanish economists around 60 years of age in 2007 has tended to decrease the percentages of stayers and brain circulation. Secondly, a large contingent of young foreigners have kept arriving in recent years. For example, 30 of the 60 brain gain economists at Carlos III and Pompeu Fabra in 2018 (or one third of the total in Spain) are in tenure track and/or have been hired since 2012. The fact that the sum of brain circulation and brain gain has increased from 68.8% in 2007 to 75.6% in 2018 indicates that, in spite of the crisis, Spain continues to be an attractive option. Together with the role of the good governance practices emphasized in this paper, it should be noted that national and European funds for research excellence have been exerting a positive impact on Spanish centers since the turn of the century.[27] An analysis of brain drain patterns and a comparison with other countries is beyond the scope of this paper.

7. Conclusions

In this paper, we have presented some evidence on geographic mobility patterns in elite academic institutions in economics. Conditional on some personal, departmental, and country characteristics, as well as a set of country dummy variables, we have estimated the effect of working in 2007 in a given country on the probability of becoming brain gained, and the effect of being born in a given country on the probability of becoming brain drained. Then, we have also estimated the net effect of each country dummy, defined as the difference between the previous two.

Collecting information on a selection of the best institutions and their faculties using international rankings as well as department and personal web pages is a difficult job. Thus, our department selection is debatable; the listing of economists in each department might not accurately reflect the roster of full-time researchers in each case, and the information on personal characteristics and publications might be

[27] In 2918, a total of 56 individuals enjoy special fellowships: 26 from Spanish programs (8 Ramón y Cajal, 8 Maria de Maeztu, 6 Juan de la Cierva, and 4 from other non-profit institutions), 11 ICREA fellowships in Catalunya, and 19 from European sources (15 from the European Research Council, and 4 Marie Curie). In addition, the Catalan institutions (through the Barcelona Graduate School) enjoy the Severo Ochoa grant.

subject to measurement error. We are fully aware that the interest of our results is conditioned by the shortcomings of our dataset. However, in a context of scant information on comparable mobility patterns across countries, we have argued that our data on the brain gain, brain circulation, and brain drain phenomena is of good quality. Moreover, our correlation results on productivity comparisons justify a scientific policy for attracting foreign talent, minimizing brain drain, and promoting brain circulation.

It can be observed that, until 1990, Spain can be characterized as a brain circulation country where promising B.As. earn a Ph.D. abroad and then come back to work to their country of origin. Italy, Greece, Portugal, Turkey, Brazil, Argentina, and Chile are the countries in our dataset exhibiting this pattern. From 1990 until 2007, however, Spain has joined the U.S., the four open countries –UK, Canada, Australia, and Switzerland–, and Mexico and China in their ability to attract a sizable proportion of foreigners. In addition, many Spaniards earning a Ph.D. abroad have returned home, thus reducing the brain drain flow. Differences in the patterns of brain gain, brain circulation, and brain drain between Spain and comparable European countries, i.e. Germany, France, and Italy, are maintained after the introduction of control variables.

How can these mobility patterns be explained? We have suggested an interpretation along the following lines. Against all odds, in the midst of a public system with fixed salaries for tenured positions, coalitions of brain circulation economists in the six Spanish centers in our dataset have autonomously changed the governance of their working places by introducing a rigorous merit system, international Ph.D. programs, and the use of English as a working language. Meanwhile, in the rest of continental Europe there were excellent but isolated comparable experiences. Although we are not well informed on the details, in countries like Germany, France, and Italy the governance of economics departments remained, by and large, unchanged during the period of study. We have argued that the combination of such governance differences with the availability of resources to finance certain strategic research needs have made possible the appearance of a relatively large brain gain and a relatively small brain drain in Spain.

In the search for an explanation of the relatively poor performance of continental Europe in life science, information science, and materials science, Bonaccorsi (2007) has proposed a shift of attention from science policy to scientific institutions: "*This is not to say that policies do not matter, but rather that we should consider to what extent their impact may be neutralized by existing institutional features*" (p. 311). In this context, the limitations of the dataset and the lack of variables capturing governance characteristics render our results and their interpretation merely suggestive. Nevertheless, they are important because it indicates that, even in the absence of an official policy at the university or the national level and in the presence of relatively low wages, changing the rules at the institution level in an isolated discipline matters by affecting brain gain, brain circulation, and brain drain mobility patterns.

However, lack of resources for retaining some of the best foreigners –and even nationals– has given rise to a second type of brain circulation. Since 1990, Ph.Ds. from top international graduate programs have come to Spain to start their careers before leaving again to their own or other countries. So far, those who had left have been replaced by the next cohort. However, we should note that the results reviewed in this paper favoring Spanish centers in economics are the consequence of favorable circumstances. As indicated in Ruiz-Castillo (2008), *ceteris paribus*, when the rest of the European countries loosen the reins, establish a higher level of competition in their university systems and design their incentive schemes so as to promote quality research, with the current real salaries in Spain it will be difficult for the most prestigious Spanish institutions to maintain their current attractiveness, and hence to emulate the best centers in the rest of the world.

REFERENCES

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A., and Sapir, A. (2007). Why reform Europe's universities?. *Bruegel Policy Brief*, Issue 2007/04.

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A., and Sapir, A. (2010). The governance and performance of universities: evidence from Europe and the US. *Economic Policy*, 7-59.

Albarrán, P., J. Crespo, I. Ortuño, and J. Ruiz-Castillo (2010). A comparison of the scientific performance of the U.S. and Europe at the turn of the 21st Century. *Scientometrics*, *85*, 329-344.

Albarrán, P., Ortuño, I. & Ruiz-Castillo, J. (2011). High- and low-impact citation measures: empirical applications. *Journal of Informetrics*, *5*, 122-145.

Albarrán, P., Carrasco, R., and Ruiz-Castillo, J. (2014). The elite in economics. Working Paper 14-14, Universidad Carlos III (http://hdl.handle.net/10016/19151).

Albarrán, P., Carrasco, R., and Ruiz-Castillo, J. (2017a). Geographic mobility and research productivity in a selection of top world economics departments, *Scientometrics*, *111*, 241-265.

Albarrán, P., Carrasco, R., and Ruiz-Castillo, J. (2017b). Are migrants more productive than stayers? some evidence from a set of highly productive academic economists, *Economic Inquiry*, *55*, 1308-1323.

Ali, S., Carden, G., Culling, B., Hunter, R., Oswald, A., Owen, N., Ralsmark, H., and Snodgrass, N. (2007). Elite scientists and the global brain drain. Working Economic Research Papers, Number 825, University of Warwick.

Avveduto, S. (2005). International mobility of scientists and engineer: a study of brain drain and obstacles to mobility. In Gabbaldon, T., Horta, H., Meyer, D. M., and Pereira, J. B. (eds.), *Career, path and mobility of researchers in Europe*, Culliver Verlag, 16-21.

Basu, A. (2006). Using ISI's 'Highly cited researchers' to obtain a country level indicator of citation excellence. *Scientometrics, 68:* 361-375.

Batty, M. (2003). The geography of scientific citation. *Environment and Planning A., 35,* 761-765.

Bauwens, L., Mion, G. and Thisse, J-F. (2008). The resistible decline of European science. Revision of CORE DP 2003/11.

Bonaccorsi, A. (2007). Explaining poor performance of European science: institutions versus policies, *Science and Public Policy*, *34*, 303-316.

Bonacorosi, A., Cicero, T., Haddawy, P. and Hassan, S. (2017a). Explaining the transatlantic gap in research excellence. *Scientometrics*, *110*, 217-241.

Bonaccorsi, A., Haddawy, P., Cicero, T., and Hassan, S. (2017b). The solitude of stars. An analysis of the distributed excellence model of European universities, *Journal of Informetrics*, *11*, 435-454.

Borjas, G. (1999). The economic analysis of immigration. In O. Ashenfelter and D. card (Eds.), *Handbook of Labor Economics*, Amsterdam, Elsevier.

Borjas, G., and Bratsberg, B. (1996). Who leaves? The outmigration of the foreign-born. *Review of Economics and Statistics*, *78*, 165-176.

Carrasco, R., and Ruiz-Castillo, J. (2014). The evolution of the scientific productivity of highly productive economists, *Economic Inquiry*, *52*, 1-16.

Doquier, F., and Rapoport, H. (2012). Globalization, brain drain, and development", *Journal of Economic Literature*, *50*: 681-730.

Dosi, G, Llerena, P., and Sylos Labini, M. (2006). The relationship between science, technologies, and their industrial exploitation: An illustration through the myths and realities of the so-called 'European Paradox'. *Research Policy*, *35*, 1450-1464.

Drèze, J. and F. Estevan (2007). Research and higher education in economics: can we deliver the Lisbon objectives?. *Journal of the European Economic Association*, *5*, 271-304.

Econphd.net rankings (2004), http://econphd.econwiki.com/rank/rallec.htm.

Ehrenberg, R. G. (2003). Studying ourselves: the academic labor market. *Journal of Labor Economics*, *21*, 267-288.

Franzoni, C., Scellato, G., and Stephan, P. (2014). The movers' advantage: the superior performance of migrant scientists. *Economics Letters*, *112*, 89-93.

Franzoni, C., Scellato, G., and Stephan, P. (2015). International mobility of research scientists: lessons from GlobSci. In A. Geuna (ed.), *Global Mobility of Research Scientists: The Economics of Who Goes Where and Why*, Academic Press.

Frey, B. and Eichenberger, R.(1993). American and European economics and economists. *Journal of Economic Perspectives*, 7, 185-193.

Freeman, R. (2010). Globalization of scientific and engineering talent: internationalization of students, workers, and ideas and the world economy. *Economics of Innovation and New Technology*, *19*, 393-406.

Freeman, R., and Huang, W. (2015). China's 'GreatLeap Forward' in science and engineering. In Geuna, A. (ed.), *Global Mobility of Research Scientists: The Economics of Who Goes Where and Why*, Academic Press.

Geuna, A. (ed.) (2015), *Global Mobility of Research Scientists: The Economics of Who Goes Where and Why*, Academic Press.

Herranz, N. & Ruiz-Castillo, J. (2013). The end of the 'European paradox'. *Scientometrics*, *95*, 453-464.

Hunter, R, Oswald, A., and Charlton, B. (2009). The elite brain drain. *The Economic Journal*, *119*, F231-F251.

Jacob, M. and Meek, V. L. (2013). Scientific mobility and international research networks: trends and policy tools for promoting research excellence and capacity building. *Studies in Higher Education*, 38, 331-344.

Jones, B., The knowledge trap: Human capital and development reconsidered. NBER Working Paper No. w14138. Last revised October 2014. (Available at SSRN: https://ssrn.com/abstract=1152679)

Kalaitzidakis, P., T. Mamuneas and T. Stengos (2003). Rankings of academic journals and institutions in economics. *Journal of the European Economic Association*, 1, 1346-1366.

Kerr, W. R., and Lincoln, W. F. (2010). The supply side of innovation: H-1B visa reforms and U.S. ethnic invention. *Journal of Labor Economics*, 28, 473-508.

Laudel, G. (2003). Studying the brain drain: can bibliometric methods help? *Scientometrics*, 57, 215-237.

Laudel, G. (2005). Migration currents among the scientific elite. *Minerva*, *43*, 377-395.

Lepori, B., Seeber, M, and Bonaccorsi, A. (2015). Competition for talent. Country and organization-level effects in the internationalization of European higher education institutions, *Research Policy*, *44*, 789-802.

McDowell, J., and Singell, L. (2000). Productivity of highly skilled immigrants: economists in the postwar period. *Economic Inquiry*, *38*, 672-684.

Musselin, C. (2004). Towards a European academic labor market? Some lessons drawn from empirical studies on academic mobility. *Higher Education*, *48*, 55-78.

Musselin, C. (2005). European academic labor markets in transition. *Higher Education*, *49*, 135-154.

OECD (2008). *The global competition for talent. Mobility of the highly skilled.* OECD, Paris.

Panaretos, J., and Malesios, C. (2012). Influential mathematicians: birth, education, and affiliation. *Notices of the AMS*, *59*, 274-286.

Parey, M., Ruhose, J, Waldinger, F., and Netz, N. (2017). The selection of high-skilled migrants. *The Review of Economics and Statistics*, *99*, 776-792.

Parker, J. N., Lortie, C., and Allesina, S. (2010). Characterizing a scientific elite: the social characteristics of the most highly cited scientists in environmental science and ecology. *Scientometrics*, *85*, 129-143.

Pérez-Díaz, V. (2005). La crisis endémica de la Universidad española. *Claves de razón práctica*, *158*, 38-43.

Portes, R. (1987). Economics in Europe. *European Economic Review*, *31*, 1329-40.

Rodriguez-Navarro, A. (2016). Research assessment based on infrequent achievements: A comparison of the United States and Europe in terms of highly cited papers and Nobel Prizes. *Journal of the Association for Information Science and Technology*, *67*, 731-746.

Rodriguez-Navarro, A., and Narin, F. (2018). European paradox or delusion—Are European science and economy outdated? *Science and Public Policy*, *45*, 14-23.

Rodriguez-Navarro, A., and Brito, R. (2018). Technological research in the EU is less efficient than the world average. EU research policy risks Europeans' future. *Journal of Informetrics*, *12*, 718-731.

Ruiz-Castillo, J. (2008). Economics research in Spain during the 1990s: A literature review. *Spanish Economic Review*, *10*, 221–249.

Sauermann, H., and Roach, M. (2010). A taste for science? Ph.D. scientists' academic orientation and self-selection into research careers in industry. *Research Policy*, *39*, 422-434.

Scellato, G, Franzoni, C., and Stephan, P. (2015). Migrant scientists and international networks. *Research Policy*, *44*, 108-120.

Stark, O. (2005). The new economics of brain drain. *World Economics, 6*, 137-140.

Stephan, P. (2012). *How economics shapes science.* Cambridge, MA: Harvard University Press.

Stephan, P. and Levin, S. (2001). Exceptional contributions to U.S. science by the foreign-born and foreign educated. *Population Research and Policy Review*, *20* 59-79.

Stephan, P., Franzoni, C., and Scellato, G. (2015). International competition for Ph.Ds. and postdoctoral scholars: what does (and does not) matter. In W. Kerr, J. Lerner, and S. Stern (eds.), *Innovation, policy, and the economy* (Vol. 15), MIT Press.

Velema, T. (2012). The contingent nature of brain gain and brain circulation: Their foreign context and the impact of return scientists on the scientific community in their country of origin. *Scientometrics*, 93, 893-913.

Veugelers, R, and Van der Ploeg, F. (2008). Reforming European universities: scope for an evidence-based process. In M. Dewatripont and F. Thys-Clement (eds.), *Governance of European Universities.*

Veugelers, R., and Van Bouwel, L. (2015). Destinations of mobile European researchers: Europe versus the United States. In A. Geuna (ed.), *Global Mobility of Research Scientists: The Economics of Who Goes Where and Why*, Academic Press.

Van Bouwel, L. and Veugelers, R. (2014). An 'elite brain drain': are foreign top Ph.Ds. in the U.S. less likely to return home? In S. Uebelmesser and M. Gérard (eds.), *Cross border mobility of students and researchers*, MIT Press.

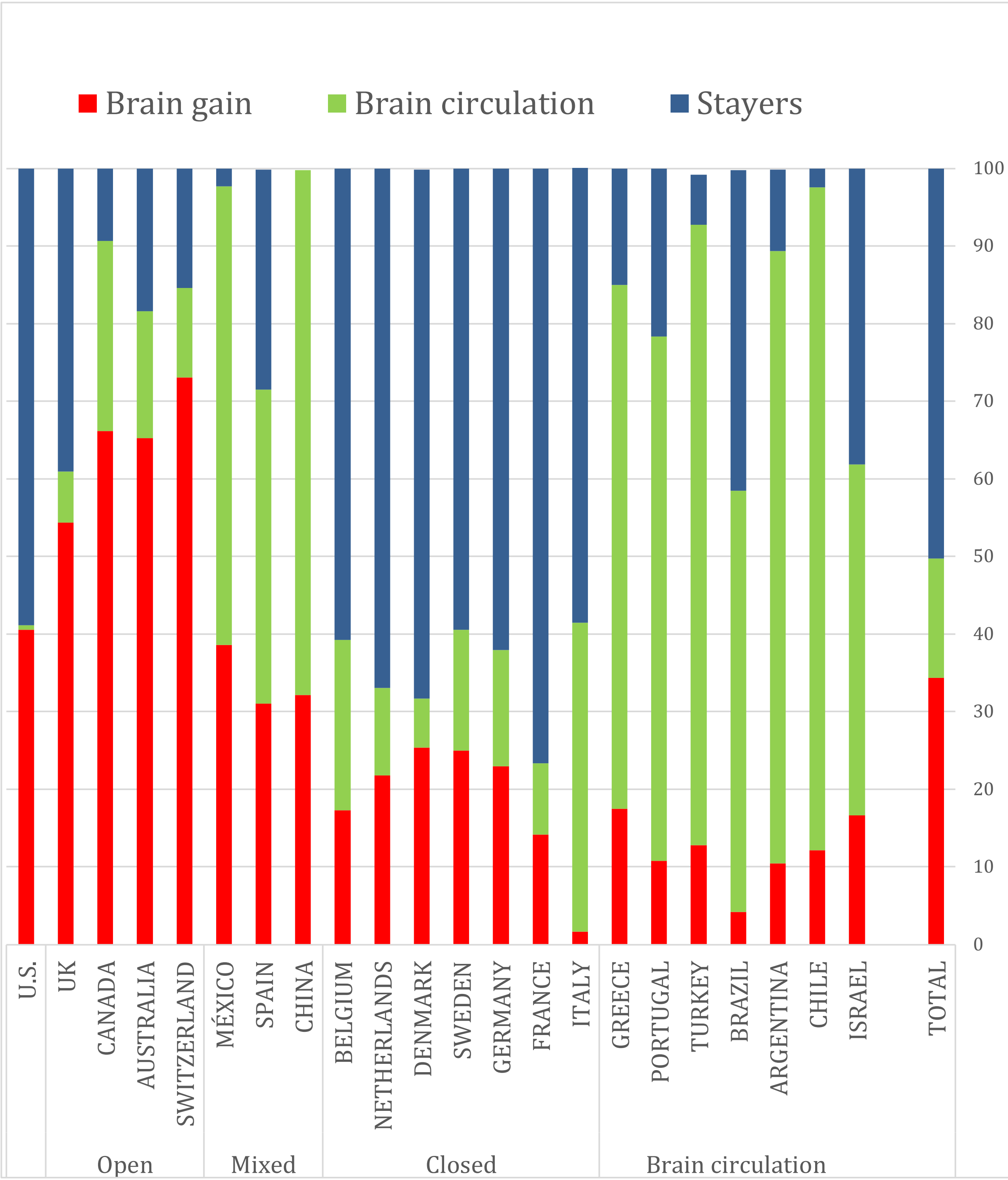

Figure 1. Partition of individuals working in 2007 in each country into brain gain, brain circulation, and stayers

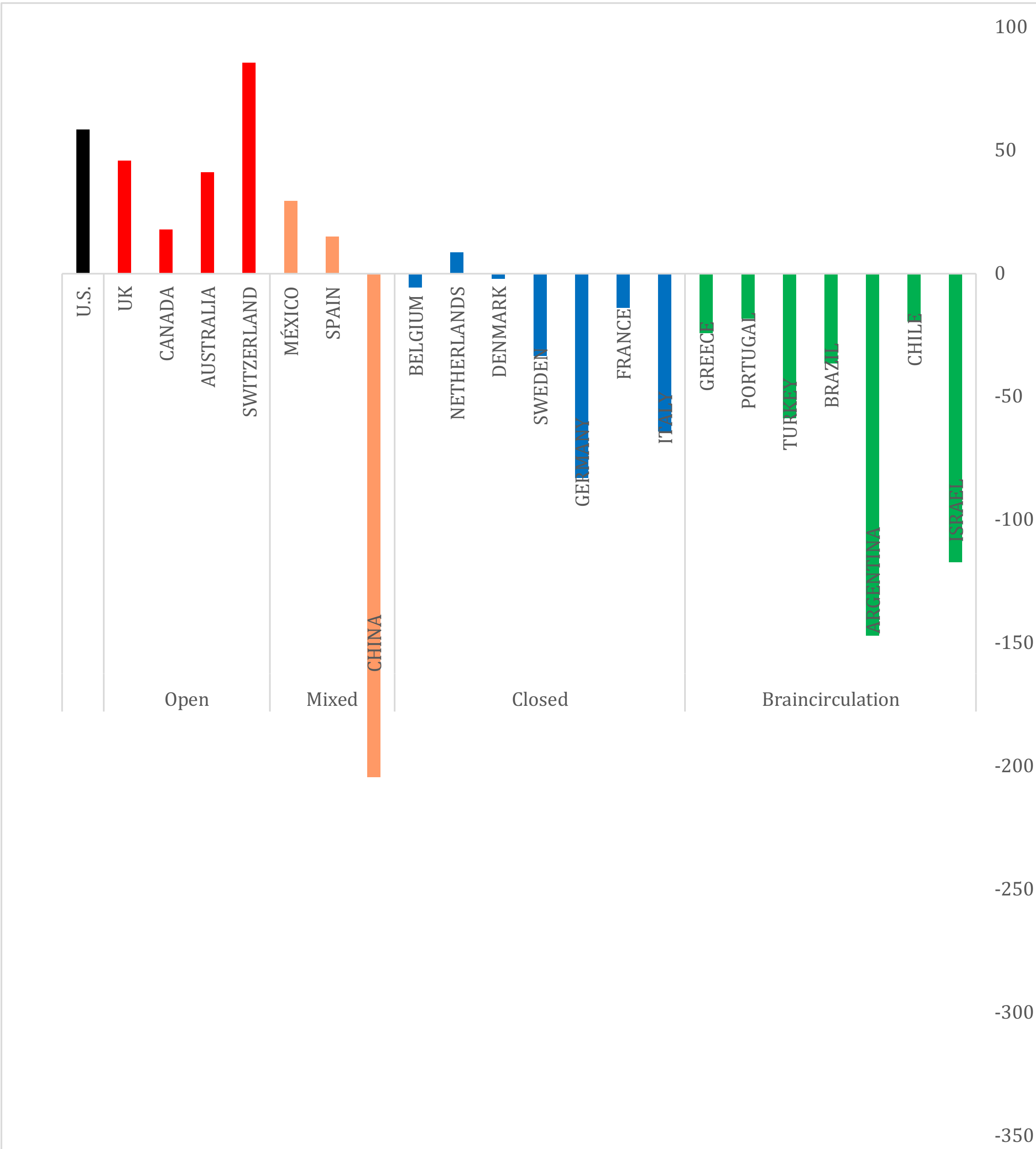

Figure 2. Countries classified according to the percentage of net gain over the nationals (brain circulation + stayers) working in each country

Table 1. Productivity comparisons between foreigners, brain circulation, and stayers working in all countries

A. Results within the five department categories

Top 25 U.S. departments *Top 15* non-U.S. departments	Foreigners ≈ Brain circulation ≈ Stayers
Next 27 U.S. departments *Bottom 43* non-U.S. departments	Brain circulation > Foreigners > Stayers
Last 15 non-U.S. departments in brain circulation countries except Israel (Portugal, Greece, Turkey, Brazil, Argentina, Chile)	Foreigners ≈ Brain circulation > Stayers

B. Results within specific countries

Mexico	Foreigners > Brain circulation and Stayers
Top 25 U.S. *U.K.* *Canada* *Israel*	Foreigners ≈ Brain circulation ≈ Stayers
Australia/Switzewrland *Germany* *Belgium* *Denmark/Sweden* *Portugal, Greece, Turkey, Brazil, Argentina, Chile*	Foreigners ≈ Brain circulation > Stayers
Next 27 U.S. departments *France* *Spain*	Brain circulation > Foreigners > Stayers
China (there are no stayers)	Brain circulation > Foreigners
Netherlands	Brain circulation ≈ Stayers > Foreigners

Table 2. Productivity comparisons between brain drain, brain circulation, and stayers among economists born in all countries

U.K., Sweden/Denmark	Brain drain in the *Top 25* U.S. departments > Stayers
Spain, Germany, France, Italy, Italy, Belgium, Australia/Switzewrland Chine, Portugal, Greece, Turkey, Brazil, Argentina, Chile	Brain drain in *All other* departments > Stayers
Canada, Netherlands, Israel	Brain drain in the *Top 25* U.S. departments < Stayers
U.S.	Brain drain < Stayers in the *Top 25* U.S. departments

Table 3. Estimated coefficients of the probability of becoming brain gained and brain drained

	BRAIN GAINED		BRAIN DRAINED	
	Coeff.	t-statistic	Coeff.	t-statistic
Constant[a]	-1.550	-5.3	-3.422	-12.4
U.S.	0.219	1.2	-1.260	-8.2
UK	0.871	4.8	0.359	2.3
Canada	1.243	6.1	0.538	3.2
Australia	1.233	4.8	0.846	3.8
Switzerland	1.300	4.4	1.366	4.1
Germany	0.181	0.8	0.616	4.0
France	-0.194	-1.0	0.090	0.6
Italy	-1.023	-3.6	0.614	5.3
Spain	0.421	2.4	-0.101	-0.7
Netherlands	-0.076	-0.4	-0.192	-1.0
Belgium	-0.022	-0.1	0.116	0.7
Sweden	0.090	0.3	0.435	1.8
Denmark	0.195	0.8	0.092	0.5
Israel	0.068	0.2	0.101	0.6
Mexico	1.125	3.7	0.059	0.3
China	1.352	3.2	0.018	0.1
Log indiv. *Q* index	0.058	2.4	0.061	2.2
Exp	-0.055	-6.3	-0.054	-5.9
Exp2	0.001	2.9	0.001	3.1
Female	0.011	0.2	0.069	0.9
Ph.D. in[b]:				
(i) Harvard & MIT	-0.428	-3.5	0.271	2.3
(ii) Next 8 U.S.	-0.055	-0.5	0.650	6.6
(iii) Next 15 U.S.	-0.017	-0.2	0.815	7.3
(iv) Next 27 U.S.	-0.089	-0.6	0.741	5.1
(v) Other U.S.	-0.248	-1.1	0.682	2.6
(vi) UK, Canada, Australia	-0.107	-1.0	0.181	1.6
(vii) Other Western	-	-	-	-
(viii) Rest of the World	0.102	0.4	0.178	0.6
Log department mean *Q* index	0.237	3.8	0.576	8.8
Relative GDP *per capita*	1.658	9.9	0.507	2.7
N	3,540		3,523	
Pseudo R^2	0.293		0.304	

[a] Greece, Portugal, Turkey, Brazil, Argentina, and Chile

[b] Dummy variables that take the value one if the individual obtained her Ph.D. at the following places: (i) Harvard and MIT, the two most popular graduate schools in the U.S. among the economists with at least one publication that work in 2007 in the top 81 Economics departments worldwide according to the Econphd (2004) ranking (Albarrán *et al.*, 2017a); (ii) the next eight, (iii) the next fifteen, (iv) and the last 27 U.S. economics departments in the dataset (see Table A in the Supplementary Material for the specific schools); (v) other U.S. departments; (vi) the UK, Canada, and Australia; (vi) the remaining countries in the European Union after the accession in 2004 (Germany, France, Italy, Spain, Netherlands, Belgium, Sweden, Denmark, Greece, Portugal, Austria, Finland, and Ireland), as well as Israel, referred to as *Other Western*, which are in the regressions' constants, and (vii) other countries in the Rest of the World (individuals without a Ph.D. are included in the last category).

Table 4. Effects of the country dummies on the probability of becoming brain gained

	Effects[a] (1)	Differences relative to Spain[b] (2)	*p*-values (3)
Greater than Spain			
China	0.501	0.350	0.005
Switzerland	0.484	0.333	0.000
Canada	0.465	0.314	0.000
Australia	0.462	0.311	0.000
México	0.425	0.274	0.009
UK	0.329	0.178	0.002
Equal to Spain			
Spain	**0.151**	**-**	-
U.S.	0.075	-0.076	0.158
Denmark	0.067	-0.084	0.275
Germany	**0.061**	**-0.090**	0.209
Sweden	0.030	-0.121	0.206
Israel	0.022	-0.129	0.238
Smaller than Spain			
Belgium	-0.007	-0.185	0.006
Netherlands	-0.024	-0.175	0.003
France	**-0.058**	**-0.209**	0.000
Italy	**-0.210**	**-0.361**	0.000

[a] Effects of each country dummy on the probability of becoming brain gained with respect to the countries in the constant (Greece, Portugal, Turkey, Brazil, Argentina, and Chile)
[b] Differences between the effect of each country dummy on the probability of becoming brain gained and the effect of the Spanish dummy

Table 5. Effects of the country dummies on the probability of becoming brain drained

	Effects[a] (1)	Differences relative to Spain[b] (2)	*p*-values (3)
<u>**Greater than Spain**</u>			
Switzerland	0.494	0.530	0.000
Australia	0.328	0.364	0.000
Germany	**0.239**	**0.275**	0.000
Italy	**0.238**	**0.274**	0.000
Canada	0.208	0.244	0.000
Sweden	0.167	0.203	0.042
UK	0.137	0.173	0.004
<u>**Equal to Spain**</u>			
Belgium	0.043	0.079	0.192
Israel	0.037	0.073	0.292
Denmark	0.034	0.070	0.336
France	**0.033**	**0.069**	0.197
México	0.021	0.057	0.546
China	0.007	0.043	0.650
Spain	**-0.036**	**-**	-
Netherlands	-0.066	-0.030	0.641
<u>**Smaller than Spain**</u>			
U.S.	-0.281	-0.245	0.000

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[a] Effects of each country dummy on the probability of becoming brain drained with respect to the countries in the constant (Greece, Portugal, Turkey, Brazil, Argentina, and Chile)

[b] Differences between the effect of each country dummy on the probability of becoming brain drained and the effect of the Spanish dummy

Table 6. Net effects of the country dummies

	Effects[a] (1)	Differences relative to Spain[b] (2)	*p*-values (3)
Greater than Spain			
China	0.494	0.307	0.000
México	0.404	0.217	0.033
Equal to Spain			
U.S.	0.356	0.169	0.172
Canada	0.257	0.007	0.210
UK	0.192	0.005	0.674
Spain	**0.187**	**-**	-
Australia	0.134	-0.053	0.680
Smaller than Spain			
Netherlands	0.042	-0.145	0.027
Denmark	0.033	-0.154	0.086
Switzerland	-0.010	-0.197	0.000
Israel	-0.015	-0.202	0.008
Belgium	-0.050	-0.237	0.001
France	**-0.091**	**-0.278**	0.000
Sweden	-0.137	-0.324	0.006
Germany	**-0.178**	**-0.365**	0.000
Italy	**-0.448**	**-0.635**	0.000

[a] Net effects of each country dummy with respect to the countries in the constant (Greece, Portugal, Turkey, Brazil, Argentina, and Chile)

[b] Differences between the net effect of each country dummy and the net effect of Spain

Table 7. Partition of the economists working in 2007 in Spain into stayers brain circulation, and brain gain

	UAB	Alicante	IAE	CEMFI	Carlos III	Pompeu Fabra*	Total	%	% in 2007**
Stayers	10	21	1	1	10	12	55	24.4	31.2
Brain circulation	14	9	8	13	17	16	77	34.3	40.4
Brain gain	7	9	10	7	23	37	93	41.3	28.4
Total	31	39	19	21	50	65	222	100.0	100.0

* Excluding Economic and Business History, Finance and Accounting, Management and Oerganization Studies, and Operations Management

** From Table B in Section SM4 in the Supplementary Material

SUPPLEMENTARY MATERIAL

This Supplementary Material document consists of eleven Sections and an Appendix.

SM1. The selection of countries and departments

As indicated in Section 2.1, we begin with a dataset consisting of 2,530 economists with at least one publication who work in 2007 in the top 81 Economics departments worldwide according to the Econphd (2004) ranking consisting of 321 institutions.[28] In all sciences, we observe a heavy concentration of the most productive and influential researchers in top U.S. research institutions. However, the dominance of U.S. institutions in economics is considerably stronger than in most other disciplines (Albarrán *et al.*, 2017a). Thus, not surprisingly, 52 out of the 81 departments and 1,600 of the 2,530 economists are located in the U.S. Apart from the European Institute in Florence, which is excluded from the sample because it is a European Union institution that cannot be assigned to any specific country, the remaining 28 departments are located in the eleven countries other than the U.S. reported in Section 2.1. Five of these countries are well represented in the original sample, and the remaining six are completed with departments placed after the top 81.

Next, we consider the 44 institutions between the 81 and the 125th position in the Econphd (2004) ranking. Thirty-three departments belong to some of the original twelve countries (15 to the US, seven to the UK, three to Canada and Germany, two to France, and one to Netherlands, Israel, and China). Aa indicated in the text, among the new countries with at least one department in the remaining eleven institutions, we include (with the number of departments in brackets): Italy (5), Australia (2), and Switzerland (2). Finally, we add the following seven countries in spite of the fact that their best departments do not appear within the first 125 positions in the Econphd (2004) ranking: Greece (2), Portugal (2), Turkey (4), Mexico (4), Brazil(3), Argentina(2), and Chile (2).

[28] As explained in Albarrán *et al.* (2017a), this list of departments has been compared with other equally acceptable university rankings. The main conclusion is that, apart from differences in the order in which each institution appears in the various rankings, our list has between 70 and 73 departments in the top 81 in common with each of the other rankings.

The above selection of countries and departments has generally followed the Econphd (2004) ranking. There are three exceptions. Firstly, five countries with at least one department between the 81 and the 125 entries were excluded for the following reasons. Austria and Norway, with the University of Vienna and the University of Oslo ranked 100 and 102, are not included because they are well represented by other European countries whose best departments are further up in the ranking. On the other hand, we decided that adding India, Taiwan, and Japan –with the Indian Statistical Institute, the Academia Sinica, and the University of Osaka ranked 104th, 119th, and 123rd, respectively–, was not worth the cost.

Secondly, seven institutions ranked in Econphd (2004) in five countries were eventually excluded. (i) The University of Melbourne in Australia, ranked 86th, was mistakenly overlooked and substituted by the University of South Wales, ranked 124th. (ii) In Spain, in order to ensure the coverage of the more innovative centers, we include the IAE (Institut d'Anàlisi Econòmica)[29] instead of the University of País Vasco, ranked 226. (iii) In France, two economics departments –Cergy-Pontoise and Aix-en-Provence, Marseille II, ranked 143 and 160– substitute for the INSEAD Business School and the Ecole Politechnique, ranked 106 and 141. (iv) In Germany, since the University of Bielefeld, ranked 196, had only five researchers with complete information, it was substituted by the University of Heidelberg, ranked 252. (v) In Italy, the University of Padova, ranked 263, enters for the University of Modena, ranked 251. More importantly, we mistakenly overlooked the University of Torino, ranked 185, including instead the unranked University of Rome Tor Vergata, whose composition in 2007 was directly facilitated to us several years after that date by a colleague working there.

Thirdly, together with the IAE in Spain and University of Rome Tor Vergata in Italy, nine of the remaining 123 centers are not ranked in Econphd (2004). These belong to the following countries added

[29] The IAE is a public research center without teaching responsibilities that belongs to the CSIC (Consejo Superior de Investigaciones Científicas) –a large Spanish body of research institutes in all sciences– and is located in the same campus of Bellaterra as the UAB.

in the last step to the dataset: Mexico (3), Turkey (2), and one in Greece, Argentina, Brazil, and Chile. The list of institutions in each country, ordered by their Econphd rank, is in Table A.

Table A around here

SM2. The information on individual characteristics, and the distribution of institutions by size in each country

In 116 centers, we searched for individual researchers in the departmental web pages in 2007. It should be noted that in 2007, the web pages of many institutions were not very well organized, so that in many instances it is hard to distinguish between tenure-track and tenured faculty –our desired contingent– and visiting faculty, part-time or full-time teaching staff, and other personnel sometimes included in department web pages. In the remaining nine cases, which were completed several years afterwards, we received information about the faculty members active in 2007 from colleagues working in these institutions.[30]

The information concerning each individual's publications up to 2007 was obtained from the Internet (CVs available in departmental or personal web pages, *RePEc*, *Publish or Perish*, etc.). The information concerning the country of birth is very often lacking. Therefore, we generally assign the nationality in terms of the country where each individual obtains a B.A. or an equivalent first college degree. In turn, since people's age is not generally available, we use the academic age, namely, the number of years elapsed since obtaining a Ph.D. (or equivalent degree) up to 2007. Whenever educational information could not be found through the Internet, we wrote to the person in question. Many people answered providing the required information. In other cases, in which we lacked information on a person's B.A., the nationality could be safely inferred from the remaining information on the person's last name, the country where s/he did her Ph.D., and the country where s/he works in 2007.

[30] This was the case for Aix-en-Provenze, Marseille II in France; Roma Tor Vergata, in Italy; the University of Creta in Greece; the Fundaçao Getulio Vargas in Sao Paulo and Rio de Janeiro, as well as the four university departments in Argentina and Chile.

It should be noted that the Ph.D. requirement for pursuing an academic career in the UK and, above all in Italy, is more recent than in other countries. Thus, for people whose higher university degree is an M.A., academic age is counted from that date up to 2007. For individuals that never obtained a Ph.D. or an M.A., academic age is counted from the B.A. up to 2007. In a reduced number of cases in other countries where the only missing data is the date of obtaining a Ph.D., this piece of information was imputed taking into account the first published Working Paper or professional article.

The distribution of the 3,540 individuals in the dataset with at least one publication and complete information on education, and age by institutions in each country is presented in Table A. The following three observations concerning the average number of faculty members per center should be noted. Firstly, in several Southern European countries –such as France, Italy, and Spain– the large number of students pursuing a B.A. degree in economics have led to the buildup of large economics departments during the last 50 years. In our dataset, this is the case of Paris I and Toulouse in France, as well as Padova and Bologna in Italy, which account for approximately 70% and 79% of the 237 and 188 economists working in these two countries. In Spain, however, comparable large departments do not belong to the dataset. Instead, the inclusion of two relatively small research centers, such as the IAE and CEMFI (Centro de Estudios Monetarios y Financieros)[31], contributes to lowering the average number of individuals per center.

Secondly, the organization of the public higher education sector in Germany is quite different from other countries. Typically, professors and researchers belong to highly hierarchical units headed by a full-professor. Obtaining tenure through the *habilitation* and *lehrstuhl* (chair) system takes longer than elsewhere. However, there is no tenure-track system analogous to what we find in other countries. The problem is that departmental web pages provide possibly incomplete information concerning the junior members of such units. Consequently, in the sample of 100 economists working in Germany, the average number of

[31] CEMFI is a non-public research center located in Madrid that offers an M.A. in economics and finance.

faculty members is only 16.7 per center, a figure clearly smaller than the average in the remaining large continental countries: 43.6 in France, 32.6 in Italy, and 30.5 in Spain.

Thirdly, in terms of their centers' size, the 22 countries can be classified into three groups. (i) Together with the U.S. and three of the four large European countries –France, Italy, Spain–, seven other Western countries have more than 24 faculty members per center, ranging from Australia with 24.5 to Belgium, where KU Leuven pushes the average up to 50. (ii) Together with Germany, seven other countries have an intermediate average, ranging from Brazil with 15.3 to Israel with 21. (iii) The remaining four countries have small averages, ranging from 9.5 in Argentina to 13 in Switzerland.

In brief, as explained in Section SM4 below, we can be reasonably confident concerning the accuracy of our data on mobility variables. The greatest difficulty might relate to the quality of our information on stayers, and hence on the total number of economists working in 2007 or originating in a given country. For example, if we are unable to include all junior stayers in German institutions, then our estimate of the percentage of brain gain, brain drain, and net gain over the sum of brain circulation and stayers in Germany will be biased upwards. The opposite will be the case if we have too many stayers in some French or Italian universities.

SM3. The index of individual productivity (this section is taken from Albarrán *et al.*, 2017a)

As indicated in the text, because of budgetary restrictions, our information on productivity suffers from two limitations. Firstly, the article count in our dataset made no distinction between single and multiple-authorship. Consequently, no correction for co-authorship could be implemented. This amounts to assigning full credit to all authors in co-authored publications. Although at an aggregate level they recommend fractional counting for co-authored publications, Waltman & Van Eck (2015) argue that the multiplicative practice we adopt here is admissible at the individual level. Moreover, the average number of authors per article in Economics & Business in 2003-2011 is 1.8, whereas the mean and standard deviation for 30 broad scientific disciplines is 3.1 and 1.1 (Ruiz-Castillo & Costas, 2015). Therefore, under the assumption that the assignment of equal responsibility for co-authored publications is a more acceptable option when the number of authors per publication is small, the alternative we adopted is a lesser problem in our case. Secondly, although we know the journal where each article is published, it was impossible to search for the citation impact achieved by every article. Therefore, we are constrained to measuring individual productivity as a function of the total number of publications per person over her academic career up to 2007.

In every science, there is broad agreement about the different merit associated to publishing in a reduced number of top journals, a larger set of excellent field journals, or the remaining international or local journals. Starting from the top 63 journals in the Kalaitzidakis *et al.* (2003) journal ranking, and also taking into account the rankings in Lubrano *et al.* (2003), and Kodrzycki & Yu (2006), in this paper we distinguish between four journal classes.

Although any specific classification will always be controversial, a consensus on how to weight the different journal classes in order to reach a scalar productivity measure is possibly even harder to reach. This paper studies faculty members in top world departments, and seeks to isolate among them at least part of a true world elite with remarkable or outstanding productivity. In this context, we believe that it is desirable to value very highly class A journals, to stress the difference between top and local journals, and to recognize the role of excellent field journals. Thus, as indicated in the text, in our preferred weighting scheme the four classes are assigned weights equal to 40, 15, 7, and 1 point, respectively.[32]

SM4. Descriptive statistics on mobility variables

Table B presents the information on the partition of the 3,540 economists working in 2007 in the 22 sample countries into brain gain, brain circulation, and stayers, whereas Table C presents the information

[32] Oster and Hamermesch (1998) use the Laband & Piette (1994) weights that, as in our case, imply large differences between journal classes. Rauber & Ursprung (2008) use the Combes & Linneman (2003) weights that lie between unity for five top journals, 2/3 for sixteen journals, down to 1/12 for the lowest quality journals –a very different scheme from our own. Coupé *et al.* (2006) use the average of the rankings based on different weighting schemes computed in Coupé (2003). For a classification of different schemes in an elitist-egalitarian axis, see Ruiz-Castillo (2008). For the consequences of adopting an alternative weighting scheme to our own see Appendix II in Albarrán *et al.* (2014).

on the partition of the 3,253 economists born in the 22 countries into brain drain, brain circulation, and stayers.

Tables B and C around here

We can compare the flows of brain gain and brain drain as a percentage of the nationals working in each country, that is, the sum of brain circulation and stayers in each country. Table D presents these percentages, as well as the percentage of net gain defined as the difference between the percentages of brain gain and brain drain over this denominator.

Table D around here

The fact that the 125 institutions in our dataset constitute a valuable sample of the most productive centers in each of the 22 selected countries has favorable implications for the quality of the information concerning mobility variables. In the first place, consider the large contingent of brain drained economists from the non-U.S. countries in our sample. They will be working in the U.S., a country very well represented by 52 departments in our sample, or elsewhere, where we have information from two sources: a selection of 50 of the most productive centers in twelve important Western countries, and 20 centers in eight (not so outstanding) countries in different geographical areas. In particular, of the 837 brain drained economists of this type, 59.1% work in the U.S., 27.6% in open and mixed countries, and 13.3% in the remaining closed and brain circulation countries.[33] In the second place, in so far as our selection of centers in non-U.S. countries constitutes a good sample of their most productive institutions, we expect our brain gain data for these countries to be of good quality. Finally, since economists in brain circulation are likely to end up in one of the best institutions in their country of origin (Van Bouwel and Veugelers, 2014), we expect our data on these movers to be of good quality too.

Table E around here

SM5. A contrast with other sciences

[33] For further details concerning the remaining brain drained economists, see Table E.

Franzoni *et al.* (2015) study four scientific fields: biology, chemistry, materials science, and earth and environmental sciences. In a first step, 47,304 researchers were randomly selected on the basis of being a corresponding author of an article published in 2009 in a journal in any of the four sciences. Researchers were working or studying in one of 16 'core' countries, which produce about 70% of the publications in these fields. Fourteen of these countries coincide with some of our 22 sample countries. In a second step, a questionnaire was sent to these authors, with an overall response rate of 35.6%. Country of origin was determined by asking the respondents to report their country of residence at age 18. Note the roundabout manner in which the dataset is constructed.

Those living a given country are partitioned into three groups: (i) foreigners working, studying or taking a postdoc or job position for at least 12 months in the country in question, a larger contingent than our brain gain; (ii) returnees after studying or working abroad, again a larger contingent than our brain circulation, and (iii) stayers. The partition of the 17,182 respondents into the three groups, as well as the number of respondents and the percentage of brain drain among 15,115 nationals in each country are presented in Table F.

Table F around here

Four points should be noted. Firstly, out of the total number of researchers, 53.4% are movers – 24.0% foreign-born, and 29.4% returnees– a percentage comparable with the 49.4% in our sample (see Table B in Section SM4 in the Supplementary Material). Secondly, in Table F we observe a concentration of foreigners into a few countries of the same order of magnitude that our own: 42.0% work or study in the U.S., and 34.4% in our open countries plus Sweden. Only 17.0% of foreigners live in five of our closed countries (Germany, France, Netherlands, Belgium, and Denmark), while they are virtually absent in Italy, Spain, Brazil, Japan, and India. Thirdly, it should be emphasized that the percentage of brain drain in Spain in our sample is 31.1% but only 7.3% in Table F. This clearly illustrates how, in comparison with other sciences, the Spanish case in economics constitutes an exception in need of an explanation. Finally, the main difference between the four sciences in Franzoni *et al.* (2015) and economics is that, in terms of the percentages of brain drain, open and closed countries in Table F are more similar to each other than in our case (see Table C in Section SM4 in the Supplementary Material). In particular, the percentage of brain drain in Spain in Table F is also considerably lower than in the open and closed European countries. This possibly reflects that Spaniards in these four fields are of lesser quality than the nationals from other countries.

We only know of another comparable dataset, consisting of 317 highly cited mathematicians (Panaretos and Malesios, 2012). The importance of movers and the concentration of brain gain in the U.S. are of a similar order of magnitude as our own: 55.6% are movers –38.3% brain gain, and 17.3% brain circulation– whereas among the brain drain 50.9% work in the U.S. For a more detailed analysis, see Section III.5 in Albarrán *et al.* (2014).

Sugimoto *et al.* (2017) and Chinchilla-Rodriguez *et al.* (2018) constitute the first attempt to investigate mobility patterns using large datasets. They study about 14 million documents in the Web of Science, published between 2008 and 2015, and authored by about 16 million individuals. They operationalize mobility as Robinson-García *et al.* (2018): an individual is classified as *mobile* if she had more than one affiliation during the period 2008-2015. Lacking information on researchers' nationality or where they attend graduate school, they cannot study the brain gain, brain circulation, or brain drain phenomena. Thus, their almost 600,000 "movers" during this period only represent 3.7% of the sample, a figure very much below the approximately 50% of movers in our dataset and Franzoni *et al.* (2015).

SM6. Productivity comparisons

Given the high skewness of the individual productivity distribution, the dependent variable in this Section is always the log of the Q index.

SM6.1. Explanatory variables

Among personal characteristics, we have information on demographics, and the university where individuals obtain their first college degree and the university where they attend graduate school. Since our measure of aggregate productivity up to 2007 favors older people, among demographics it is essential to control for the individuals' age or academic experience. Together with the variable *Experience* (or *Exp* hereafter), and $(Exp)^2$, we introduce a dummy variable, *Young*, that takes the value one for young people, defined as those who earn a Ph.D. at most 20 years before 2007. Taking into account that the median age for finishing a Ph.D. is approximately 30 (Scott & Sigfried, 2008), young people in our sample are those with at most 50 years of age in 2007. They represent around 59% of the total sample. To account for the possibility that the productivity effect of one more year of academic experience is different for young and older individuals, our specification includes an interaction between the cohort and the age variable. The dummy variable *Female* takes the value one for females, representing 15% of the population. As far as the first college degree, due to multicollinearity problems we only introduce the dummy variable *RW* that takes the value one if the individual has obtained a B.A. outside the universities in the sample countries, representing 25% of the total. Finally, graduate education is measured by seven dummy variables.

We measure department effects by means of five dummy variables. As in Albarrán *et al.* (2017b), in the U.S. we distinguish between the *Top 25* departments, which practically coincide with the top 25 departments in the world, and the *Next 27* U.S. departments. Outside the U.S., the remaining 58 departments in the four open countries, the three mixed countries, the seven closed countries, and Israel are separated in three categories: *15 Top* departments according to the Econphd (20014) ranking, from the London School of Economics to Stockholm University, *43 Bottom* departments, and the *Last 15* departments in the brain circulation countries except Israel (the reason for excluding Israel is that, as we will see below, it is a much more productive country).[34] We should emphasize that the two intermediate

[34] Of course, which departments are at any moment in the "top 25" or "bottom 27" in the U.S., or the "top 15", "bottom 43", and the last 15 outside the U.S. is open to debate. Moreover, even if this classification is appropriate for the period 2004-2007,

groups, namely, the *Next 27* U.S. departments and the *15 Top* departments outside the U.S., are heterogeneous categories with a large overlap in terms of their Econphd ranking (for the Econphd rankings, see Table A in Section SM1 in the Supplementary Material).

Finally, economists working in our sample countries are partitioned into three groups: foreigners or brain gain, brain circulation, and stayers, which represent 34.4%, 27.4%, and 38.3%, respectively. Descriptive statistics on personal, department, and mobility characteristics, as well as regression results for individual productivity in terms of all explanatory variables are presented in Tables G and H, respectively.[35]

Tables G and H around here

In the first place, note that the explanatory variables account for a large proportion of the variance: the adjusted R^2 in Table H is 0.503. Next, in agreement with human capital models, we find a humped-shaped progression of individual research productivity with academic age because the stock of human capital needs to be built up at the beginning of the career while, due to the finiteness of life, no new investment offsets depreciation and net investment declines (eventually) over time. Moreover, the old are more productive than the young, and the productivity gap decreases with experience. Females are 51.1% less productive than males. On the other hand, only two of the educational variables are significant: individuals having earned a B.A. outside our sample countries (or having earned a Ph.D. in Hatvard or MIT) have a significantly smaller (greater) productivity than the corresponding reference group.

For our purposes, it is worth noting the existence of strong department effects. The productivity of economists in the *Top 25 U.S.* departments is greater than their productivity in the *Next 27* institutions. On the other hand, the productivity of researchers in the *Next 27* U.S. departments is indistinguishable with their productivity in the *Top 15* departments outside the U.S. Given the overlapping in the department rankings in these two groups, this is not a surprising result. Finally, the productivity of individuals in these

individual departments are likely to have changed positions over the period of this study prior to 2007. Therefore, it is advisable to take this partition as representative of "top" or "bottom" departments in general.

35 All regressions in the paper include clustered standard errors by the university where each individual works in 2007.

two department categories is greater than their productivity in the *Bottom 43* departments and the *Last 15* departments in the countries in the constant.[36]

The existence of the above department effects requires discussing whether higher performing universities contribute to the productivity of individual researchers and/or whether they simply attract more productive individuals. As discussed in detail in Albarrán *et al.* (2017b), although our data do not allow us to address this issue, the results of the literature on the existence of spillover effects are clearly negative (Han Kim *et al.*, 2009, Azoulay *et al.*, 2010, Waldinger, 2012, Borjas & Doran, 2014, and Dubois *et al.*, 2014). However, as in Han Kim *et al.* (2009), the decline of spillover effects is compatible with the existence of department effects: highly productive economists tend to come together in institutions of high productivity and prestige in a hierarchically ordered manner. In our dataset, as we have seen, there is a four-level hierarchy: (i) *Top 25* U.S. departments; (ii) *Next 27* U.S. and *Top 15* departments outside the U.S.; (iii) *Bottom 43* departments outside the U.S. and (iv) 15 departments in the brain circulation countries except Israel.

SM6.2. Productivity comparisons between foreigners, brain circulation and stayers working in each country

A question of interest is whether foreigners and brain circulation are more productive than stayers. The results in the literature concerning the existence of productivity differences between immigrants and nationals are mixed. Independently of the fact that different studies use different methodologies, as well as different productivity measures for scientists in different fields during different time periods, there are also important differences in the characteristics of the group to whom immigrants are compared. For example, using a small sample of highly cited physicists, Hunter *et al.* (2009) conclude that, due to low mobility costs, the distribution of talent can be expected to be similar across different countries, so that foreigners who move to the U.S. go on to be neither more nor less distinguished than American-born elite physicists. This contradicts the results from two important contributions whose datasets consist of more than 2,500

[36] P-values for these and the remaining productivity comparisons in this Section are available on request.

Ph.D. economists working in the U.S. (McDowell & Singell, 2000), or more than 17,000 retrospective questionnaires in several sciences (Franzoni *et al.*, 2014). Both studies find that, after controlling for the endogeneity of the migration decision, immigrant scientists exhibit superior performance.[37]

However, none of the above contributions explore department effects. Regression results in Table H indicate that, controlling for fixed department effects, foreigners are more productive than brain circulation, and the latter are more productive than stayers. However, in Albarrán *et al.* (2017b) we found that, when we made productivity comparisons between immigrants and stayers *within* department categories, the situation was different in top and bottom U.S. institutions. This is the approach we apply to our present sample, where we distinguish between immigrants, stayers, and brain circulation in each department category. However, since there are only three and six brain drain circulation economists in the *Top 25* and *Next 27* U.S. departments, we include all U.S. brain circulation in a single dummy variable. Thus, including the reference group, there are 14 dummy mobility variables within the five department categories. Note that the percentages of brain gain in the U.S. and the *Top 15* departments outside the U.S. are 40.5% and 39.1%, whereas these percentages in the *Bottom 43* and the last 15 departments outside the U.S. are only 27.8% and 11.3% (descriptive statistics are presented in Table G). Personal control variables are the same as before. Regression results for this model are in Table I.

Table I around here

Note that the adjusted R^2 in Table H is 0.506. We begin by confirming the existence of strong department effects: each of the three groups in the partition of the total into brain gain, brain circulation, and stayers are hierarchically ordered into the four productivity levels identified in Table H.

A key question for understanding the role of foreigners in our dataset is how their productivity compares with the nationals' productivity within each department category. We begin by comparing the

[37] The same conclusion is reached by Ruhose *et al.* (2015) for 565 high-skilled German immigrants *versus* 289,538 high-skilled U.S. natives. However, rather than Ph.D. holders working in the U.S. academic sector, the high-skilled in this paper are individuals with a B.A. or higher degree who work in any type of full-time job in the U.S.

productivity of foreigners and stayers. The situation is very different within the two U.S. department categories: at the top, the productivity of foreigners and stayers was indistinguishable, while at the bottom foreigners were more productive than stayers. This situation is essentially reproduced outside the U.S.: foreigners and stayers in the *Top 15* departments are equally productive, whereas immigrants are more productive than stayers both in the *Bottom 43* and the *Last 15* departments in the brain circulation countries in the constant.

On the other hand, the handful of U.S. brain circulation are as productive as foreigners and stayers in the *Top 25* U.S. departments, and more productive than both groups in the *Next 27* U.S. departments. As far as the role of brain circulation economists outside the U.S., the situation is the following. Firstly, brain circulation are always more productive than stayers. Secondly, foreigners are more productive than brain circulation in the *Bottom 43*, but the two groups are indistinguishable in the remaining two department categories.

With our sample, we can also study these phenomena in specific countries with the following limitations. Lacking observations to have each three separate dummy variables, two open countries – Australia and Switzerland– and two closed countries –Sweden and Denmark– must be treated together. On the other hand, because there are no stayers in China, Chinese nationals are partitioned into brain drain and brain circulation. In Italy, since there are only three foreigners, we treat them together with brain circulation in a dummy for Italian movers versus a dummy for Italian stayers. In Mexico we are forced to distinguish between foreigners, on one hand, and brain circulation and stayers on the other hand. Thus, including the reference group, there are 44 dummy mobility variables (descriptive statistics can be found in Table B in Section SM1). Regression results for this model, where the adjusted R^2 is 0.542, are in Table J.

Table J around here

Four points should be noted. Firstly, as in the *Top 25* U.S. departments, foreigners and stayers are equally productive in the U.K., Canada, and Israel. Secondly, as in the *Next 27* U.S. departments, foreigners are more productive than stayers in Australia/Switzerland, Spain, Germany, France, Belgium, Sweden/Denmark, and the six countries in the constant. Similarly, in Italy movers are more productive than stayers. Thirdly, foreigners are less productive than stayers in Netherlands, and less productive than brain circulation in China. Finally, except in Franc, Spain, and Netherlands, where brain circulation are more productive than foreigners, in all other countries foreigners and brain circulation are indistinguishable.

SM6.3. Productivity comparisons between movers and stayers among those born in a given country

Ideally, for all economists born in a given country, we would like to compare the average productivity of three types of individuals: brain drain, brain circulation, and stayers. If possible, we would like to differentiate between brain drained economists in different department categories. Because of data limitations, we can separate brain drained individuals at most into two groups: those working in *Top 25* U.S. departments, and those working in what we call *All other* departments, namely, the sum of the *Next 27* U.S. departments plus the 73 non-U.S. departments. There are nine countries for which we can construct a maximum of four dummy variables that take the value one when an individual is brain drained in these two department categories, or works in her country of origin as brain circulation or stayer. These countries are Israel, the U.K., Canada, Spain, Germany, France, Italy, Belgium, and Netherlands. As before, we include dummy variables for the union of Sweden and Denmark, and Australia and Switzerland. Brain circulation countries, except Israel, are also treated together. On the other hand, because there are no stayers in China, Chinese nationals are partitioned into the two types of brain drain, and those in brain circulation. In Mexico we are forced to distinguish between all brain drain individuals, on one hand, and all brain circulation and stayers on the other hand. Finally, U.S. nationals constitute an special case where there are a handful of highly productive brain circulation economists working in the *Top 25* U.S. departments. Therefore, U.S. stayers in this department category will refer hereafter to both stayers and brain circulation individuals. Thus, there are three dummy variables for U.S. nationals: stayers in the *Top 25* and the *Next 27* U.S. departments, and U.S. economists working abroad, i.e. U.S. brain drain. Thus, including the reference group, there are 56 dummy mobility variables (descriptive statistics can be found in Table C in Section SM1). Regression results for this model, including demographic and educational control variables, are in Table K.

Table K around here

Note that the adjusted R^2 is 0.535. In this model, department effects are present whenever the productivity of individuals working in *Top 25* U.S. departments is greater than the productivity of those working in *All other* departments. Unsurprisingly, given the more disaggregated previous results, this is the situation in a majority of cases (the U.S., the U.K., Canada, Spain, Germany, France, Italy, Netherlands, Sweden/Denmark, and the six countries in the constant). Only in Israel, Australia/Switzerland, China, and Belgium the two coefficients are indistinguishable.[38]

The question we are most interested in is whether the productivity of movers, i.e. brain drain and brain circulation, is greater than the productivity of stayers. We will also study whether brain circulation individuals are negatively selected relative to brain drain researchers.

As far as the comparison between the productivity of brain drain and stayers is concerned, three points should be noted. Firstly, generally the productivity of brain drain in the *All other* category is greater than the productivity of stayers. This is the case for 13 countries: Spain, Germany, France, Italy, Belgium, Australia/Switzerland, and the six countries in the constant. In the U.K. and Sweden/Denmark the superiority of brain drain economists is only verified for those working in the *Top 25* U.S. departments. Secondly, the U.S. is a special case in which brain drain economists, which only represent 8.9% of the total, appear to be negatively selected relative to stayers in the *Top 25* U.S. departments. However, it can be shown that, under certain values of the parameters capturing the utility of being abroad, the cost of moving, and the premium received for remaining in the U.S., this is a prediction in an extension of the

[38] Since all Mexican brain drain are treated together, this issue does not apply to this country.

Hunter *et al.* (2009) model. Thirdly, there are three countries for which the productivity of stayers is so high that it is indistinguishable with the productivity of those brain drained even in the *Top 25* U.S. departments: Israel, Canada, and Netherlands.[39]

To finish with the comparison between movers and stayers, the productivity of brain circulation is greater than the productivity of stayers in twelve countries (Israel, Australia/Switzerland, Spain, France, Italy, and the six countries in the constant), while the productivity of the two groups is indistinguishable in the remaining seven instances (the U.K., Canada, Germany, Netherlands, Belgium, Sweden/Denmark).[40]

Finally, we review the relationship between brain drain and brain circulation. In our case, the productivity of brain circulation is smaller than the productivity of the two brain drain categories in nine countries (China, Italy, Belgium, and the six countries in the constant). In seven cases (Israel, Canada, Spain, Germany, France, Sweden/Denmark), the productivity of brain circulation is indistinguishable from the productivity of brain drain in *All other* departments, but smaller than the productivity of brain drain in the *Top 25* U.S. departments. In the remaining four countries the superiority of brain drain in the *Top 25* U.S. departments is almost significant (p-values in brackets): the U.K. (0.12), Australia/Switzerland (0.14), and Netherlands (0.12).[41]

With our data we cannot discriminate between the alternative interpretations, namely, that the reason for the productivity of brain circulation being smaller than the productivity of brain drain is the existence of spillover effects, or the fact that economists in brain circulation are negatively selected. The literature offers mixed results: although some of the evidence indicates that the two groups are similarly productive (Khan & MacGarvie, 2016, for those who return to high income countries, Gaulé, 2014, and Franzoni *et al.*, 2015), most of the results indicate that the second interpretation is more likely (Borjas, 1989, Da Vanzo & Morrison, 1981, Lam, 1986, Ramos, 1992, and Borjas & Bratsberg, 1996, Dustmann *et al.*, 2011, Grogger &

[39] Since Mexican brain circulation and stayers are treated together and there are no Chinese stayers, this issue does not apply to these countries.

[40] Since in the U.S., Mexico, and China brain circulation and stayers are treated together, this issue does not apply to these countries.

[41] Since in the U.S. and Mexico brain circulation and stayers are treated together, this issue does not apply to these countries.

Hanson, 2013, and Khan & MacGarvie, 2016, for those who return to low income countries).[42] In the absence of strong spillover effects that favor the productivity of immigrants remaining abroad, our finding that the average productivity of brain circulation is generally smaller than the average productivity of those who remain abroad can be interpreted as indicating that brain circulation involves negative selection relative to brain drain, particularly relative to those working in the *Top 25* U.S. departments.

SM6.4. A productivity ranking of those working in each country

Finally, we investigate the effects of working in the different countries once we control for personal characteristics. In particular, we are interested in the comparison between economists working in Spain and those working in other sample countries. Regression results for this model, where the adjusted R^2 is 0.509, are in Table L.

Table L around here

After controlling for personal characteristics, the marginal effect of working in Spain is indistinguishable from the effect of working in Australia, France, Belgium, Denmark, and China, and greater than the effect of working in Italy, Mexico, and the six brain circulation countries in the constant. However, the effect of working in Spain is smaller than the effect of working in the remaining countries, namely, the U.S., Israel, the U.K., Canada, Germany, Sweden, Switzerland, and Netherlands.

SM7. Results on estimated average probabilities

The estimated results on the average probability of brain gain, brain drain and net gain in each country, defined in expressions (6) to (8) in Section 4.1 in the text, are presented in Table M. They warrant the following four comments.

Table M around here

Firstly, as expected, the U.S., which has an average probability of brain gain and brain drain greater and smaller, respectively, than Spain, ends up as the only country with a greater net average probability

[42] Note that Mexico, China and the six countries in the constant are low income countries, while the other 13 sample countries in our dataset are wealthy ones.

than Spain: 29.2% versus 8.4% (*p*-values for all comparisons in Table I are available on request). Secondly, on average, the open countries are capable of attracting more migrants than Spain, but they also suffer a greater brain drain. Consequently, the UK, Switzerland and Australia end up with a net average probability indistinguishable from Spain, while Canada ends up below the latter. Thirdly, two other countries exhibit a remarkable performance: Mexico performs very well in brain gain and brain drain, whereas Netherlands has a smaller average probability of brain gain *and* brain drain than Spain. Thus, both countries end up in the same category as Spain. On the other hand, China exhibits a large average probability of brain gain but its brain drain is so large that it ends up with a negative net average probability. Last but not least, the following is an important result. Although France and Spain's brain drain behavior are indistinguishable, the net average probability ends up being greater for Spain (8.4%) than for the three comparable European countries, namely, Germany (-28%), France (-2.9%), and Italy (-37.6%). As a matter of fact, these three countries, together with China and the remaining ten sample countries end up with a negative average probability of net gain.

SM8. Results on the probability of brain circulation

We run two regressions on the probability of an individual in brain circulation as a function of all control variables, and the two sets of working country and country of origin dummy variables. The adjusted R^2 for the two samples of 3,540 and 3,253 observations are 0.53 and 0.51. As far as country effects are concerned, the main results can be summarized as follows (detailed results are available on request). In agreement with unconditional results in Tables B and C in Section SM4, the effect of working in Spain on the probability of brain circulation is smaller than the effect of working in Italy, whereas the effect of being born in Spain on this probability is greater than the effect of being born in Italy. On the other hand, the effects of working or being born in Spain on the probability of brain circulation is greater than these effects in Germany, France, Netherlands, Sweden, and Denmark, as well as in all open countries and the U.S.

SM9. The effect of control variables on the brain drain performance in China and Spain

The unconditional proportions of brain drain in China and Spain are 70.9% and 23.2% (Table C in Section SM3). Consequently, when the probability of becoming brain drained is a function of only country of origin dummy variables, country regression coefficients for China and Spain (with *t*-statistics in brackets) are 0.923 (5.6) and -0.360 (-2.8). However, in the presence of all control variables, country-dummy regression coefficients are both insignificant (Table 3), and country marginal effects are indistinguishable (Table 5). The reason, of course, must be found in the explanatory role of the additional control variables. For example, regression coefficients in equation (2) for individual productivity and the relative GDP *per capita* (the ratio of the log GDP *per capita* of the country of destination over the log GDP *per capita* of the country of origin) are both positive and significant (Table 3). But Chinese economists are on average 1.6 times more productive than Spanish ones, and Spain's GDP *per capita* is more than six times greater than China's (Table H). This could explain why China and Spain are conditionally indistinguishable in spite of being unconditionally very different. Nevertheless, in line with unconditional results, the average estimated probabilities of brain drain in China and Spain are 0.738 and 0.234 (Table J in Section SM5).

SM10. The case of Mexico and China

Mexico shares some basic characteristics with brain circulation countries, namely, a high percentage of brain circulation and a low percentage of stayers (Figure 1). However, its effect on the probability of becoming brain gained and its net marginal effect are greater than the Spanish ones (Tables 2 and 4). Moreover, Mexico is one of the eight countries with a positive net average probability which is indistinguishable from the Spanish one (Table J in Section SM5). In particular, two of the four Mexican institutions in our dataset –ITAM and CIDE– are capable of attracting a considerable proportion of foreigners. Since Mexico is not characterized by high values of our control variables, its good performance must be found, as in Spain, in unobservable. These might include relatively high salaries in ITAM, a private institution, as well as good governance practices both in ITAM and CIDE.

As far as China is concerned, note first that there are only 34 economists working in 2007 in two Chinese departments, Hong Kong University and Chinese University of Hong Kong. It is known that China has programs to attract their natives back home after attending graduate school abroad (Stephan, 2012, Jacob and Meek, 2013). Thus, it is not surprising that 67.6% of those working in these two departments are classified as brain circulation. In addition, since there are no stayers at all, the remaining 32.4% constitute brain gain (Figure 1). Thus, it turns out that the effect of China on the probability of becoming brain gained is greater than that of Spain (Table 2). Given that, as we saw above, the two country effects on the probability of becoming brain drained are indistinguishable, the net effect of China is also greater than the Spanish one. However, due to its large average probability of brain drain, the net average probability in China is negative and smaller than the Spanish one (Table J in Section SM6). In conclusion, if China pursues its policy of favoring brain circulation and brain gain, it might be eventually capable of offsetting its high percentage of brain drain, becoming an open country with a positive net gain.

SM11. Remarks on inbreeding

We define inbreeding as a situation in which an individual works in 2007 in the same institution where she obtains her Ph.D. (or her highest college degree if she did not have a Ph.D.). The percentage of inbreeding over the total of nationals working in their own country, i.e. the sum of brain circulation and stayers, is presented in Table Q. The following five comments are in order.

1. The U.S. has a relatively low percentage of inbreeding over a large number of nationals working there: 10.4%, well below the mean for the dataset that is equal to 23.2%.

2. Among open countries, the percentage of inbreeding in Canada and UK is considerably greater than in the U.S., whereas in Switzerland and Australia, with a low percentage of nationals, this percentage goes up to 57.1% and 58.8%.

3. Closed European countries, with a large proportion of stayers, exhibit the largest proportion of

inbreeding. Among the four small countries, the percentage of inbreeding ranges from 46.1% in Netherlands to 89.4% in Denmark. In Italy and France, it is 30.9% and 38%, whereas in Germany, where promotion usually requires changing universities, this percentage is only 24.7%.

4. Given their very low proportion of stayers, brain circulation countries have a low proportion of inbreeding, ranging from 0% in Turkey, Chile and China to 21.2% and 28.6% in Portugal and Israel.

5. Because the IAE and CEMFI do not grant Ph.Ds., the proportion of inbreeding in Spain is computed over the sum of brain circulation and stayers in the remaining four university departments. Nevertheless, this proportion –equal to 7.1%– is significantly lower than in the other large European continental countries, i.e. Germany, France, and Italy. Finally, in Mexico, with a very small proportion of stayers, the percentage of inbreeding is only 3.7%.

Table Q around here

References not included in the text

Azoulay, P., Zivin, J.G., and Wang, J. (2010). Superstar extinction. *The Quaterly Journal of Economics*, *125*: 549-589.

Borjas, G. (1989). Immigrant and emigrant earnings: A longitudinal study. *Economic Inquiry*, *27*: 21-37.

Borjas, G., and Bratberg, B. (1996). Who leaves? The Outmigration of the Foreign-born. *Review of Economics and Statistics*, *78*: 165-176.

Borjas, G., and Doran, K. (2015). Which peers matter? The relative impacts of collaborators, colleagues, and competitors. *The Review of Economics and Statistics*, *97*: 1104–1117.

Chinchilla-Rodriguez, Z., Miao, L., Murray, D., Robinsón-García, N., Costas, R., and Sugimoto, C. (2018). A global comparison of scientific mobility and collaboration according to national scientific capacities. *Frontiers in Research Metrics and Analytics*, https://www.frontiersin.org/journals/1268.

Combes, P. and L. Linnemer (2003). Where Are the Economists Who Publish? Publication Concentration and Rankings in Europe Based on Cumulative Publications. *Journal of the European Economic Association*, *1*, 1250-1308.

Coupé, T. (2003). Revealed performances: Worldwide ranking of economists and economic departments. *Journal of the European Economic Association*, *1*, 1309-1345.

Coupé, T., Smeets, V., and Warzynski, F. (2006). Incentives, Sorting and Productivity along the Career: Evidence from a Sample of Top Economists. *Journal of Law, Economics, & Organization*, *22*, 137-167.

Da Vanzo, J. S., and Morrison, P. A. (1981). Return and Sequences of Migration. *Demography*, *18*: 85-101.

Dubois, P., Rochet, J-C., and Schlenker, J-M. (2014). Productivity and Mobility in Academic Research: Evidence from Mathematicians. *Scientometrics*, *98*: 1669-1701.

Dustmann, C., Fadlon, I, and Weiss, Y. (2011). Return migration, human capital accumulation, and the brain drain, *Journal of Development Economics*, *95*: 58-67.

Gaulé, P. (2014). Who Comes Back and When? Return Migration Decisions of Academic Scientists. *Economic Letters*, *124*: 461-464.

Grogger, J., and Hanson, G. (2013). Attracting talent: Location Choices of Foreign-Born PHDS in the U.S. Journal of Labor Economics, 33:

Han Kim, E., Morse, A., and Zingales, L. (2009). Are Elite Universities Losing their Competitive Edge? *Journal of Financial Economics*, *93*: 353-381.

Khan, S. and MacGarvie, M. (2016). How Important is U.S. Location for Research in Science? ", Working Paper, Boston University, forthcoming in *Review of Economics and Statistic, 98:* 397-414..

Lam, K. (1986). Imprefect Information, Specificity of Schooling, and Rate of Return Migration. *Economic Letters*, *21*: 283-289.

McDowell, J., and Singell, L. (2000). Productivity of Highly Skilled Immigrants: Economists in the Postwar Period. *Economic Inquiry*, *38*: 672-684.

Oster, S., and Hammermesch, D. (1998). Aging and Productivity Among Economists. *The Review of Economics and Statistics*, *80*: 154-156.

Ramos, F. (1992). Out-Migration and Return Migration of Puerto Ricans", in *Immigration and the Work Force: Economic Consequences for the United States and Source Areas*, edited by G. Borjas and R. Freeeman, Chicago: Chicago University Press.

Rauber, M. and H. W. Ursprung (2008). Life cycle and cohort productivity in economic research: The Case of Germany. *German Economic Review*, *9*: 431-456.

Robinson-García, N., Sugimoto, C. R., Murray, D., Yegros-Yegros, A., Larivière, V., and Costas, R. (2018). *The Many Faces of Mobility: Using Bibliometric Data to Track Scientific Exchanges*. arxiv:1803.03449 [Cs]. Available online at: http://arxiv.org/abs/1803.03449.

Ruiz-Castillo, J., and Costas, R. (2014). The skewness of scientific productivity. *Journal of Informetrics*, *8*, 917-934.

Scott, C.E., and Siegfried, J.J. (2008). American Economic Association Universal Academic Questionnaire Summary Statistics. *American Economic Review*, *98*, 630-33.

Sugimoto, C. R., Robinson-García, N., Murray, D. R., Yegros-Yegros, A., Costas, R., and Lariviere, V. (2017). Scientists have most impact when they are free to move. *Nature* 32, 29–31.

Waldinger, F. (2012), "Peer effects in science: evidence from the dismissal of scientists in Nazi Germany", *Review of Economic Studies*, *79*, 838-861.

Waltman, L., and Van Eck, N.J. (2015). Field normalized citation impact indicators and the choice of an appropriate counting method. *Journal of Informetrics, 9*, 872-894.

APPENDIX

Table M. Estimated coefficients of the probability of becoming brain gained and brain drained as a function of country dummies without controls for individual, departmental and other country characteristics

	BRAIN GAINED		BRAIN DRAINED	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**
U.S.	0.972	8.6	-0.972	-10.7
UK	1.317	10.2	0.183	1.7
Canada	1.628	10.5	0.742	5.6
Australia	1.604	7.5	0.614	2.9
Switzerland	1.826	6.4	0.759	2.6
Germany	0.472	2.7	0.450	3.7
France	0.140	0.9	-0.354	-3.1
Italy	-0.920	-3.6	0.111	1.1
Spain	0.719	4.9	-0.360	-2.8
Netherlands	0.432	2.6	-0.616	-4.0
Belgium	0.269	1.7	-0.450	-3.3
Sweeden	0.536	2.0	0.120	0.6
Denmark	0.548	2.7	-0.253	-1.4
Israel	0.243	0.9	0.571	3.6
México	0.884	4.0	-0.370	-1.5
China	0.631	2.4	0.923	5.6
Constant*	-1.210	-11.1	-0.373	-5.2
N	3,540		3,253	
Pseudo R^2	0.101		0.142	

*** Greece, Portugal, Turkey, Brazil, Argentina, Chile.**

Table N. Explanatory variables and descriptive statistics: mean values (standard deviations)

	Individuals working in each country	Nationals from each country
<u>Country variables</u>:		
U.S.	1,600	1,043
UK	319	252
Canada	139	132
Australia	49	42
Switzerland	26	20
Germany	100	164
France	218	245
Italy	181	295
Spain	183	164
Netherlands	133	124
Belgium	150	156
Sweden	32	40
Denmark	63	64
Israel	42	83
China	32	79
Mexico	43	35
Other *	230	316
Experience	18.9 (12.0)	19.2 (12.0)
Female	0.15 (0.36)	0.15 (0.36)
<u>% Ph.D. in</u>:		
Harvard & MIT	0.11 (0.31)	0.11 (0.32)
Next eight U.S	0.24 (0.43)	0.25 (0.43)
Next 15 U.S	0.15 (0.36)	0.14 (0.35)
Next 27 U.S	0.06 (0.24)	0.06 (0.24)
Other U.S	0.02 (0.14)	0.02 (0.13)
UK, Canada, Australia	0.12 (0.33)	0.12 (0.33)
Rest of Europe and Israel	0.27 (0.44)	0.28 (0.45)
Rest of the World	0.01 (0.11)	0.01 (0.10)
Mean *Q* index	250.0 (369.2)	251.5 (368.2)
Department mean *Q*	250.0 (192.5)	246.5 (191.8)
Total number	**3,540**	**3,253**

*** Greece, Portugal, Turkey, Brazil, Argentina, China**

Table O. Mean values (standard deviations) for individuals working in the different countries

	% Ph.D in:											
	Harvard & MIT	**Next 8 U.S.**	**Next 15 U.S.**	**Next 27 U.S.**	**Other U.S.**	**UK, Can. Australia**	**Rest of Europe & Israel**	**Rest of the world**	**Years of experience**	**% female**	***Q* index**	**GDP *per capita***
U.S.	0.20	0.38	0.21	0.10	0.02	0.05	0.03	0.00	21.76	0.14	387.71	47,954.48
	(0.40)	(0.49)	(0.41)	(0.30)	(0.15)	(0.21)	(0.18)	(0.05)	(13.16)	(0.34)	(462.54)	
Open countries												
UK	0.04	0.15	0.07	0.02	0.03	0.55	0.12	0.02	17.67	0.16	230.33	36,434.70
	(0.21)	(0.36)	(0.25)	(0.15)	(0.18)	(0.50)	(0.32)	(0.12)	(11.41)	(0.37)	(290.09)	
CANADA	0.04	0.40	0.21	0.07	0.01	0.19	0.07	0.01	19.28	0.11	214.91	39,201.91
	(0.19)	(0.49)	(0.41)	(0.26)	(0.12)	(0.39)	(0.26)	(0.08)	(11.51)	(0.31)	(226.31)	
AUSTRALIA	0.02	0.08	0.18	0.10	0.06	0.47	0.06	0.02	17.63	0.20	134.61	39,431.61
	(0.14)	(0.28)	(0.39)	(0.31)	(0.24)	(0.50)	(0.24)	(0.14)	(10.33)	(0.41)	(206.50)	
SWITZERLAND	0.00	0.12	0.00	0.00	0.00	0.15	0.73	0.00	17.08	0.12	183.31	51,355.20
	(0.00)	(0.33)	(0.00)	(0.00)	(0.00)	(0.37)	(0.45)	(0.00)	(10.84)	(0.33)	(244.90)	
Mixed countries												
MÉXICO	0.00	0.16	0.30	0.21	0.09	0.07	0.14	0.02	12.63	0.09	30.88	15,398.49
	(0.00)	(0.37)	(0.46)	(0.41)	(0.29)	(0.26)	0.35)	(0.15)	(7.14)	(0.29)	(51.41)	
SPAIN	0.05	0.11	0.19	0.02	0.02	0.13	0.47	0.01	13.68	0.22	98.32	32,736.00
	(0.23)	(0.32)	(0.39)	(0.15)	(0.13)	(0.34)	0.50)	(0.07)	(8.91)	(0.41)	(139.91)	
CHINA	0.03	0.34	0.25	0.06	0.06	0.25	0.00	0.00	13.91	0.03	130.16	6,820.60
	(0.18)	(0.48)	(0.44)	(0.25)	(0.25)	(0.44)	(0.00)	(0.00)	(7.78)	(0.18)	(120.84)	
Closed countries												
BELGIUM	0.02	0.08	0.04	0.03	0.01	0.03	0.78	0.00	16.57	0.20	91.15	39,084.10
	(0.14)	(0.27)	(0.20)	(0.18)	(0.12)	(0.18)	(0.42)	(0.00)	(9.98)	(0.40)	(133.03)	
NETHERLANDS	0.07	0.07	0.07	0.03	0.00	0.14	0.59	0.03	15.8	0.08	162.7	44,065.70
	(0.26)	(0.26)	(0.26)	(0.18)	(0.00)	(0.35)	(0.50)	(0.18)	(9.20)	(0.28)	(180.6)	
DENMARK	0.02	0.00	0.00	0.05	0.00	0.03	0.90	0.00	16.52	0.11	101.13	42,538.18
	(0.13)	(0.00)	(0.00)	(0.21)	(0.00)	(0.18)	(0.30)	(0.00)	(11.00)	(0.32)	(113.21)	
SWEEDEN	0.00	0.09	0.06	0.00	0.00	0.13	0.72	0.00	14.91	0.22	168.81	41,459.80
	(0.00)	(0.30)	(0.25)	(0.00)	(0.00)	0.34)	(0.46)	0.00)	(9.37)	(0.42)	(246.47)	
GERMANY	0.04	0.05	0.03	0.01	0.02	0.04	0.81	0.00	17.70	0.15	148.35	39,345.40
	(0.20)	(0.22)	(0.17)	(0.10)	0.14)	(0.20)	(0.39)	(0.00)	(11.82)	(0.36)	(174.76)	
FRANCE	0.03	0.04	0.00	0.01	0.00	0.04	0.87	0.00	16.15	0.22	113.49	36,724.59
	(0.16)	(0.19)	(0.07)	(0.12)	(0.07)	(0.19)	(0.34)	(0.07)	(9.24)	(0.42)	(242.11)	
ITALY	0.03	0.07	0.03	0.01	0.01	0.17	0.67	0.01	17.37	0.18	55.69	36,050.39
	(0.18)	(0.26)	(0.16)	(0.07)	(0.10)	(0.38)	(0.47)	(0.07)	(10.55)	(0.39)	(104.63)	
Brain circulation countries												
GREECE	0.00	0.05	0.20	0.00	0.05	0.47	0.20	0.03	18.98	0.13	70.32	31,125.31
	(0.00)	(0.22)	(0.41)	(0.00)	(0.22)	(0.51)	(0.41)	(0.16)	(7.24)	(0.33)	(71.67)	
PORTUGAL	0.14	0.14	0.27	0.00	0.03	0.00	0.43	0.00	13.43	0.27	61.59	25,794.51
	(0.35)	(0.35)	(0.45)	(0.00)	(0.16)	(0.00)	(0.50)	0.00)	(6.93)	(0.45)	(60.51)	
TURKEY	0.02	0.17	0.30	0.21	0.04	0.09	0.09	0.09	14.32	0.26	48.02	16,289.31
	(0.15)	(0.38)	(0.46)	(0.41)	(0.20)	(0.28)	(0.28)	0.28)	(9.57)	(0.44)	(40.21)	
BRAZIL	0.07	0.30	0.13	0.02	0.00	0.02	0.02	0.43	14.61	0.09	60.61	12,606.80
	(0.25)	(0.47)	(0.34)	(0.15)	(0.00)	(0.15)	(0.15)	0.50)	(10.05)	(0.28)	83.20)	
ARGENTINA	0.16	0.16	0.32	0.00	0.00	0.11	0.16	0.11	14.32	0.16	72.21	17,128.60
	(0.37)	(0.37)	(0.48)	(0.00)	(0.00)	(0.32)	(0.37)	0.32)	(10.76)	(0.37)	(80.13)	
CHILE	0.15	0.34	0.27	0.07	0.00	0.10	0.05	0.02	16.46	0.05	34.41	17,483.89
	(0.36)	(0.48)	(0.45)	(0.26)	(0.00)	(0.30)	(0.22)	(0.16)	(10.95)	(0.22)	(37.11)	
ISRAEL	0.14	0.36	0.10	0.00	0.00	0.02	0.38	0.00	24.83	0.05	390.02	26,848.51
	(0.35)	(0.48)	(0.30)	(0.00)	(0.00)	(0.15)	(0.49)	(0.00)	(13.07)	(0.22)	(334.33)	
TOTAL	0.11	0.24	0.15	0.06	0.02	0.12	0.27	0.01	18.9	0.15	249.9	
	(0.31)	(0.43)	(0.36)	(0.24)	(0.14)	(0.33)	0.44)	(0.11)	(12.0)	(0.36)	(369.2)	

Table P. Mean values (standard deviations) for individuals born in the different countries

	% Ph.D in:											
	Harvard & MIT.	**Next 8 U.S.**	**Next 15 U.S.**	**Next 27 U.S.**	**Other U.S.**	**UK, Can. Australia**	**Rest of Europe & Israel**	**Rest of the world**	**Years of experience**	**% female**	***Q* index**	**GDP *per capita***
U.S.	0.23	0.39	0.21	0.12	0.03	0.01	0.00	0.00	5.02		409.24	47,954.48
	(0.42)	(0.49)	(0.41)	(0.32)	(0.18)	(0.11)	(0.06)	(0.03)	(12.63)		(487.18)	
Open countries												
UK	0.06	0.14	0.04	0.02	0.00	0.67	0.08	0.00	21.99	0.10	316.77	36,434.70
	(0.24)	(0.35)	(0.19)	(0.13)	(0.00)	(0.47)	(0.27)	(0.06)	(11.52)	(0.30)	(359.79)	
CANADA	0.05	0.42	0.19	0.08	0.01	0.25	0.00	0.00	23.88	0.13	379.75	39,201.91
	(0.21)	(0.50)	(0.39)	(0.28)	(0.09)	(0.43)	(0.00)	(0.00)	(11.83)	(0.34)	(350.79)	
AUSTRALIA	0.12	0.19	0.05	0.05	0.02	0.55	0.00	0.02	20.95	0.14	205.14	39,431.61
	(0.33)	(0.40)	(0.22)	(0.22)	(0.15)	(0.50)	(0.00)	(0.15)	(10.49)	(0.35)	(214.37)	
SWITZERLAND	0.00	0.05	0.00	0.00	0.00	0.15	0.80	0.00	16.45	0.10	139.10	51,355.20
	(0.00)	(0.22)	(0.00)	(0.00)	(0.00)	(0.37)	(0.41)	(0.00)	(14.76)	(0.31)	(200.56)	
Mixed countries												
MÉXICO	0.03	0.17	0.29	0.17	0.09	0.09	0.14	0.03	12.77	0.09	42.06	15,398.49
	(0.17)	(0.38)	(0.46)	(0.38)	(0.28)	(0.28)	(0.36)	(0.17)	(8.15)	(0.28)	(90.95)	
SPAIN	0.09	0.12	0.19	0.01	0.02	0.14	0.44	0.01	14.93	0.23	119.77	32,736.00
	(0.28)	(0.32)	(0.39)	(0.08)	(0.13)	(0.35)	(0.50)	(0.08)	(8.70)	(0.42)	(156.56)	
CHINA	0.08	0.33	0.29	0.11	0.03	0.15	0.01	0.00	13.11	0.16	196.53	6,820.60
	(0.27)	(0.47)	(0.46)	(0.32)	(0.16)	(0.36)	(0.11)	(0.00)	(8.92)	(0.37)	(197.70)	
Closed countries												
BELGIUM	0.03	0.12	0.04	0.03	0.01	0.03	0.74	0.00	16.51	0.17	116.61	39,084.10
	(0.16)	(0.33)	(0.21)	(0.16)	(0.11)	(0.18)	(0.44)	(0.00)	(10.02)	(0.37)	(173.39)	
NETHERLANDS	0.02	0.05	0.01	0.02	0.00	0.06	0.85	0.00	16.84	0.07	189.29	44,065.70
	(0.13)	(0.22)	(0.09)	(0.15)	(0.00)	(0.23)	(0.36)	(0.00)	(8.83)	(0.26)	(192.56)	
DENMARK	0.02	0.03	0.06	0.02	0.00	0.05	0.83	0.00	15.02	0.11	106.41	42,538.18
	(0.13)	(0.18)	(0.24)	(0.13)	(0.00)	(0.21)	(0.38)	(0.00)	(10.71)	(0.31)	(126.32)	
SWEEDEN	0.00	(0.13)	0.08	0.00	0.00	0.05	0.75	0.00	16.25	0.20	230.00	41,459.80
	(0.00)	(0.33)	(0.27)	(0.00)	(0.00)	(0.22)	(0.44)	(0.00)	(8.55)	(0.41)	(352.91)	
GERMANY	0.04	0.18	0.05	0.02	0.02	0.07	0.62	0.00	13.37	0.17	136.07	39,345.40
	(0.19)	(0.39)	(0.22)	(0.13)	(0.13)	(0.26)	(0.49)	(0.00)	(10.08)	(0.38)	(154.53)	
FRANCE	0.06	0.05	0.00	0.02	0.00	0.03	0.83	0.00	15.71	0.20	156.05	36,724.59
	(0.24)	(0.22)	(0.06)	(0.14)	(0.06)	(0.18)	(0.38)	(0.00)	(9.48)	(0.40)	(307.49)	
ITALY	0.06	0.19	0.06	0.02	0.01	0.18	0.48	0.00	14.40	0.21	95.48	36,050.39
	(0.23)	(0.39)	(0.23)	(0.14)	(0.08)	(0.38)	(0.50)	(0.06)	(9.95)	(0.41)	(166.31)	
Brain circulation countries												
GREECE	0.02	0.06	0.25	0.06	0.04	0.38	0.19	0.00	17.69	0.10	108.63	31,125.31
	(0.14)	(0.24)	(0.44)	(0.24)	(0.20)	(0.49)	(0.39)	(0.00)	(9.03)	(0.31)	(135.67)	
PORTUGAL	0.09	0.12	0.40	0.00	0.02	0.02	0.35	0.00	13.51	0.30	85.65	25,794.51
	(0.29)	(0.32)	(0.49)	(0.00)	(0.15)	(0.15)	(0.48)	(0.00)	(6.43)	(0.46)	(121.26)	
TURKEY	0.01	0.25	0.37	0.18	0.03	0.07	0.04	0.04	11.48	0.24	97.23	16,289.31
	(0.12)	(0.44)	(0.49)	(0.39)	(0.17)	(0.26)	(0.20)	(0.20)	(8.63)	(0.43)	(149.02)	
BRAZIL	0.05	0.39	0.16	0.02	0.00	0.02	0.03	0.34	12.85	0.11	77.35	12,606.80
	(0.22)	(0.49)	(0.37)	(0.13)	(0.00)	(0.13)	(0.18)	(0.48)	(9.93)	(0.32)	(146.60)	
ARGENTINA	0.09	0.27	0.41	0.05	0.00	0.07	0.07	0.05	13.00	0.14	128.45	17,128.60
	(0.29)	(0.45)	(0.50)	(0.21)	(0.00)	(0.25)	(0.25)	(0.21)	(10.62)	(0.35)	(159.54)	
CHILE	0.17	0.33	0.23	0.06	0.00	0.10	0.06	0.04	14.69	0.06	87.75	17,483.89
	(0.38)	(0.48)	(0.42)	(0.24)	(0.00)	(0.31)	(0.24)	(0.20)	(10.48)	(0.24)	(230.32)	
ISRAEL	0.20	0.40	0.13	0.00	0.00	0.00	0.27	0.00	21.53	0.10	439.02	26,848.51
	(0.41)	(0.49)	(0.34)	(0.00)	(0.00)	(0.00)	(0.44)	(0.00)	(13.11)	(0.30)	(441.49)	
TOTAL	0.11	0.24	0.14	0.06	0.02	0.12	0.28	0.01	19.2	0.15	251.4	
	(0.32)	(0.43)	(0.35)	(0.24)	(0.13)	(0.33)	(0.45)	(0.10)	(12.0)	(0.36)	(369.2)	

Table S. Percentage distribution of foreigners by years of experience

	≤ 6 years	7 – 12	> 12	Total	Average
U.S.	26.8	20.2	53.0	100.0	16.2
UK	27.2	33.5	39.3	100.0	13.1
Canada	16.3	28.3	55.4	100.0	16.2
Australia	18.8	28.1	53.1	100.0	13.8
Switzerland	10.5	36.9	52.6	100.0	14.3
Germany	8.7	26.1	65.2	100.0	19.9
France	9.7	32.2	58.1	100.0	16.6
Netherlands	48.3	24.1	27.6	100.0	10.9
Belgium	15.4	26.9	57.7	100.0	13.7
Sweden	62.5	12.5	25.0	100.0	8.4
Denmark	31.2	25.0	43.8	100.0	14.2
Israel	0.0	14.3	85.7	100.0	31.3
China	11.1	11.1	77.8	100.0	16.7
México	12.5	56.2	31.3	100.0	11.0
Spain	45.6	35.1	19.3	100.0	8.3

Table A. Econphd ranking, number of individuals and mean productivity in each institution in all countries

	Econphd	Institution	Number of individuals	Mean productivity
1. U.S.				
	1	Harvard University	57	906.8
	2	University of Chicago	35	643.0
	3	MIT	40	907.6
	4	U. of California, Berkeley	57	541.9
	5	Princeton University	50	637.0
	6	Stanford University	48	564.2
	7	Northwestern University	34	488.4
	8	University of Pennsylvania	31	527.3
	9	Yale University	36	648.5
	10	New York University	47	619.5
	11	University of California, LA	44	330.0
	13	Columbia University	45	561.6
	14	University of Wisconsin, Madison	25	304.3
	15	Cornell University	31	441.9
	16	University of Michigan	48	316.1
	17	University of Maryland	37	306.3
	18	University of Texas, Austin	31	298.5
	21	University of California, San Diego	37	379.6
	22	University of Rochester	16	262.6
	23	Ohio State University	37	305.5
	25	University of Illinois, Urbana	25	207.8
	26	Boston University	34	318.9
	27	Brown University	25	351.5
	28	University of California, Davis	30	207.9
	29	University of Minnesota	23	361.1
	32	University of Southern California	27	346.9
	33	Michigan State University	43	241.7
	35	Duke University	44	291.8
	38	PA State University	22	254.8
	40	Carnegie Mellon University	23	255.5
	41	University of North Carolina	23	160.8
	42	Boston College	25	280.4
	43	California Institute of Technology	17	384.1
	44	Texas A and M	24	217.3
	49	University of Indiana	24	166.9
	51	Johns Hopkins	14	442.4
	52	Rutgers University	32	162.9
	53	University of Virginia	28	211.9
	54	Vanderbilt University	33	297.5
	55	Georgetown University	23	212.0

	56	Arizona State University	25	295.6
	57	University of Arizona	19	178.9
	58	Dartmouth College	27	178.2
	60	University of Washington	24	348.6
	62	Iowa State University	44	173.0
	63	Washington University, St Louis	29	359.8
	67	Purdue University	15	211.0
	70	University of Pittsburgh	20	202.2
	72	University of Iowa	15	248.0
	75	Rice University	18	307.6
	77	University of California, Irvine	22	187.2
	78	University of Florida	17	215.4
Total			**1,600**	**387.7**
Mean department size			**30.7**	
2. UK				
	12	London School of Economics	52	294.3
	31	Oxford University	44	316.8
	34	University of Warwick	42	262.2
	39	Cambridge University	32	226.1
	47	University College London	33	308.3
	48	University of Essex	28	141.2
	65	University of York	41	96.7
	68	University of Nottingham	47	167.8
Total			**319**	**230.3**
Mean department size			**39.7**	
3. GERMANY				
	81	University of Bonn	21	266.0
	89	Humboldt University	14	101.5
	94	University of Mannheim	19	106.4
	115	University of Munich	22	123.5
	172	Free University of Berlin	15	159.7
	252	University of Heidelberg	9	77.1
Total			**100**	**148.3**
Mean department size			**16.7**	
4. FRANCE				
	18	Toulouse University	78	171.8
	93	Paris I University	73	63.9
	97	Ecole Nationale de Ponts et Chaussees	10	158.9
	143	University Cergy-Pontoise	23	57.6
	160	Aix-en-Provenze University, Marseille II	34	110.5
Total			**218**	**113.5**
Mean department size			**43.6**	

5. ITALY				
	101	Bocconi University	23	151.0
	206	University of Bologna	70	44.1
	217	University of Venezia	11	80.5
	263	University of Padova	59	28.6
		University of Roma, Tor Vergata	18	52.7
Total			**163**	**55.7**
Mean department size			**32.6**	
6. SPAIN				
	46	University Carlos III, Spain	51	84.9
	66	University Pompeu Fabra	36	133.8
	79	University Autonoma, Barcelona	33	87.7
	132	University of Alicante	31	56.5
	189	CEMFI	10	195.7
		IAE	22	102.1
Total			**183**	**98.3**
Mean department size			**30.5**	
7. NETHERLANDS				
	24	Tilburg University	52	197.3
	37	University of Amsterdam	38	128.2
	73	Erasmus University	21	181.7
	80	Free University of Amsterdam	22	122.4
Total			**133**	**162.7**
Mean department size			**33.2**	
8. BELGIUM				
	76	Catholic University of Louvain	40	144.8
	134	Free University of Brussels	35	86.2
	139	KU Leuven	75	64.8
Total			**150**	**91.1**
Mean department size			**50**	
9. SWEEDEN				
	59	Stockholm University	18	151.8
	71	Stockholm School of Economics	14	190.7
Total			**32**	**168.8**
Mean department size			**16**	
10. DENMARK				
	74	University of Copenhagen	43	89.4
	147	University of Aarhus	20	126.4
Total			**63**	**101.1**
Mean department size			**31.5**	

11. PORTUGAL				
	201	University Nova de Lisboa	26	61.1
	321	Catholic University of Portugal	11	62.7
Total			**37**	**61.6**
Mean department size			**18.5**	
12. GREECE				
	181	Athens University	23	90.8
		University of Creta	17	42.6
Total			**40**	**70.3**
Mean department size			**20.2**	
13. SWITZERLAND				
	99	University of Zurich	9	356.1
	215	University of St. Gallen	17	91.8
Total			**26**	**183.3**
Mean department size			**13**	
14. ISRAEL				
	30	University of Tel Aviv	16	401.6
	50	Hebrew University	26	382.9
Total			**42**	**390.0**
Mean department size			**21**	
15. TURKEY				
	199	Bilkent University	21	51.8
	249	Koc University	10	49.5
		Sabanci University	8	64.5
		Bogazi University	8	19.8
Total			**39**	**48.0**
Mean department size			**9.7**	
16. CANADA				
	20	University of British Columbia	27	243.0
	36	University of Toronto	45	207.3
	61	Queen's University	23	249.5
	64	University of Montreal	22	182.1
	103	University of Western Ontario	22	192.8
Total			**139**	**214.9**
Mean department size			**27.8**	
17. AUSTRALIA				
	84	Australian National University	17	87.9
	124	University of South Wales	32	159.4
Total			**49**	**134.6**
Mean department size			**24.5**	

18. CHINA				
	69	Hong Kong University	14	165.8
	85	Chinese University of Hong Kong	18	102.4
Total			**32**	**130.1**
Mean department size			**17**	
19. MÉXICO				
	187	ITAM	19	51.8
		CIDE, Mexico	6	32.5
		University of Guanajuato, Mexico	8	8.6
		University Autonoma de Nuevo Leon	10	8.0
Total			**43**	**30.9**
Mean department size			**11**	
20. BRAZIL				
	277	Getulio Vargas Sao Paulo	18	87.6
	277	Getulio Vargas Rio	12	51.1
		PUC Rio	16	37.4
Total			**46**	**60.6**
Mean department size			**15.3**	
21. ARGENTINA				
	306	University Torcuato di Tella	11	91.7
		University of San Andres	8	45.4
Total			**19**	**72.2**
Mean department size			**9.5**	
22. CHILE				
	230	University of Chile	19	34.5
		University Catolica of Chile	22	34.3
Total			**41**	**34.3**
Mean department size			**20.5**	
TOTAL SAMPLE			**3,541**	**250.0**
Mean department size			**28.3**	

Table B. Partition of the economists working in 2007 in each country into brain gain, brain circulation, and stayers

	NUMBER OF INDIVIDUALS				PERCENTAGES			
	Brain gain	Brain circ.	Stayers	Total	Brain gain	Brain circ.	Stayers	Total
U.S.	649	9	942	1,600	40.6	0.6	58.8	100.0
Open countries								
UK	173	21	125	319	54.4	6.6	39.0	100.0
CANADA	92	34	13	139	66.2	24.5	9.3	100.0
AUSTRALIA	32	8	9	49	65.3	16.3	18.4	100.0
SWITZERLAND	19	3	4	26	73.1	11.5	15.4	100.0
Mixed countries								
MÉXICO	16	26	1	43	38.6	59.1	2.3	100.0
SPAIN	57	74	52	183	31.1	40.4	28.4	100.0
CHINA	9	23	0	32	32.2	67.6	0.0	100.0
Closed countries								
BELGIUM	26	33	91	150	17.3	22.0	60.7	100.0
NETHERLANDS	29	15	89	133	21.8	11.3	66.9	100.0
DENMARK	16	4	43	63	25.4	6.3	68.2	100.0
SWEDEN	8	5	19	32	25.0	15.6	59.4	100.0
GERMANY	23	15	62	100	23.0	15.0	62.0	100.0
FRANCE	31	20	167	218	14.2	9.2	76.6	100.0
ITALY	3	72	106	181	1.7	39.8	58.6	100.0
Brain circulation countries								
GREECE	7	27	6	40	17.5	67.5	15.0	100.0
PORTUGAL	4	25	8	37	10.8	67.6	21.6	100.0
TURKEY	6	38	3	47	12.8	80.0	6.4	100.0
BRAZIL	2	25	19	46	4.2	54.3	41.3	100.0
ARGENTINA	2	15	2	19	10.5	78.9	10.5	100.0
CHILE	5	35	1	41	12.2	85.4	2.4	100.0
ISRAEL	7	19	16	42	16.7	45.2	38.1	100.0
TOTAL	1,216	546	1,778	3,540	34.4	15.4	50.2	100.0

Table C. Partition of individuals born in each country into brain drain, brain circulation, and stayers. Net gain = brain gain – brain drain in each country, and percentage of net gain over the nationals working in each country = brain circulation + stayers

	NUMBER OF INDIVIDUALS				PERCENTAGES			
	Brain. drain	Brain. circulation	Stayers	Total	Brain drain	Brain circulation	Stayers	Total
U.S.	92	9	942	1,043	8.9	0.9	90.2	100.0
Open countries								
UK	106	21	125	252	42.5	8.3	49.2	100.0
CANADA	85	34	13	132	64.4	25.8	9.8	100.0
AUSTRALIA	25	8	9	42	59.5	19.0	21.4	100.0
SWITZERLAND	13	3	4	20	65.0	15.0	20.0	100.0
Other countries								
MÉXICO	8	26	1	35	22.9	74.3	2.9	100.0
SPAIN	38	74	52	164	23.2	45.1	31.7	100.0
CHINA	56	23	0	79	70.9	29.1	0.0	100.0
Closed countries								
BELGIUM	32	33	91	156	20.5	21.2	58.3	100.0
NETHERLANDS	20	15	89	124	16.1	12.1	71.8	100.0
DENMARK	17	4	43	64	26.6	6.2	67.2	100.0
SWEDEN	16	5	19	40	40.0	12.5	47.5	100.0
GERMANY	87	15	62	164	53.0	9.1	37.7	100.0
FRANCE	58	20	167	245	23.7	8.2	68.2	100.0
ITALY	117	72	106	295	39.7	24.4	35.9	100.0
Brain circulation countries								
GREECE	15	27	6	48	31.2	56.2	12.5	100.0
PORTUGAL	10	25	8	43	23.3	58.1	18.6	100.0
TURKEY	30	38	3	71	42.2	53.5	4.2	100.0
BRAZIL	18	25	19	62	29.0	40.3	30.6	100.0
ARGENTINA	27	15	2	44	61.4	34.1	4.5	100.0
CHILE	12	35	1	48	26.0	72.9	2.1	100.0
ISRAEL	48	19	16	83	57.8	22.9	19.3	100.0
TOTAL	929	546	1,778	3,253	28.6	16.8	54.6	100.0

Table D. Percentage of brain gain, brain drain, and net gain over the nationals (brain circulation + stayers) working in 2007 in each country

	% Brain gain (1)	% Brain drain (2)	% Net gain (3) = (1) - (2)
U.S.	68.2	9.7	58.5
Open countries			
UK	118.5	72.6	45.9
CANADA	198.7	180.8	17.9
AUSTRALIA	188.2	147.0	41.2
SWITZERLAND	271.4	185.7	85.7
Mixed countries			
MÉXICO	59.2	29.6	29.6
SPAIN	45.2	30.1	15.1
CHINA	39.1	243.5	-204.4
Closed countries			
BELGIUM	20.1	25.8	-5.7
NETHERLANDS	27.9	19.2	8.7
DENMARK	34.0	36.1	-2.1
SWEDEN	33.3	66.7	-33.4
GERMANY	29.9	112.9	-83.0
FRANCE	16.6	30.5	-13.9
ITALY	1.7	65.7	-64.0
Brain circulation countries			
GREECE	21.2	45.4	-24.2
PORTUGAL	12.1	30.3	-18.2
TURKEY	14.6	73.2	-58.6
BRAZIL	4.5	40.9	-36.4
ARGENTINA	11.8	158.8	-147.0
CHILE	13.9	33.3	-19.4
ISRAEL	20.0	137.1	-117.1
TOTAL	52.3	40.0	12.3

Table E. Partition of individuals born in three geographical areas into the five country types

	NUMBER OF INDIVIDUALS BORN IN:				PERCENTAGES			
	Non-U.S. sample countries	U.S.	Rest of the World	Total	Non-U.S. sample countries	U.S.	Rest of the World	Total
U.S.	495	-	154	649	59.1	-	53.7	53.4
Open countries	176	54	86	316	21.0	58.7	30.0	26.0
Mixed countries	55	11	16	82	6.6	12.0	5.6	6.7
Closed countries	95	23	22	140	11.4	25.0	7.6	11.5
Brain circulation countries	16	4	9	29	1.9	4.3	3.1	2.4
Total	**837**	**92**	**287**	**1,216**	**100.0**	**100.0**	**100.0**	**100.0**

Table F. Mobility patterns for 16 countries in 2011. Tables 1 and 2 in Franzoni *et al.* (2015)

	Number of respondents	**% of workers and students: Foreign-born**	**Returnees**	**Stayers**	**Nº of nationals**	**% of brain drain**
U.S.	4,518	38.4	9.3	52.3	2,924	5.0
Open countries						
UK	1,205	32.9	27.9	39.2	1,090	25.1
Canada	902	46.9	29.8	23.3	613	23.7
Australia	629	44.5	30.2	25.3	418	18.3
Switzerland	330	56.7	29.4	13.9	330	33.1
Sweden	314	37.6	29.0	33.4	226	13.9
Closed countries						
Germany	1,187	23.2	34.9	41.9	1,254	23.3
France	1,380	17.3	43.8	38.9	1,303	13.2
Italy	1,792	3.0	27.3	69.7	1,938	16.2
Netherlands	347	27.7	26.2	46.1	339	26.4
Belgium	253	18.2	32.4	49.4	261	21.7
Denmark	206	21.8	36.9	41.3	183	13.3
Japan	1,707	5.0	37.3	57.7	1,676	3.1
Other countries						
Spain	1,185	7.3	55.3	37.4	1,175	8.4
Brazil	702	7.1	43.3	49.6	700	8.3
India	525	0.8	57.9	41.3	806	39.8
Total	17,182	24.0	29.4	46.6	15,115	

Table G. Descriptive statistics. Explanatory variables

	Mean	Std. Dev.
Dependent variable: Log *Q*	4.524	1.65
Demographic variables		
Exp	18.9	12.0
DUMMY VARIABLES	**Number of observations**	**% of the total**
1. *Young*	2,092	59.2
2. *Old*, Reference group	1,448	40.8
1. *Female*	531	15.0
2. *Male*, Reference group	3,009	85.0
Education variables		
1. *B.A. = Non-sample countries*	873	24.7
2. *B.A. = Sample countries*, Reference group	2,667	75.3
1. *Ph.D. = Harvard* & *MIT*	397	11.2
2. *Ph.D. = Other Top 10 U.S.*	870	24.6
3. *Ph.D. = Next* 15 *U.S.*	531	15.0
4. *Ph.D. = Next* 27 *U.S.*	228	6.5
5. *Ph.D. = Other U.S.*	73	2.1
6. *Ph.D. = Open countries*	444	12.6
7. *Ph.D. = Closed countries and Israel*	77	2.2
8. *Ph.D. = Rest of the World*, Reference group		
Mobility variables		
1. *Foreigners*	1,216	34.4
2. *Brain circulation*	971	27.4
3. *Stayers in the 15 departments in brain circulation countries except Israel*, Reference group	1,353	38.2
Mobility variables within department categories		
1. *U.S. Brain circulation in all U.S. departments*∫	9	0.002
2. *Foreigners in Top 25 U.S. departments*	389	11.0
3. *U.S. Stayers in Top 25 U.S. departments*	528	14.9
4. *Foreigners in Next 27 U.S. departments*	260	7.3
5. *U.S. Stayers in Next 27 U.S. departments*	414	11.7
6. *Foreigners in Top 15 non-U.S. departments*	227	6.4
7. *Brain circulation in Top 15 non-U.S. departments*	257	7.3
8. *Stayers in Top 15 non-U.S. departments*	98	2.8
9. *Foreigners in Bottom 43 non-U.S. departments*	314	8.9
10. *Brain circulation in Bottom 43 non-U.S. departments*	540	15.2
11. *Stayers in Bottom 43 non-U.S. departments*	274	7.7
12. *Foreigners in the 15 departments in brain circulation countries except Israel*	26	0.7
13. *Brain circulation in the 15 departments in brain circulation countries except Israel*, Reference group	165	1.1
14. *Stayers in the 15 departments in brain circulation countries except Israel*	39	4.7

Table H. Individual productivity in terms of demographic, educational, department, and mobility variables

Dependent variable: Log *Q*

	Coefficient	**t-statistic**
Constant	2.6863	6.1*
Demographic variables		
1. *Exp*	0.0683	2.8*
2. Exp^2	-0.0008	-2.2*
3. *Young* x *Exp*	0.1129	6.3*
4. *Young*	-1.5308	-3.9*
1. *Female*	-0.5112	-9.1*
2. *Male,* Reference group	-	-
Education variables		
1. *B.A. = RW*	-0.1165	-2.1*
2. *B.A. = Sample countries,* Reference group	-	-
1. *Ph.D. = Harvard* & *MIT*	0.4183	2.6*
2. *Ph.D. = Other Top 10 U.S.*	0.1225	0.8
3. *Ph.D. = Next* 15 *U.S.*	0.1136	0.7
4. *Ph.D. = Next* 27 *U.S.*	-0.0626	-0.4
5. *Ph.D. = Other U.S.*	-0.14.29	-0.7
6. *Ph.D. = Open countries*	0.1377	0.9
7. 7. *Ph.D. = Closed countries and Israel*	-0.0931	-0.6
8. Ph.D. = Rest of the World, Reference group	-	-
Department categories		
1. *Top 25 U.S. departments*	1.8771	16.9*
2. *Next 27 U.S. departments*	1.1364	10.1*
3. *Top 15 non-U.S. departments*	1.0689	10.2.*
4. *Bottom 43 non-U.S. departments*	0.4392	4.5*
5. *Last 15 departments in brain circulation countries except Israel,* Reference group	-	-
Mobility dummy variables		
1. *Foreigners*	0.3251	6.2*
2. *Brain circulation*	0.1984	2.6*
3. *Stayers in the Last 15,* Reference group	-	-
N	3,540	
Adjusted-R^2	0.503	

Table I. Productivity comparisons between foreigners and nationals within department categories

Dependent variable: Log *Q*

	Coefficient	**t-statistic**
Constant	3.3110	7.1*
Mobility dummy variables within department categories		
1. *U.S. Brain circulation in all U.S.. departments*	2.2007	5.4*
2. *Foreigners in Top 25 U.S. departments*	1.7576	16.1*
3. *U.S. Stayers and brain circulation in Top 25 U.S. departments*	1.6367	14.1*
4. *Foreigners in Next 27 U.S. departments*	1.2028	10.4*
5. *U.S. Stayers in Next 27 U.S. departments*	0.7890	6.7*
6. *Foreigners in Top 15 non-U.S. departments*	0.9513	7.9*
7. *Brain circulation in Top 15 non-U.S. departments*	0.9213	6.1*
8. *Stayers in Top 15 non-U.S. departments*	0.8547	6.6*
9. *Foreigners in Bottom 43 non-U.S. departments*	0.6205	5.3*
10. *Brain circulation in Bottom 43 non-U.S. departments*	0.2226	1.9
11. *Stayers in Bottom 43 non-U.S. departments*	0.0489	0.4
12. *Foreigners in the 15 departments in brain circulation countries except Israel*	-0.3901	-1.6
13. *Stayers in the 15 departments in brain circulation countries except Israel*	-0.9717	-3.4*
14. *Brain circulation in the 15 departments in brain circulation countries except Israel,* Reference group	-	-
Demographic variables		
1. *Exp*	0.0697	2.8*
2. Exp^2	-0.0008	-2.2*
3. *Young* x *Exp*	0.1122	6.3*
4. *Young*	-1.5113	-3.9*
1. *Female*	-0.5142	-9.2*
2. *Male,* Reference group	-	-
Education variables		
1. *B.A. = RW*	-0.0915	-1.6
2. *B.A. = Sample countries,* Reference group	-	-
1. *Ph.D. = Harvard* & *MIT*	0.0860	0.4
2. *Ph.D. = Other Top 10 U.S.*	-0.2039	-1.0
3. *Ph.D. = Next* 15 *U.S.*	-0.2256	-1.1
4. *Ph.D. = Next* 27 *U.S.*	-0.4035	-1.9
5. *Ph.D. = Other U.S.*	-0.5040	-2.1*
6. *Ph.D. = Open countries*	-0.2076	-1.0
7. 7. *Ph.D. = Closed countries and Israel*	-0.4134	-2.0*
8. Ph.D. = Rest of the World, Reference group	-	-
N	3,540	
Adjusted-R^2	0.506	

Table J. Productivity comparisons between foreigners, brain circulation, and stayers in each country

Dependent variable: Log *Q*	**Coefficient**	**t-statistic**	
Constant	3.4430	7.6*	
Country dummy variables			
1. *U.S. Brain circulation in all U.S. departments*	1.2794	5.8*	
2. *Foreigners in the Top 25 U.S. departments*		1.7687	16.8*
3. *U.S. Stayers in the Top 25 U.S. departments*	1.6529	14.5*	
4. *Foreigners in the Next 27 U.S. departments*	1.1973	10.7*	
5. *U.S. Stayers in the Next 27 U.S. departments*	0.7966	6.9*	
6. *Foreigners in U.K.*	1.0005	8.0*	
7. *U.K. Brain circulation*	1.1143	4.2*	
8. *U.K. Stayers*	0.9548	6.2*	
9. *Foreigners in Canada*	1.0623	7.2*	
10. *Canada Brain circulation*	1.0692	5.0*	
11. *Canada Stayers*	1.5195	4.6*	
12. *Foreigners in Australia/Switzewrland*	0.5355	2.9*	
13. *Australia/Switzewrland Brain circulation*	0.8095	2.3*	
14. *Australia/Switzewrland Stayers*	-0.2424	-0.7	
15. *Foreigners in China*	-0.0438	-0.1	
16. *China Brain circulation*	0.8656	3.5*	
17. *Foreigners in Mexico*	-0.0162	-0.1	
18. *Mexico Brain circulation and Stayers*	-1.4688	-6.3*	
19. *Foreigners in Spain*	0.2316	1.3	
20. *Spain Brain circulation*	0.6232	3.8*	
21. *Spain Stayers*	-0.2040	-1.0	
22. *Foreigners in Germany*	0.9168	3.6*	
23. *Germany Brain circulation*	0.7396	2.4*	
24. *Germany Stayers*	0.3145	1.7	
25. *Foreigners in France*	0.2181	1.0	
26. *France Brain circulation*	0.7824	2.9*	
27. *France Stayers*	-0.2126	-1.4	
28. *Foreigners and Brain circulation in Italy*	-0.2437	-1.5	
29. *ItalyStayers*	-1.0155	-6.3*	
30. *Foreigners in Netherlands*	0.2175	0.9	
31. *Netherlands Brain circulation*	0.7470	2.4*	
32. *Netherlands Stayers*	0.7175	4.3*	
33. *Foreigners in Belgium*	0.3501	1.4	
34. *Belgium Brain circulation*	0.2360	1.1	
35. *Belgium Stayers*	-0.0816	-0.5	
36. *Foreigners in Denmark/Sweden*	0.7511	3.0*	
37. *Denmark/Sweden Brain circulation*	0.4884	1.3	
38. *Denmark/Sweden Stayers*	0.3087	1.7	
39. *Foreigners Israel*	1.1462	2.6*	
40. *Brain circulation Israel*	1.1881	4.3*	
41. *Stayers Israel*	1.7673	5.8*	
42. *Foreigners in Brain circulation countries except Israel*	-0.4155	-1.7	
43. *Stayers in Brain circulation countries except Israel*	-1.0364	-3.8*	
44. *Brain circulation in Brain circulation countries except Israel,* Reference group	-	-	
- -			
Demographic variables			
1. *Exp*	0.0653	2.7*	
2. Exp^2	-0.0008	-2.2*	
3. *Young* x *Exp*	0.1164	6.7*	
4. *Young*	-1.5605	-4.2*	

1. *Female*	-0.4831	-8.9*
2. *Old*, Reference group	-	-
Education variables		
1. *B.A. = RW*	-0.1171	-1.8
2. *B.A. = Sample countries,* Reference group	-	-
1. *Ph.D. = Harvard* & *MIT*	0.0049	0.0
2. *Ph.D. = Other Top 10 U.S.*	-0.2895	-1.5
3. *Ph.D. = Next* 15 *U.S.*	-0.2780	-1.4
4. *Ph.D. = Next* 27 *U.S.*	-0.4440	-2.2*
5. *Ph.D. = Other U.S.*	0.5595	-2.4*
6. *Ph.D. = Open countries*	-0.3741	-1.9
7. *Ph.D. = Closed countries and Israel*	-0.2381	-1.2
8. *Ph.D. = Rest of the World,* Reference group	-	-
N	3,540	
Adjusted-R^2	0.542	

Table K. Productivitry comparisons between movers (brain drain and brain circulation) and stayers in each country

Dependent variable: Log *Q*

	Coefficient	**t-statistic**
Constant	3.8797	7.2*
Country dummy variables		
1. *U.S. Stayers and Brain circulation in Top 25 U.S.*	1.6900	11.6*
2. *U.S. Stayers in Next 27 U.S.*	0.8016	5.5*
3. *U.S. Brain drain*	0.7864	4.4*
4. *China Brain drain in Top 25 U.S.*	1.7333	6.9*
5. *China Brain drain in All Other countries*	1.3643	6.1*
6. *China Brain circulation*	0.8324	3.3*
7. *Mexico Brain drain in all departments*	0.7595	1.8
8. *Mexico Brain circulation and Stayers*	-1.5020	-6.3*
9. *U.K. Brain drain in Top 25 U.S.*	1.7049	7.4*
10. *U.K. Brain drain in All Other countries*	0.7468	3.9*
11. *U.K.Brain circulation*	1.1667	4.1*
12. *U.K. Stayers*	0.9964	5.6*
13. *Canada Brain drain in Top 25 U.S.*	1.9526	9.6*
14. *Canada Brain drain in All Other countries*	1.1877	6.0*
15. *Canada Brain circulation*	1.0442	4.8*
16. *Canada Stayers*	1.5196	4.5*
17. *Australia/Switzewrland Brain drain in Top 25 U.S.*	1.6284	4.4*
18. *Australia/Switzewrland a Brain drain in All Other countries*	1.0243	4.3*
19. *Australia/Switzewrland Brain circulation*	0.5486	1.4
20. *Australia/Switzewrland Stayers*	-0.2398	-0.7
20. *Spain Brain drain in Top 25 U.S.*	1.3758	3.9*
22. *Spain Brain drain in All Other countries*	0.6159	2.4*
23. *Spain Brain circulation*	0.6661	3.6*
24. *Spain Stayers*	0.0063	0.0
25. *Germany Brain drain in Top 25 U.S.*	1.5225	6.4*
26. *Germany Brain drain in All Other countries*	1.4701	5.1*
27. *Germany Brain circulation*	0.8016	2.5*
28. *Germany Stayers*	0.5246	2.5*
29. *France Brain drain in Top 25 U.S.*	2.1445	7.3*
30. *France Brain drain in All Other countries*	1.0737	4.6*
31. *France Brain circulation*	0.8349	2.9*
32. *France Stayers*	-0.0017	-0.0
33. *Italy Brain drain in Top 25 U.S.*	2.0280	8.4*
34. *Italy Brain drain in All Other countries*	0.6466	3.6*
35. *Italy Brain circulation*	-0.2368	-1.3
36. *Italy Stayers*	-0.8033	-0.0
37. *Netherlands Brain drain in Top 25 U.S.*	1.8147	3.1*
38. *Netherlands Brain drain in All Other countries*	0.5714	1.8
39. *Netherlands Brain circulation*	0.7883	2.5*
40. *Netherlands Stayers*	0.9337	4.8*
41. *BelgiumBrain drain in Top 25 U.S.*	1.7897	3.4*
42. *Belgium Brain drain in All Other countries*	0.9862	3.8*
43. *Belgium Brain circulation*	0.2529	1.1
44. *Belgium Stayers*	0.1286	0.7
45. *Denmark/Sweden Brain drain in Top 25 U.S.*	2.2048	5.5*
46. *Denmark/Sweden Brain drain in All Other countries*	0.9669	3.6*
47. *Denmark/Sweden Brain circulation*	0.5486	1.4
48. *Denmark/Sweden Stayers*	0.5222	2.5*
49. *Israel Brain drain in Top 25 U.S.*	1.9145	8.3*
50. *Israel Brain drain in All Other countries*	1.6160	5.7*

51. *Israel Brain circulation*	1.1755	4.2*
52. *Israel Stayers*	1.9390	6.2*
53. *Brain drain in Top 25 U.S. from Brain circulation countries except Israel*	1.8203	8.9*
54. *Brain drain in All Other from Brain circulation countries except Israel*	0.8054	5.0*
55. *Brain circulation from Brain circulation countries except Israel,* Reference group	-	-
56. *Stayers from Brain circulation countries except Israel*	-1.3410	-3.6*
Demographic variables		
1. *Exp*	0.0559	2.3*
2. *Exp* ^{2}	-0.0006	-1.8
3. *Young* x *Exp*	0.1200	6.7*
4. *Young*	-1.6790	-4.3*
1. *Female*	-0.4685	-8.2*
2. *Male*, Reference group	-	-
Education variables		
1. *B.A. = RW*	-0.0740	-0.5
2. *B.A. = Sample countries,* Reference group	-	-
1. *Ph.D. = Harvard* & *MIT*	-0.3046	-1.0
2. *Ph.D. = Other Top 10 U.S.*	-0.5854	-1.9
3. *Ph.D. = Next* 15 *U.S.*	-0.5751	-1.8
4. *Ph.D. = Next* 27 *U.S.*	-0.6051	-1.9
5. *Ph.D. = Other U.S.*	-0.8852	-2.6*
6. *Ph.D. = Open countries*	-0.6856	-2.2*
7. *Ph.D. = Closed countries and Israel*	-0.7248	-2.3*
8. *Rest of the World,* Reference group	-	-
N	3,253	
Adjusted-R^2	0.535	