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"GOVERNANCE, BRAIN DRAIN, AND BRAIN GAIN IN ELITE ACADEMIC INSTITUTIONS IN ECONOMICS. THE CASE OF SPAIN"

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Abstract. Since the late 1970s and, above all, since 1990, a sizable contingent of Spanish economists coming back home after attending graduate school abroad, mostly in the U.S. and the UK, managed to introduce drastic changes in governance in a number of economics departments and research centers, including meritocratic hiring and promotion practices. These initiatives were also favored by the availability of resources to finance certain research needs, including the organization of international Ph.D. programs. Using a dataset of 3,540 economists working in 2007 in 125 academic centers in 22 countries, this paper presents some evidence on the role of this institutional revolution on the patterns of brain gain, brain drain, and net gain in Spain and other countries. Conditional on some personal, department, and country characteristics, the net effect of a given country is defined as the difference between the effect of working in 2007 in that country on the probability of brain gain and the effect of being born in that country on the probability of brain drain. The main result is that the net effect of Spain is greater than the net effect of comparable large, continental European countries, i.e. Germany, France, and Italy, where economists have similar opportunities for publishing their research in English, the *lingua franca* of science, or in their own languages. On the other hand, we define the average probability of net gain in any country as the difference between the average of the estimated individual probabilities of brain gain and brain drain in the country in question. We find that the average probability of net gain in Spain is only below that of the U.S., but it is greater than that of Germany, France or Italy.

Key words: governance; economics institutions; brain drain; brain circulation; brain gain
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INTRODUCTION

Until fairly recently, graduate programs in Spain in economics were below international standards. As a result, in the 1970s and 1980s many Spanish economists went abroad –mostly to the U.S. and the UK– to earn a Ph.D. A sizable proportion of this contingent came back to Spain and, during the 1990s, managed to establish drastic changes in the governance of a number of economics departments and research centers, including the introduction of meritocratic hiring and promotion rules with the aim of fomenting quality research.[1] At the same time, beginning in the mid-1980s the Spanish public sector increased higher education budgets, while Spanish and European Union competitive grants made additional resources available for research. The ensuing improvement of Spanish economics institutions in international rankings based on research publications has been documented elsewhere (Drèze and Estevan, 2007, and Ruiz-Castillo, 2008). This paper presents some evidence on the role of this institutional revolution on the patterns of geographic mobility exhibited by economists born in Spain and by economists working in Spanish centers, relative to the same patterns in 21 other countries.

Nationals from any country can be partitioned into three groups: those who migrate abroad (brain drain), those who study and/or work for some time abroad but come back to work in their country of origin (brain circulation), and those who study and work in their own country (stayers). In turn, scientists working in any country can be partitioned into three groups: brain circulation and stayers born in the country in question, and those born elsewhere (brain gain). Thus, in our empirical analysis we compare key aspects of these two partitions for economists working in 2007 in a number of elite centers in 22 selected countries.

[1] As pointed out by Velema (2012), besides facilitating knowledge exchange and access to international knowledge networks and communities, scientists coming back to their country of origin can contribute to the national science system 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 –the last task is the one emphasized in this paper.

We begin with a dataset used in previous contributions (Carrasco and Ruiz-Castillo, 2014, and Albarrán *et al.*, 2017a, b), 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. 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. Our dataset includes eleven other countries with at least one of the remaining 29 non-U.S. departments in the original dataset, and three countries with at least one department between the 81st and the 125th institutions in the Econphd (2004) ranking. Finally, to ensure covering a variety of institutional and mobility situations, we include seven countries in different geographical areas whose best departments are ranked beyond the first 125 institutions in the Econphd (2004) ranking. The final dataset consists of 3,540 economists working in 2007 in 125 departments in 22 countries.

The countries in our sample can been partitioned into five groups according to their proportion of brain gain, brain drain, stayers, and brain circulation. (i) Four *open* countries with a large percentage of brain gain and brain drain –Canada, UK, Australia, and Switzerland. (ii) The U.S., with a large proportion of brain gain but with the lowest proportions of brain circulation and brain drain. (iii) Seven *closed* European countries with a very high proportion of stayers, and a low proportion of brain gain and brain circulation –Netherlands, Belgium, Denmark, Sweden, France, Germany, and Italy. (iv) Seven countries with a large proportion of brain circulation and a low proportion of stayers –Portugal, Greece, Turkey, Brazil, Argentina, Chile, and China; these countries will be referred to as forming the *brain circulation* group.[2] (v) Spain and Mexico.

[2] Although it has a smaller proportion of brain circulation and a greater proportion of stayers than the other countries, Israel will be classified with this group.

According to our data, Spain, which used to have a relatively high proportion of brain circulation and a low proportion of brain gain from 1970 to 1990 (as most of the countries in the fourth group in the previous partition), became an open country in the sense that since 1990 to 2007 has attracted a considerable proportion of foreigners. The difference with the four countries in the first group is that Spain exhibits a greater percentage of brain circulation and a smaller percentage of brain drain. This unconditional evidence must be subject to as many controls as possible. The reason, of course, is that the probability that an individual becomes a migrant 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. In our case, we control for demographic variables, Ph.D. education, a measure of individual productivity, average department productivity, and *per capita* GDP.

Our empirical strategy can be summarized as follows. We first estimate the probability that an individual selected at random becomes a migrant 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. This is the conditional probability that an individual working in 2007 in a given country has been born somewhere else, i.e. the probability that she has been gained by that country. We refer to this as *the probability of brain gain in any of the possible countries of destination*. The difference between the estimated probability when a country's dummy variable takes the value one and when it takes the value zero captures the *effect of working in 2007 in that country on the probability of brain gain*. Next, we estimate the probability that an individual selected at random becomes a migrant 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. This is the probability that an individual born in a given country becomes brain drained into any of the remaining 21 countries. We refer to this as *the probability of brain drain in any of the possible countries of origin*. The difference between the estimated probability when a country's dummy variable takes the value one and when it takes the value zero captures the *effect of being born in that country on the*

probability of brain drain. The difference between the two coutry dummy effects is referred to as the *net effect of the country in question*.

Given the set of individual, departmental, and country characteristics we control for, a significant difference between the effect of the Spanish and country A's dummies on the probability of brain gain or brain drain must be attributed to uncontrolled variables. In particular, in so far as we can assume that governance in country A has remained unaltered prior to 2007, we will interpret this result as *prima facie* evidence in favor of the hypothesis that the difference can be attributed to the dramatic governance change in Spain. The more similar country A is to Spain in the space of unobservable characteristics, the more convincing this indirect evidence will be. Therefore, we focus on the comparison between Spain versus Germany, France, and Italy. These are four continental members of the European Union, demographically comparable, and non-English speaking countries where economists have similar opportunities for publishing their research in English, the *lingua franca* of science, or in their own languages.

The main results of the paper on country dummy effects are the following three. Firstly, the effect of working in Spain in 2007 on the probability of brain gain is indistinguishable from the effect of working in Germany, but it is significantly greater than the effect of working in France or Italy. Secondly, the effect of being born in Spain on the probability of brain drain is indistinguishable from the effect of being born in France, but it is significantly smaller than the effect of being born in Germany or Italy. Thirdly, the difference between the two previous effects shows that the net effect of the Spanish dummy is greater than the net effect of the German, French, and Italian dummies.

On the other hand, we also compute the *average probability of net gain in each country* as the difference between the average of the estimated individual probabilities of brain gain and brain drain in the country in question. The main result is that Spain is one of the eight countries in the dataset with a positive average probability of net gain, while Germany, France or Italy belong to the set of 14 countries with a

negative average probability of net gain. The estimated average probability of net gain for Spain is 8.4%, while the corresponding figures for Germany, France and Italy are -28.4%, -2.9% and -37.6%, respectively.

The importance of these results in the context of increased global competition for skilled workers (OECD, 2008, Freeman, 2010, and Geuna, 2015) and a generalized preoccupation in the sending countries with what Hunter *et al.* (2009) call the elite brain drain[3], hardly needs to be emphasized. Even if one accepts as a first approximation that the matching between demand and supply forces works well at the world level, it is likely that the degree of concentration of the best scientific talent in the U.S. in all sciences constitutes only a second best. Better governance and some additional resources in the rest of the world may give rise to an improved situation with an elite less concentrated in the U.S.

As indicated in Van Bouwel and Veugelers (2014), although the focus in a single discipline does not allow the generalization of our results to other scientific disciplines, it has the advantage that the heterogeneity of labor market characteristics and the metric for assessing research quality across scientific disciplines are held constant.

The remainder of this article is organized as follows. Section II discusses the institutional framework in Spain. Sections III and IV present the data and the partition of the sample countries into five groups. In order to facilitate the reading of the text, an Appendix contains some additional material on the construction of the dataset, the quality of our information on geographic mobility, and some additional descriptive statistics. Section V contains the empirical model and the estimation results, Section VI discusses them, and Section VII concludes.

II. INSTITUTIONAL FRAMEWORK

II.1. The beginnings

Before 1970, only a handful of Spaniards held a foreign Ph.D. and/or had ever written a paper

[3] For the elite brain drain, see *inter alia* Stephan & Levin, 2001, Laudel, 2003, 2005, Ali *et al.*, 2007, Bauwens *et al.*, 2008, Panaretos & Malesios, 2012, Van Bouwel, and Veugelers, 2014, and Albarrán *et al.*, 2017b.

in a peer reviewed international journal. Starting at this date, an increasing number of Spaniards went abroad to obtain a Ph.D. Out of 164 Spanish economists in our dataset, 41.5% earn 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. By the early 1980s, 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 País Vasco and a sizable minority at Universidad Complutense of Madrid. These three groups, together with two analogous French contingents at the University of Toulouse and Aix-en Provence, Marseille II, formed ASSET (Association of Southern European Economic Theorists) that started publishing SEEDS (Southern European Economic Discussion Papers) in 1982. A few years later, the University of Alicante joined ASSET. At the same time, 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.[4] 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. Nevertheless, the UAB, the oldest of the best Spanish centers today, quickly achieved some European and world prominence as of the early 1990s[5].

A key feature in the Spanish institutional landscape is the creation of two entirely new university economics departments in 1990: Carlos III in Madrid, and Pompeu Fabra in Barcelona. As documented in Ruiz-Castillo (2008), Spain –which occupied the eleventh place in Europe in 1990– leapt up in only

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

[5] For some time, the IAE's research output often appears together with that of the UAB in international rankings because both are placed in the same campus.

fifteen years up to the fourth position in Europe and the seventh in the world around 2005 as a producer of research of excellence measured by journal pages adjusted by journal quality and other factors.

II.2. Policy changes

For reasons explained in Section III, the Spanish centers included in our dataset are the following six: UAB, Pompeu Fabra, Carlos III, University of Alicante, IAE, and CEMFI. Since we will claim in the sequel that differences in geographic mobility patterns between these Spanish institutions and comparable ones in other countries are largely explained by the governance innovations introduced in Spain, we summarize at the outset these drastic changes in terms of the following four points.

1. Since the early 1980s in the UAB, and since 1990 in the other five Spanish centers, personnel policies are 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 has been drastically reduced. The recruitment of new faculty is carried out by means of a rigorous selection system open to interested candidates from any other university.[6] Secondly, the academic staff hired in this way, whose performance is evaluated every two years, have 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 are clearly established beforehand; letters of recommendation from outside experts are required; merits are evaluated in written reports by *ad hoc* committees, and final decisions are 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

[6] The steps include: publishing job vacancies on the Internet; first round candidate selection by an *ad hoc* committee; interviews with those selected in the job market, which has 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.

candidate must pass a competitive public examination contest –*oposiciones*– similar to the system followed in other European countries. Thus, there is a dual system at work: the public system for the country as a whole, and the system described above that operates exclusively within the elite economics centers in the dataset. However, since the tenure and promotion standards in the latter are much more demanding than in the rest of the system, whenever there is an official vacancy, the "internal" candidate has 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 have strong Ph.D. programs consisting of two years of course study and two or three years for the writing of a dissertation. Graduate teaching counts as part of faculty members' teaching load. Students, all of whom receive financial support during the entire program, are recruited internationally among hundreds of applicants. Moreover, the Ph.D. programs in the UAB and the University of Alicante are part of European networks.[7] Finally, the prohibition of hiring their own Ph.Ds. provides incentives to these departments for organizing the best possible program in order to facilitate the placement of their graduate students elsewhere.

3. As far as resources are concerned, tenured Associate and full professors in the Spanish public institutions in the dataset are paid the same salary as faculty members in the corresponding categories in the Spanish public university system. There are two qualifications. Firstly, there is some leeway concerning what can be paid to young tenure-track candidates. Secondly, contingent on the research (and teaching) trajectory of each faculty member, there are internal incentive systems to assign the teaching load and/or to complement –in a moderate way– the civil servant salaries in public institutions. These two features are important: having some wage autonomy during the tenure-track

[7] 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. At the same time, QUE 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 Univerity of Venice, and the University of Vienna.

period, as well as the annual recognition of research merits are valuable weapons.

On the other hand, 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, have 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 are also funded.

4. The use of English as a working language was recognized 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 are conducted in this language. Moreover, in many disciplines within undergraduate degree programs at UAB, Carlos III and Pompeu Fabra, one group for Erasmus and for Spanish students who voluntary choose this option, is also taught in English.

III. THE DATASET

III.1. The selection of a sample of countries and departments

Our aim is that all centers in the dataset constitute a sound sample of the most productive academic institutions in each country. 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 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.[8] Some exceptions are discussed in Section A1 in the Appendix.

[8] 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).

We select countries and departments in four steps. We begin by focusing on a dataset consisting of the first 81 economics departments in the Econphd (2004) ranking.[9] The original 81 departments are distributed as follows. First, 52 are located in the U.S. Next, 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, 28 departments are located in eleven countries. For our purposes in this paper, the size of the sample in most countries other than the U.S. is clearly too small. Thus, in the second step 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 four countries are well represented in the original sample (with the number of departments in brackets): the UK (8), the Netherlands (4), Sweden (2), and Israel (2). In the remaining seven countries, 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 a third step 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 the Netherlands, Israel, and China). Among the countries with at least one department in the remaining eleven institutions, we include the following three (with the number of departments in brackets): Italy (5), whose Università Bocconi occupies the 101 positions; Australia (2), whose first three universities are ranked in this interval, and Switzerland (2), whose University of Zürich occupies the 99th position.

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. Firstly, Greece and Portugal

[9] 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.

are included to complete the vision offered by other small members of the European Union that are considerably more affluent. Secondly, we include Turkey, a country geographically close to the European Union but with a different culture and with a number 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, Argentina, and Chile– plus Brazil. As we will see, the inclusion of these countries with 19 departments (four in Turkey and Mexico, three in Brazil, and two in Greece, Portugal, Argentina, and Chile) has been worthwhile. Thus, the 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 the Appendix.

III.2. Collecting individual information

In 116 centers, we searched for individual researchers in the departmental web pages in 2007. 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.[10] 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.

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. Details on how we collected this information, as well as how

[10] 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.

researchers are distributed among the different institutions in each country are discussed in Section A2 in the Appendix.

III.3. The measurement of individual productivity

As explained in Albarrán *et al.* (2017a), 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 take into account 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.

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, and the remaining international or local journals. Starting from the top 63 journals in the Kalaitzidakis *et al.* (2003) journal ranking, and taking also into account the rankings in Lubrano *et al.* (2003), and Kodrzycki & Yu (2006), we distinguish between four journal classes.[11] Although any specific journal partition 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. 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.

The mean Q for all centers is presented in Table A in the Appendix. As already noted, 114 institutions appear within the 321 centers in the Econphd (2004) ranking. The correlation coefficient between these 114 ranks and the ranks according to mean Q is 85%.

[11] 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 further details concerning this construction, including the listing of all journals in classes B and C.

IV. DESCRIPTIVE STATISTICS

IV.1. Mobility variables

This paper studies the potential importance of the governance in academic institutions on the geographical mobility patterns of economists working in 2007 in a selection of the most productive institutions in 22 countries. Geographical mobility is a key characteristic of all sciences. However, as indicated by Franzoni *et al.* (2015), there is virtually no data that allow for consistent comparisons of mobility patterns across countries among the Ph.D. trained. Our information concerning this phenomenon 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 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 in the rest of the world that are part of the brain gain in these 22 countries. To facilitate the reading of the text, a discussion on the quality of the information on our mobility variables is relegated to Section A3 in the Appendix.

IV.2. Country types

These two partitions are presented in Tables C.1 and C.2 in the Appendix, which are organized taking into account the partition of countries into five types: the U.S., open countries, closed European countries, brain circulation countries, and Mexico and Spain. In order to justify how this partition comes

about, we begin by considering in Table 1 the percentage of economists attending graduate school abroad, and the percentage in brain circulation that comes back to work in their country of origin. The situation is illustrated in Figures 1 and 2.

Table 1 and Figures 1 and 2 around here

We note two points. Firstly, together with the U.S., where only 1.6% earn a Ph.D. abroad, there are only four countries (France, Denmark, Netherlands, and Sweden) in which less than one fourth of their nationals attend graduate school abroad. As observed in column 1 in Table 1, in the remaining 17 countries at least one third of economists follow this route (Belgium), whereas this percentage is greater than 95% in four countries (Argentina, Turkey, Chile, and China).[12] Secondly, having weak graduate schools, a number of countries have a policy of facilitating their best B.A. graduates 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, these countries are Greece, Portugal, Turkey, Brazil, Argentina, Chile, and China, which will be referred to as *brain circulation* countries and represented in green in Figure 1. Israel, which has a relative large percentage of brain circulation and that, as we will see, shares with these countries other characteristics, will be also included in the brain circulation group. Instead, for reasons that will become apparent in a moment, Mexico and Spain, with a relatively high percentage of brain circulation, stand out as a type of its own and are represented in red in Figure 1.

Of course, the number of individuals born in a country need not be equal to the number of economists working there in 2007. Some nationals will be brain drained, and some foreigners will become brain gained in the country in question. The percentages of brain gain and brain drain in any country with respect to the corresponding totals in Table C.2 in the Appendix are not comparable.

[12] As documented in Table D in the Appendix economists in the dataset are attracted in great numbers to the U.S. for their graduate education: 1,573 U.S. nationals and 1,073 foreigners, representing 44.4% and 30.3% of the total sample, obtain a Ph.D. from a U.S. university.

However, we can compare the flows of brain gain and brain drain as a percentage of the sum of brain circulation and stayers in each country (columns 1 and 2 in Table 2). We define the *percentage of net gain* as the difference between the percentages of brain gain and brain drain over the same denominator (column 3 in Table 2). The situation is illustrated in Figures 3 to 5.

Table 2 and Figures 3, 4 and 5 around here

We are now in a position of fully justifying our partition. Firstly, it is clear that the U.S. is a special case better treated separately. As is well known, a large quantity of foreigners is typically attracted to working in U.S. institutions: in our dataset, 649 economists, or 68.2% of the nationals in that country constitute the U.S. brain gain (column 1 in Table 2). On the other hand, the U.S. net gain, that is, the difference between migrants working in the U.S. and the tiny minority of U.S. nationals working abroad, represents 58.5% of U.S. nationals working at home.

Secondly, we typify the UK, Canada, Australia, and Switzerland as *open* countries mostly because they are capable of attracting a sizable proportion of migrants –a rare phenomenon in our dataset. As a matter of fact, the number of foreigners in these countries is greater than the number of their nationals working there. Thus, in spite of the fact that a large percentage of nationals from these countries end up brain drained abroad, open countries exhibit a positive net gain: the percentage of net gain ranges from 17.9% in Canada to 85.7% in Switzerland –where there are very few nationals–, or 41.2 and 45.9% in Australia and the UK (column 3 in Table 2).

Thirdly, consider the seven European countries represented in blue in Figures 3 to 5, that is, Netherlands, Belgium, Sweden, Denmark, Germany, France, and Italy. A low ability to attract foreigners to work in them (Figure 3), a relatively low percentage of brain circulation (Figure 2) and, therefore, a large proportion of stayers, ranging from 58.6% of the total number of nationals in Italy to 76.6% in France (Table C.2 in the Appendix), are all features justifying our classification of these countries as *closed*. On the other hand, since these countries experience a considerable percentage of brain drain

(Figure 4), excepting the Netherlands they exhibit a negative net gain (Figure 5).

Fourthly, note that, except China, the remaining six brain circulation countries attract a very small percentage of foreigners (Figure 3). However, the proportion of brain drain over the nationals born in each of these countries, with China on top, is relatively high (Figure 4) –a fact facilitated by the relatively small size of their institutions, and hence the relatively small number of the nationals working there. Consequently, all countries in this group are characterized by a negative net gain, ranging from 18.2% in Portugal to 147% in Argentina and more than 200% in China (column 3 in Table 2 and Figure 5).[13]

Finally, it is now clear why Mexico and Spain should not be classified as brain circulation countries: although they have a very high proportion of nationals obtaining a Ph.D. abroad, and a high percentage of brain circulation (Figures 1 and 2), they are both able to attract foreigners to work in their elite institutions (Figure 3) and, in spite of a considerable percentage of brain drain (Figure 4), they become one of the few countries with a positive net gain (Figure 5).

In order to appreciate the usefulness of this partition, in Section A4 in the Appendix we review some descriptive statistics collected by Franzoni *et al.* (2012) for GlobSci, a major effort devised to provide consistent cross-country data on mobility patterns in four scientific fields and 16 countries. We find that the distinction between the U.S., open and closed countries is equally valid for biology, chemistry, materials science, and earth and environmental sciences. Moreover, in comparison with other sciences, the Spanish case in economics constitutes an exception in need of an explanation. On the other hand, Section A.5 in the Appendix discusses the information on average productivity, mean years of experience, and other characteristics in each country.

V. EMPIRICAL RESULTS

V.1. The model

[13] In some key respects, Israel is a very different country. For example, as we will see below, its average productivity is the highest in the dataset. However, like all of the countries in this group, Israel has a large proportion of individuals obtaining a Ph.D. in the U.S. –a large proportion of whom become brain circulation–, a relatively low proportion of stayers and brain gain, and a relatively high proportion of brain drain, which leads to a negative net gain representing 117.1% of the sum of brain circulation and stayers.

To study the effect of the country dummies on the brain gain and brain drain probabilities, we use binary choice models. Let m_i be a dummy variable taking the value 1 if the individual *i* is a migrant, that is, if she works in a different country from where she was born, and 0 otherwise. We specify two different models.

Firstly, a model in which the probability that an individual is a migrant is a function of her working country, conditional on a set of controls. This is what we call the *probability of brain gain in any of the possible countries of destination*, which can be expressed as follows:

$$Pr(m_i = 1 \mid X_i, WC_{i1}, \ldots, WC_{i21}) = F(\beta_0 + \gamma' X_i + \sum_{j=1}^{21} \alpha_j WC_{ij}), \qquad (1)$$

where we specify F as the standard normal cumulative distribution function, X denotes a vector of individual characteristics and WC_{ij} denotes a dummy variable taking the value 1 if the individual *i* works in country *j* and 0 otherwise.

Secondly, a model in which the probability that an individual is a migrant is a function of her nationality, conditional on the same set of controls. This is what we call the *probability of brain drain in any of the possible countries of origin*, which can be expressed as follows:

$$Pr(m_i = 1 \mid X_i, OC_{i1}, \ldots, OC_{i21}) = F(\delta_0 + \mu' X_i + \sum_{j=1}^{21} \lambda_j OC_{ij}), \qquad (2)$$

where OC_{ij} denotes a dummy variable taking the value 1 if the individual *i* was born in country *j* and 0 otherwise.

We estimate these models by Maximum Likelihood, and we 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 of brain gain* is:

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

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

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

Thus, the probability that an individual being born in country *s* becomes brain drained changes in $\eta_s \times 100$ percentage points with respect to the probability of being a migrant in the countries in the constant. Finally, we define the *net (marginal) effect of country s* as the difference between (3) and (4):

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

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.

Thirdly, we also report the *average probability of brain gain for each country s,* defined as:

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

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

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

where *Ms* is the number of individuals born in country *s*. Finally, the *average probability of net gain in country s* is the difference between (6) and (7):

$$\Delta_s = \Omega_s - \varphi_s \quad (8)$$

As before, we order all countries in terms of Ω_s, φ_s, and Δ_s, *s* = 1,…, 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.

V.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 take into account 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 that take the value one if the individual obtained her Ph.D. at the following places: (i) Harvard and MIT, the two most popular universities 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 Appendix 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 (*RW* hereafter). Individuals without a Ph.D. are included in the last category. Finally, individual productivity is measured by the individual *Q* index. Given its high skewness, we use the log of this variable.

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). Here we control for these effects by the department mean *Q* index. Finally, in their study explaining the share of foreign academic staff in 601 higher education institutions in eight European countries (Germany, Italy, Latvia, Lithuania, Slovenia, Spain,

Switzerland, and UK), Lepori *et al.* (2015) emphasize that although academics value primarily the institutions quality, they are also likely to take into account the characteristics of the hosting country. Since we expect that the probability that an individual becomes a migrant 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.

We estimate two models, 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. Mean values for all controls in both cases are in Table F in the Appendix. Country mean values for *Female*, Ph.D. dummy variables, and GDP *per capita* for the two subsets are in Tables G and H in the Appendix, while the mean Q for all departments in each country is in Table A in the Appendix.

V.3. Results on the probability of brain gain

The estimated coefficients for the brain gain model in expression (1) are presented in the left-hand side 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 is 0.29, which indicates a reasonably good fit for this sample of 3,540 observations.[14]

Table 3 around here

As far as the effect of control variables is concerned, older individuals have a smaller probability of becoming migrants and at an increasing rate, but gender has no effect. 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. The remaining Ph.D. dummy variables are not significant. As expected, the probability of attracting a migrant increases with the individual productivity, the department mean productivity, and the relative GDP *per capita* of the destination country.

[14] The pseudo R^2 for the probability of brain gain depending exclusively on the working country dummy variables is 0.10 (detailed results are available on request).

As far as the effect of the sixteen country dummies is concerned, regression coefficients are significant only for the four open countries, and for Spain, Italy, Mexico, and China. Except for Italy, the remaining seven coefficients are positive. The question, of course, is how Spain fairs relative to other countries. 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. expression (3) in Section IV.1. Countries are ordered by the size of such country dummy effects in column 1 in Table 4, whereas column 2 presents the effect of each country dummy with respect to the dummy for Spain, and the *p*-values for such comparison are in column 3.

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 a migrant is significantly smaller than the effect of working in the four open countries, China, and Mexico. In particular, the probability of being a migrant 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 E in the Appendix). Secondly, among the four-large continental European countries, the effect of woeking in Spain on the probability of brain gain 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).

V.4. Results on the probability of brain drain

The estimated coefficients for the brain drain model in expression (2) are presented in the right-hand side in Table 3, where the regression constant includes the same countries as before. We note that the pseudo R^2 is 0.30, indicating a reasonably good fit for this sample of 3,253 observations.[15]

As before, older individuals have a smaller probability of becoming brain drained and at an increasing rate, but gender has no effect. 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. As could be expected, the probability of brain drain increases with the individual productivity, the department mean productivity, and the relative GDP *per capita* of the destination country.

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. expression (4) in Section IV.1 are in column 1 in Table 5, whereas column 2 presents the effect of being born in each country with respect to the effect of being born in Spain, and the *p*-values for such comparison are in column 3. Three points should be emphasized. 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 brain drain 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 the probability of brain drain is indistinguishable from the effect of the remaining 13 countries, including France.

Table 5 around here

V.5. Results on net effects

[15] The pseudo R^2 for the probability of brain drain depending exclusively on the country of origin dummy variables is 0.14 (detailed results are available on request).

So far, we have obtained that the marginal effect of working in Spain on the probability of brain gain is greater than the marginal effect of working in France and Italy, but indistinguishable from the marginal effect of working in Germany. On the other hand, the marginal effect of being born in Spain on the probability of brain drain is smaller than the marginal effect of being born in Germany and Italy, but indistinguishable from the marginal effect of being born in France. Nonetheless, 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 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

V.6. Results on the estimated average probabilities

Finally, we present the estimated results on the average probability of brain gain, brain drain and net gain in each country, defined in expressions (6) to (8). The estimated results, presented in Table 7, warrant the following four comments.

Table 7 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 average probability of net gain than Spain: 29.2% versus 8.4% (*p*-values for all comparisons in Table 7 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 an average probability of net gain indistinguishable from Spain, while Canada ends up below the latter. Thirdly, three countries exhibit a remarkable performance. Mexico performs very well in brain gain and brain drain. 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 average probability of net gain. Last but not least, the following is an important result. Although Germany and Spain's brain gain performance and France and Spain's brain drain behavior are indistinguishable, the average probability of net gain 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.

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

VI. DISCUSSION

How should we interpret these results? Given that we control for a range of individual, departmental, and country characteristics, the differences in the effect of country dummies on the probability of brain gain and brain drain should be attributed to unobserved factors. In what follows, we begin by discussing this issue in relation to Spain –the only case for which we are sufficiently informed.

VI.1. The Spanish case

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

A. Unobservable 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 brain drain and the Spanish average probabiliuty of brain drain may have been underestimated, and hence the net marginal effect and the average probability of net gain in Spain may have been biased upwards. This is, indeed, a possibility. However, given the available controls, these omissions may at most cause a limited impact.

B. Unobservable department characteristics

Although department effects have been partially controlled for by means of the department of destination's mean productivity, Spanish centers may be relatively more attractive to both foreigners and natives in unobserved dimensions. In this respect, there is a valuable literature applicable to our case arguing that the research gap between the U.S. and the rest of the world in any science can be explained by differences in resources and in governance (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).

Among resources, recall that wages have not been controlled for in this study. Excluding CEMFI, tenured Associate and full professors in the Spanish public institutions in the dataset perceive salaries determined for the entire Spanish public university system. Casual information indicates that, in purchasing power terms, Spanish salaries are, in particular, below German, French, and Italian ones. Thus, observed differences in net effects between Spain and these countries can hardly be attributed to unobserved differences in wages favorable to Spanish institutions.

Within governance, perhaps the most important aspects are the role of research merits in hiring and promotion policy, and the department's autonomy concerning salaries' determination (Aghion *et al.*, 2010) and the adoption of the hiring and promotion decisions themselves. Other relevant governance features that may increase the attractiveness of a department are the existence of a strong international

Ph.D. program, and the role of English in undergraduate and graduate teaching, seminars, meetings, etc. Given our summary of institutional features in Section II, in our view this is indeed the main source of the differential performance exhibited by Spanish institutions.

C. Unobservable 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 received 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, Spain does not have an advantage in this respect relative to other European countries that might explain their differences in net effects. 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.[16] In addition, Spanish is a language worth learning because it is widely spoken in the world. However, these unobserved amenities make Spain attractive to foreign scholars in all sciences. The fact that they play a role exclusively in economics (recall Table B in Section A4 in the Appendix) is explained because they form part of a package dominated by the good governance of Spanish elite centers in this discipline.

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 both brain circulation countries with equally remarkable brain gain performances, such as Mexico and China, or the

[16] For the role of factors such as "appeal of the lifestyle or international experience" and "better quality of life", see Franzoni *et al.* (2012, Figure 1).

remaining ones capable of solely attracting brain circulation nationals.

To understand how these unobservables at the department and country level actually affect people's behavior, we must take into account the following three factors that are typically absent in other countries. Firstly, in Spain, as in Germany, France, or Italy, for example, higher education systems in our period of study are organized according to traditional rules that are relatively closed to foreign competition and where research does not necessarily hold a predominant place (Portes, 1987, and Frey & Eichenberg, 1993). Recruitment in what Bonaccorsi *et al.* (2017) 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 the Spanish institutions in our sample constitute an exception relative to the mass of public centers both in economics and other sciences in Spain and other comparable European countries. The exceptional nature of this radically new experience contributed to its international visibility from its inception.

Secondly, not without difficulties and domestic battles that need not be detailed here, coalitions of tenured brain circulation natives in a handful of Spanish economic departments have been able to impose the new governance rules without compromising with the traditional organizational mode. Spanish authorities at the university, Autonomous Communities, or the national level simply tolerate the organizational anomalies described above. The relatively smooth solution to the integration of the new ways into the traditional public system helped to overcome the generalized but very different obstacles found in each country to a single market for researchers within the European Union (Enders, 2001, Commission of the European Communities, 2001, 2008, Musselin, 2004, and Mahroum, 2005).

Thirdly, the extent of this phenomenon has decisively contributed to its success. It should be

noted that the UAB and the Universidad of Alicante managed to survive on their own until the appearance of the remaining institutions around 1990. Since then, the six centers have formed an informal network within which they compete and cooperate. They compete for the best faculty and graduate student talent, as well as for the best grants, both within and outside Spain. Thus, they direct their hiring and promotion policy, and they strive 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 increases the Spanish centers' net gain. At the same time, these centers cooperate in certain dimensions: they share information, hire some Ph.D. graduates from one another, and each one quickly copies the solution that another network member has found in order to implement a shared organization principle. At any rate, the extent of this phenomenon has decisively contributed to its success: 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 has taken place in other European countries, it must be recognized that there are 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 are based on pursuing research excellence. However, in other German, French or Italian elite centers, reformist brain circulation economists have 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 changes.

In this context, Spanish economists with an entrance opportunity into the best Spanish departments easily appreciate 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.[17] In turn, foreign colleagues and, above all, new Ph.Ds. from the U.S. and other good graduate schools quickly understood that the Spanish way to implement the Anglo-Saxon department model in a Latin country was in fact for real. 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.[18]

To finish this discussion, it must be emphasized that not all is well. 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.[19]

Consequently, as observed in Table 8, the age distribution of migrants working in Spain in 2007 is considerably different from other fourteen countries with a percentage of brain gain above 14%. For example, the percentage of migrants with less than seven years of experience, typically in tenure track, in the U.S. and the Open countries ranges from 10.5% in Switzerland to 27.2% in the UK, and is less than 10% in Germany and France; in contrast, this percentage is 45.6% in Spain –the third largest after Netherlands and Sweden. Nevertheless, during the period of study the foreigners that left Spain were essentially replaced by other younger non-Spanish colleagues.

Table 8 around here

[17] It should be noted that, after asking brain circulation scientists in four fields in the GlobSci survey to rate the importance of 12 reasons in their decision to return, Franzoni *et al.* (2015) report that while policies that affect job prospects and working conditions in the home country play a role in bringing migrants home, personal and family reasons are paramount.

[18] 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.* (2012), Van Bouwel and Veugelers (2014), Lepori *et al.* (2015), Stephan *et al.* (2015), Veugelers and Van Bouwel (2015).

[19] 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.

VI. 2. The case of other remarkable countries

In our absence of familiarity with the working of economic institutions in other countries with a remarkable performance in geographic mobility during the 1980-2007 period, we will conclude this Section with a few remarks on 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 (Table 1). However, its effect on the probability of brain gain and its net marginal effect are greater than the Spanish ones (Tables 4 and 6). Moreover, Mexico is one of the eight countries with a positive average probability of net gain which is indistinguishable from the Spanish one (Table 7). 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 unobservables. 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). 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 (Table 1). Thus, it turns out that the effect of China on the probability of brain gain is greater than that of Spain (Table 4). As a matter of fact, in spite of the fact that there are a considerable number of Chinese economists working in 2007 outside China, its net effect is also greater than the Spanish one. However, due to its large brain drain, the average probability of net gain in China is negative and smaller than the Spanish one (Table 7). 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.

VII. CONCLUSIONS

In this paper, we have presented some evidence on the impact of governance in elite academic institutions in economics on geographic mobility patterns. Our sample consists of 3,540 economists working in 2007 in 125 university departments and research centers in 22 countries. 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 brain gain, and the effect of being born in a given country on the probability of brain drain. Then, we also estimate the net effect of each country dummy, defined as the difference between the previous two.

The main results are the following two. Firstly, the net effect of Spain on the flows of brain gain and brain drain is greater than the net effect in comparable European countries, i.e. Germany, France, and Italy. Our main claim is that the observed differences between the effect of the Spanish dummy on the probability of brain gain ad brain drain relative to the effect of other countries' dummies are essentially due to the unobserved novelties in the governance in the Spanish case which start around 1980 in the UAB, continue some time later in the University of Alicante, and culminate around 1990 with the appearance of the IAE, CEMFI, Carlos III, and Pompeu Fabra. Secondly, the estimated average probability of net gain in Spain is only below that of the U.S., but it is greater than the average probability of net gain in Germany, France, and Italy.

It should be emphasized that collecting information on a selection of the best institutions and their faculties using international rankings and 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 subject to measurement error. However, we have argued that our data on the three mobility variables is of good quality. We are fully aware that the interest of our results is conditioned by

the shortcomings of our dataset.

Until 1990, Spain can be characterized as a brain circulation country that sends promising B.As. abroad to obtain a Ph.D. before coming back to work to their country of origin. Greece, Portugal, Turkey, Brazil, Argentina, Chile, Mexico, and China are the countries in our dataset that pursue this policy. From 1990 until 2007, however, Spain has joined the U.S., the UK, Canada, Australia, and Switzerland in their ability to attract a sizable brain gain. Since, in addition, many Spaniards earning a Ph.D. abroad have been welcome back home, thus reducing the brain drain flow, Spain has become one of the few countries in the dataset with a positive estimated average probability of net gain. In contrast, comparable large, continental European countries –such as Germany, France, and Italy–, as well as other small European countries –such as Belgium, Sweden, and Denmark–, and Israel, exhibit in 2007 a negative average probability of net gain.

Our explanation is as follows. Against all odds, in the midst of a public system with fixed salaries for tenured Associate and full professors, coalitions of brain circulation economists in the six Spanish centers in our dataset have forcefully changed the governance of their places of work. We have argued that the combination of a rigorous merit system in a competitive scenario for faculty and graduate students' talent with the availability of resources to finance certain strategic research needs, is what has made possible the appearance of a net gain in Spain. 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.

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 merely suggestive. Nevertheless, they are important because they are indicative 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.

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 good graduate schools have come to Spain to start their careers for a few years 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 favourable 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 Europe or those in the second or third U.S. division.

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Table 1. Percentage of economists from each country that have earned a Ph.D. abroad0. and percentage of those that have come back to work in 2007 to their country of origin (brain circulation)

	% economists that have earned a Ph.D. abroad (1)	% brain circulation (2)
U.S.	1.6	0.9
Open countries		
UK	37.3	8.3
CANADA	77.3	25.7
AUSTRALIA	74.4	19.0
SWITZERLAND	35.0	15.0
Closed countries		
BELGIUM	33.3	21.1
NETHERLANDS	21.0	12.1
DENMARK	21.9	6.2
SWEDEN	25.0	12.5
GERMANY	48.2	9.1
FRANCE	21.3	8.2
ITALY	61.7	24.4
Brain circulation countries		
GREECE	87.5	56.2
PORTUGAL	81.4	58.1
TURKEY	95.8	53.5
BRAZIL	66.1	40.3
ARGENTINA	95.4	34.1
CHILE	97.9	72.9
CHINA	100.0	29.1
ISRAEL	74.7	22.9
Other countries		
MÉXICO	97.1	74.3
SPAIN	64.6	45.1
TOTAL	37.5	16.8

Table 2. 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
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
CHINA	39.1	243.5	-204.4
ISRAEL	20.0	137.1	-117.1
Other countries			
MÉXICO	59.2	29.6	29.6
SPAIN	45.2	30.1	15.1
TOTAL	52.3	40.0	12.3

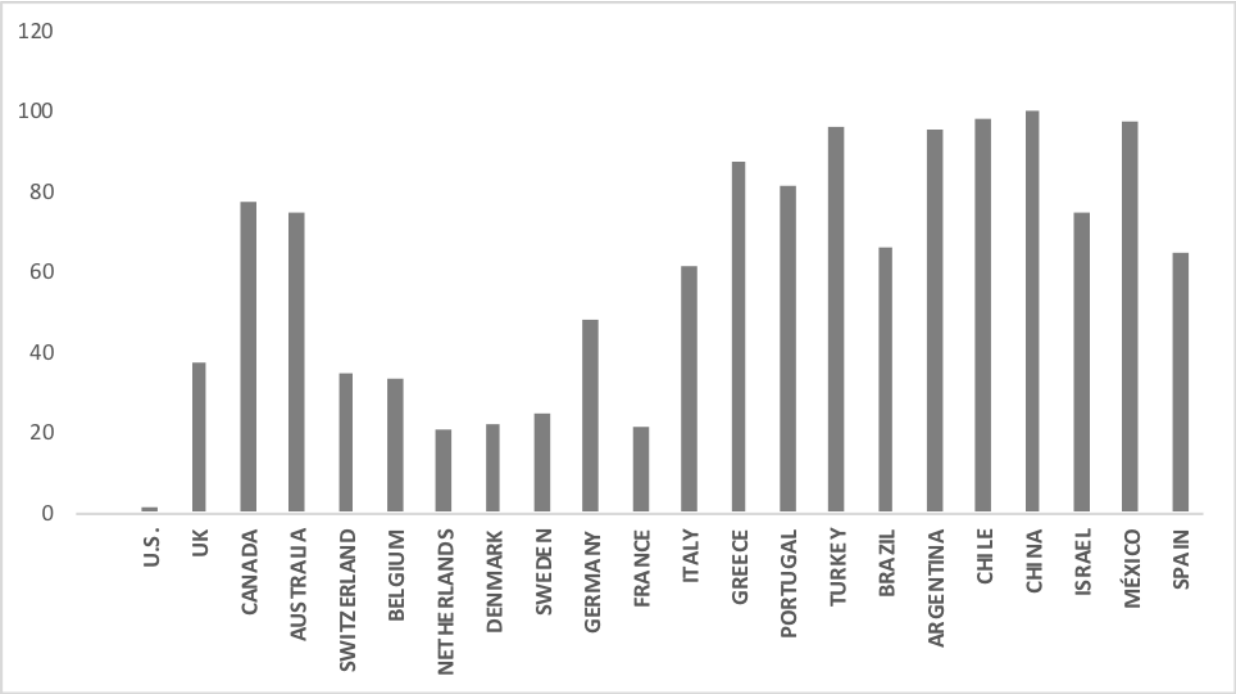

Figure 1. Percentage of economists from each country that have earned a Ph.D. abroad

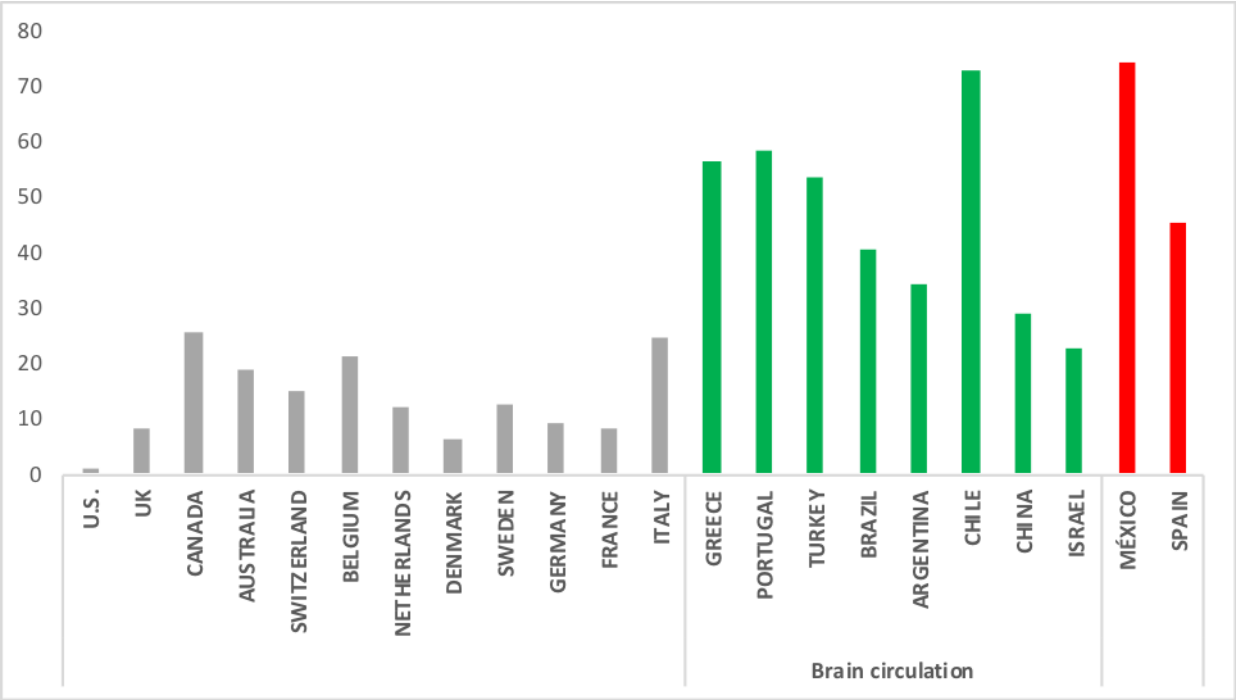

Figure 2. Percentage of economists from each country in brain circulation

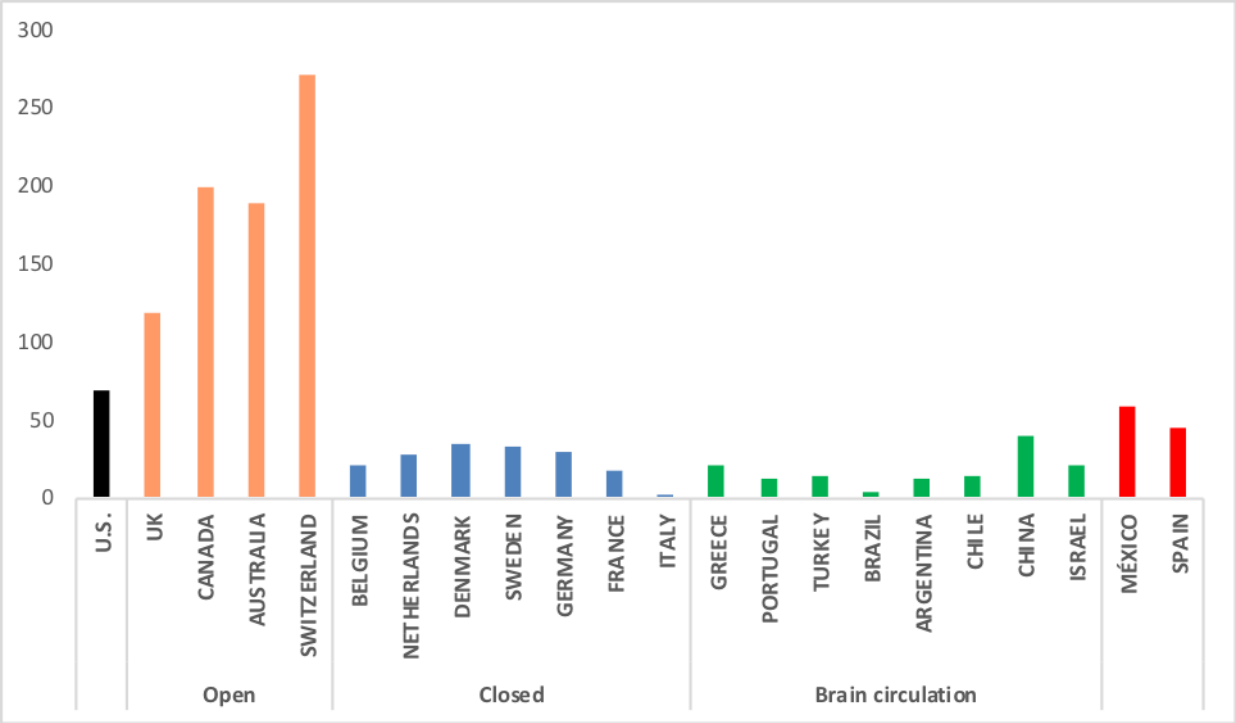

Figure 3. Percentage of brain gain over the sum of brain circulation and stayers in each country

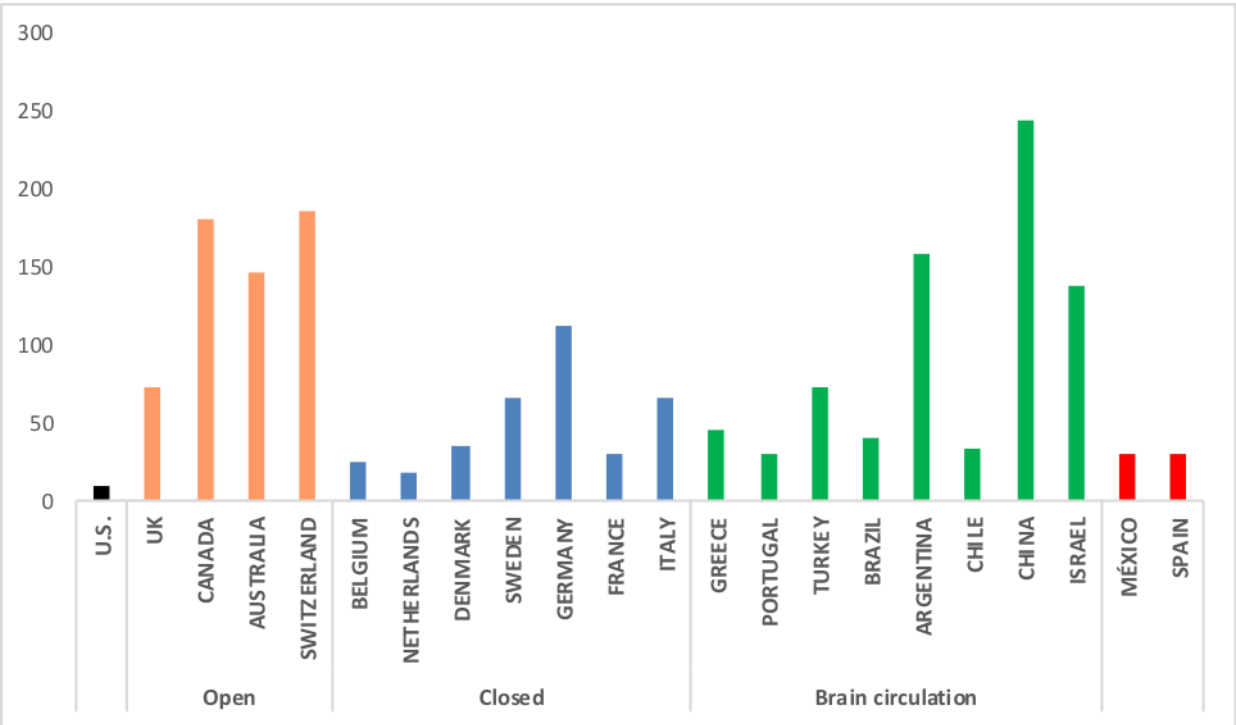

Figure 4. Percentage of brain drain over the sum of brain circulation and stayers in each country

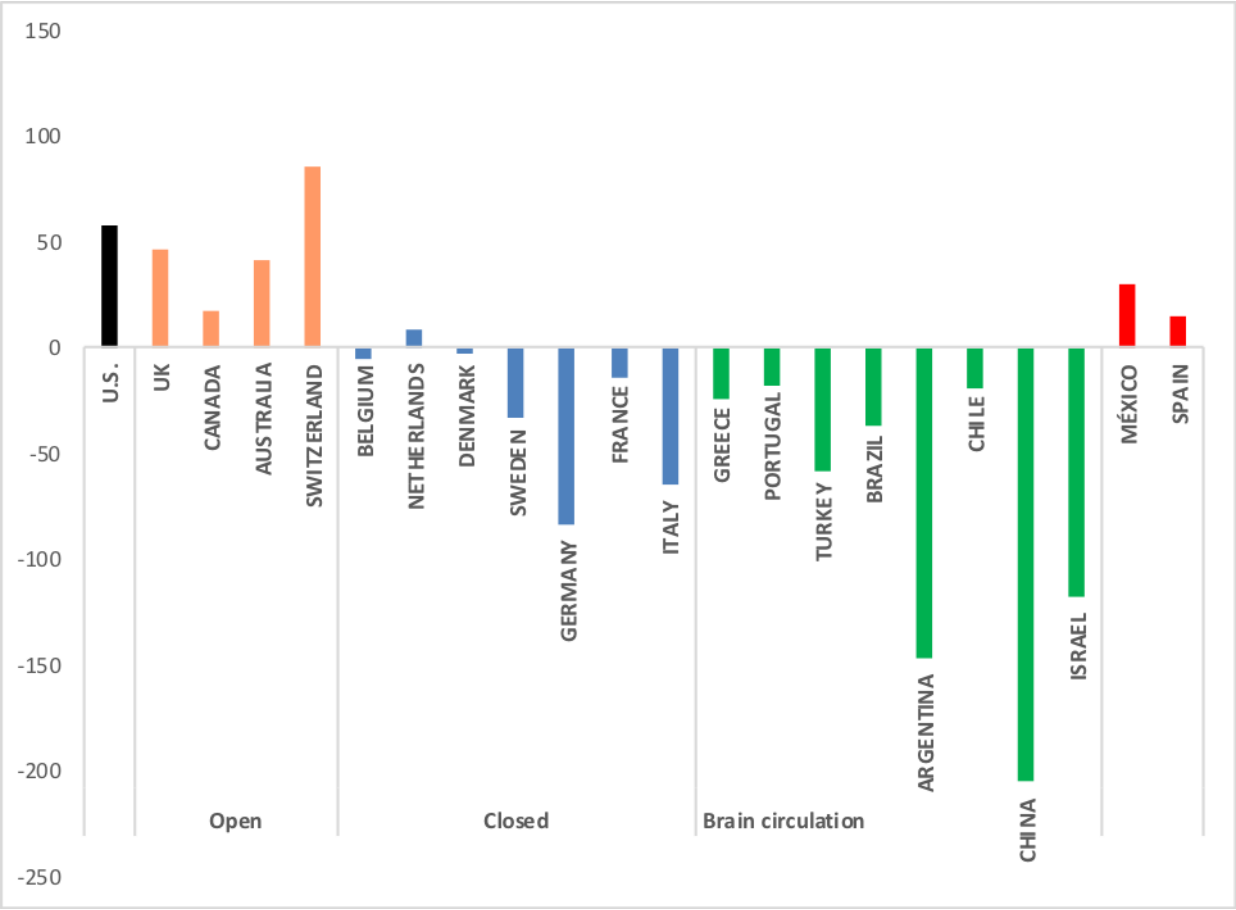

Figure 5. Percentage of net gain over the sum of brain circulation and stayers in each country

Table 3. Estimated coefficients of the probability of brain gain and brain drain

	BRAIN GAIN		BRAIN DRAIN	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**
Constant[o]	-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
México	1.125	3.7	0.059	0.3
China	1.352	3.2	0.018	0.1
Log individual *Q* index	0.058	2.4	0.061	2.2
Exp	-0.055	-6.3	-0.054	-5.9
$(Exp)^2$	0.001	2.9	0.001	3.1
Female	0.011	0.2	0.069	0.9
Ph.D in:				
Harvard & MIT	-0.428	-3.5	0.271	2.3
Next 8 U.S.	-0.055	-0.5	0.650	6.6
Next 15 U.S.	-0.017	-0.2	0.815	7.3
Next 27 U.S.	-0.089	-0.6	0.741	5.1
Other U.S.	-0.248	-1.1	0.682	2.6
UK, Canada, Australia	-0.107	-1.0	0.181	1.6
Rest of the World	0.102	0.4	0.178	0.6
Other Western*	-	-	-	-
Log dep. 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		3,253	
Pseudo R^2	0.293		0.304	

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

Table 4. Marginal effects of the country dummies on the probability of brain gain

	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

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[a] Effects of each country dummy on the probability of brain gain 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 probabilitry of brain gain and the effect of the Spanish dummy

Table 5. Effects of the country dummies on the probability of brain drain

	Effects[a] (1)	Differences relative to Spain[b] (2)	*p*-values (3)
Greater than Spain			
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
Equal to Spain			
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
Smaller than Spain			
U.S.	-0.281	-0.245	0.000

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[a] Effects of each country dummy on the probability of brain drain 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 probabilitry of brain drain 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. Average probabilities of brain gain, brain drain, and net gain in the different countries

BRAIN GAIN		BRAIN DRAIN		NET GAIN	
<u>Greater than Spain</u>		<u>Greater than Spain</u>		<u>Greater than Spain</u>	
Switzerland	0.738	**China**	0.738	**U.S.**	0.292
Canada	0.665	**Switzerland**	0.653		
Australia	0.657	**Canada**	0.651	<u>Equal to Spain</u>	
UK	0.546	**Israel**	0.582	**México**	0.191
China	0.494	**Australia**	0.560	**UK**	0.116
México	0.411	**Argentina**	0.537	**Switzerland**	0.085
U.S	0.402	**Germany**	0.533	**Spain**	0.084
		Turkey	0.457	**Australia**	0.057
<u>Equal to Spain</u>		**UK**	0.435	**Netherlands**	0.051
Spain	0.317	**Sweden**	0.402		
Denmark	0.255	**Italy**	0.393	<u>Smaller tan Spain</u>	
Sweden	0.253	**Brazil**	0.344	**Canada**	0.013
				Denmark	- 0.001
<u>Smaller tan Spain</u>		<u>Equal to Spain</u>		**Belgium**	- 0.001
Germany	0.249	**Portugal**	0.258	**France**	- 0.029
Netherlands	0.218	**Denmark**	0.256	**Portugal**	- 0.082
Israel	0.211	**Greece**	0.249	**Chile**	- 0.111
Belgium	0.173	**Spain**	0.234	**Greece**	- 0.131
Portugal	0.167	**France**	0.229	**Sweden**	- 0.149
Brazil	0.160	**México**	0.220	**Brazil**	- 0.187
Argentina	0.154	**Chile**	0.216	**China**	- 0.224
Turkey	0.150	**Belgium**	0.202	**Germany**	- 0.284
France	0.147			**Turkey**	- 0.309
Greece	0.112	<u>Smaller tan Spain</u>		**Israel**	- 0.371
Chile	0.105	**Netherlands**	0.167	**Italy**	- 0.376
Italy	0.016	**U.S.**	0.110	**Argentina**	- 0.387

Table 8. 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

APPENDIX

A1. The selection of countries and departments

As indicated in Section II.1, the selection of countries and departments has generally followed the Econphd (2004) ranking consisting of 321 institutions. 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 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 2007 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

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

A2. Individual information and distribution by institutions in each country

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.

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.

As we saw in Section II.2, there are 3,540 individuals in the dataset with at least one publication with complete information on education, and age. Their distribution 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, 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. 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 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.

A3. The quality of the information on mobility variables

It should be recognized that we may have an inaccurate selection of the best institutions in the

world for two reasons. Firstly, we have overlooked some of the best centers ranked in Econphd (2004) because they belong to countries not included in our dataset (such as Austria, Norway, India, Taiwan, and Japan) or other reasons (such as the University of Melbourne in Australia or the University of Torino in Italy). Secondly, the Econphd (2004) ranking that we have taken as our main reference for institutional excellence may surely have shortcomings. However, we believe that the 125 institutions in our dataset constitute a valuable sample of the most productive centers in each of the 22 selected countries. Consider the implications for the quality of the information concerning the three mobility variables.

Firstly, think of the total brain drain in 2007 in any of the non-U.S. countries in our sample. They must be working either in the U.S. –very well represented by 52 departments in our sample– or elsewhere in the world, 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. We conclude that our brain drain data from the nationals of the 22 countries in the dataset must be a good sample of the total.

Secondly, because of superior private and public resources and governance, we know that there is a strong clustering effect of the most productive economists in the world towards the best U.S. institutions. It is very hard indeed for any other country to compete with the U.S. in retaining its own best nationals and in attracting foreign talent. In so far as our selection of centers in non-U.S. countries constitutes a good sample of outstanding world institutions, we expect our brain gain data for the U.S. and non-U.S. countries in the dataset to be of good quality.

Thirdly, 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). Moreover, among nationals working in their own country, we expect that those who have obtained a Ph.D. abroad have this information clearly stated in their CVs. We conclude that our data on brain circulation must be of good quality too.

In brief, we can be reasonably confident about 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 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.

A4. A contrast with other sciences

It is interesting to compare the two partitions presented in Section II.3 with the corresponding information for other sciences collected by Franzoni *et al.* (2012) for GlobSci in 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, 14 of which coincide with some of our 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. The number of respondents and the percentage of foreign-born among 17,182 scientists working or studying in 2011 in the country of residence, as well as the number of respondents and the percentage of brain drain among 15,115 nationals in each country are presented in Table B.

Table B around here

Two points should be noted. Firstly, judging from the ability to attract migrants, the U.S. and the four open countries in our dataset have the highest percentages of foreign-born in Table B. Similarly, the four small continental European countries –Netherlands, Belgium, Sweden, and Denmark– and three of the large ones –Germany, France, and Italy– are in comparison relatively closed, also in Table B. The main difference between the four sciences and economics is that, in terms of the percentages of brain

drain, open and closed countries in Table B are more similar to each other than in Table 1 in our case. Secondly, the percentage of brain gain in Spain is among the lowest ones in Table B –together with Brazil and Italy, also very low in economics, plus Japan and India. This clearly illustrates how, in comparison with other sciences, the Spanish case in economics constitutes an exception in need of an explanation. Nevertheless, the percentage of brain drain in Spain in Table B 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.

A.5. Other country characteristics in our dataset

Table E presents the information on mean productivity (Q) and mean years of experience (Exp) in each country. The following three points are in order.

Table E around here

Firstly, taking into account the mean productivity of economists working in 2007 in each country, a partition into three classes is useful. (i) There are eight countries on top: Israel, the U.S. and all open countries except Australia, plus two small European countries –Sweden and Netherlands– and China. Thus, the two departments in Israel and in China are performing very well indeed. (ii) There are six countries in an intermediate position. Australia, three large European countries that play a central role in this paper –Germany, France, and Spain–, and the two remaining small closed countries, Denmark and Belgium. (iii) Italy and, as expected, all brain circulation countries except China exhibit a relatively low mean productivity. Interestingly, in spite of a positive net gain, Mexico is the next to last country in the dataset.

Secondly, it is interesting to compare the mean productivity of those working in a given country with the mean productivity of the nationals from each of them. If the brain drain contribution is greater than the brain gain, then nationals as a whole will be more productive than those working in the country. This is the case in 20 out of the 22 countries. The difference is particularly large in five instances: Canada,

UK, Argentina, Chile, and Italy. The two exceptions where foreigners contribute more than brain drained nationals are Germany and Mexico.

Thirdly, the country ranking in terms of productivity must take into account individuals' age or academic experience, whose average for the nationals in the dataset is 12 years. Recalling that the median age for finishing a Ph.D. is approximately 30 (Scott & Sigfried, 2008), on average people in our sample are at most 42 years of age in 2007. In turn, the average of the productivity per year for the total sample is 13 points, an amount close to the 15 points we assign to any of the 34 journals in class B (see note 10 in Section III.3). Only five countries remain above average: Israel, U.S., Canada, China, and UK. Next, there is a group of seven countries with mean Q/Exp between 13 and 10 points: Sweden, Netherlands, and Switzerland, which step down from category 1 according to mean Q, plus two countries from category 2 –Germany and Australia–, and two countries from category 3, Argentina and Turkey. France, Spain, and Italy, together with Denmark, come next and, finally, we have six countries which include the remaining four brain circulation countries, Belgium, and Mexico which occupies the last place. Although large standard deviations for productivity and experience variables would make many of these unconditional differences insignificant, the latter comments establish the importance of introducing the academic age in productivity comparisons.

Remarks on inbreeding

Finally, 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 1b. 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 the 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 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 Minessota	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. Mobility patterns for 16 countries. Table 1 from Franzoni *et al.* (2012)

	Nº of workers and students in 2011	% of foreign-born	Nº of nationals	% of brain drain
U.S.	4,518	38.4	2,924	5.0
Open countries				
UK	1,205	32.9	1,090	25.1
Canada	902	46.9	613	23.7
Australia	629	44.5	418	18.3
Switzerland	330	56.7	330	33.1
Closed countries				
Germany	1,187	23.2	1,254	23.3
France	1,380	17.3	1,303	13.2
Italy	1,792	3.0	1,938	16.2
Netherlands	347	27.7	339	26.4
Belgium	253	18.2	261	21.7
Sweden	314	37.6	226	13.9
Denmark	206	21.8	183	13.3
Other countries				
Brazil	702	7.1	700	8.3
Spain	1,185	7.3	1,175	8.4
Countries not included in our dataset				
Japan	1,707	5.0	1,676	3.1
India	525	0.8	806	39.8
Total number of respondents	17,182			

Table C.1. Geographical mobility in each country. Number of individuals in the two partitions of those working in 2007 and nationals from each country, plus net gain = brain gain – brain drain in each country

	WORKING IN 2007				NATIONALS				OTHER VARIABLES	
	Brain gain	Brain circ.	Stayers	Total	Brain drain	Brain circ.	Stayers	Total	Net gain	Brain circulation + Stayers
U.S.	649	9	942	1,600	92	9	942	1,043	557	951
Open countries										
UK	173	21	125	319	106	21	125	252	67	146
CANADA	92	34	13	139	85	34	13	132	7	47
AUSTRALIA	32	8	9	49	25	8	9	42	7	17
SWITZERLAND	19	3	4	26	13	3	4	20	6	7
Closed countries										
BELGIUM	26	33	91	150	32	33	91	156	- 6	124
NETHERLANDS	29	15	89	133	20	15	89	124	9	104
DENMARK	16	4	43	63	17	4	43	64	- 1	47
SWEDEN	8	5	19	32	16	5	19	40	- 8	24
GERMANY	23	15	62	100	87	15	62	164	- 64	77
FRANCE	31	20	167	218	58	20	167	245	-27	187
ITALY	3	72	106	181	117	72	106	295	-114	178
Brain circ. countries										
GREECE	7	27	6	40	15	27	6	48	-8	33
PORTUGAL	4	25	8	37	10	25	8	43	-6	33
TURKEY	6	38	3	47	30	38	3	71	-24	41
BRAZIL	2	25	19		46	18	25		19	62
ARGENTINA	2	15	2	19	27	15	2	44	-25	17
CHILE	5	35	1	41	12	35	1	48	-7	36
CHINA	9	23	0	32	56	23	0	79	-47	23
ISRAEL	7	19	16	42	48	19	16	83	-41	35
Other countries										
MÉXICO	16	26	1	43	8	26	1	35	8	27
SPAIN	57	74	52	183	38	74	52	164	19	126
TOTAL	1,216	546	1,778	3,540	929	546	1,778	3,253	287	2,324

Table C.2. Geographical mobility in each country. Percentage of individuals in the two partitions of those working in 2007 and nationals from each country, and percentage of net gain and inbreeding over the sum of brain circulation and stayers in each country

	WORKING IN 2007				NATIONALS				OTHER VARIABLES	
	Brain gain	Brain circ.	Stayers	Total	Brain drain	Brain circ.	Stayers	Total	% net gain/ (bc+sty)	% inbreed/ (bc+sty)
U.S.	40.6	0.6	58.8	100.0	8.9	0.9	90.2	100.0	58.5	10.4
Open countries										
UK	54.4	6.6	39.0	100.0	42.5	8.3	49.2	100.0	45.5	35.2
CANADA	66.2	24.5	9.3	100.0	64.4	25.8	9.8	100.0	14.9	23.4
AUSTRALIA	65.3	16.3	18.4	100.0	59.5	19.0	21.4	100.0	41.2	58.5
SWITZERLAND	73.1	11.5	15.4	100.0	65.0	15.0	20.0	100.0	85.7	51.7
Closed countries										
BELGIUM	17.3	22.0	60.7	100.0	20.5	21.2	58.3	100.0	4.8	66.9
NETHERLANDS	21.8	11.3	66.9	100.0	16.1	12.1	71.8	100.0	8.6	46.1
DENMARK	25.4	6.3	68.2	100.0	26.6	6.2	67.2	100.0	-2.1	89.4
SWEDEN	25.0	15.6	59.4	100.0	40.0	12.5	47.5	100.0	-33.3	54.2
GERMANY	23.0	15.0	62.0	100.0	53.0	9.1	37.7	100.0	-83.1	24.7
FRANCE	14.2	9.2	76.6	100.0	23.7	8.2	68.2	100.0	-14.4	38.0
ITALY	1.7	39.8	58.6	100.0	39.7	24.4	35.9	100.0	-64.0	30.9
Brain circulation countries										
GREECE	17.5	67.5	15.0	100.0	31.2	56.2	12.5	100.0	-24.2	6.1
PORTUGAL	10.8	67.6	21.6	100.0	23.3	58.1	18.6	100.0	-18.2	21.2
TURKEY	12.8	80.0	6.4	100.0	42.2	53.5	4.2	100.0	-58.4	0.0
BRAZIL	4.2	54.3	41.3	100.0	29.0	40.3	30.6	100.0	-36.4	4.5
ARGENTINA	10.5	78.9	10.5	100.0	61.4	34.1	4.5	100.0	-147.0	0.0
CHILE	12.2	85.4	2.4	100.0	26.0	72.9	2.1	100.0	-19.4	0.0
CHINA	32.2	67.6	0.0	100.0	70.9	29.1	0.0	100.0	-195.6	0.0
ISRAEL	16.7	45.2	38.1	100.0	57.8	22.9	19.3	100.0	-117.1	28.6
Other countries										
MÉXICO	38.6	59.1	2.3	100.0	22.9	74.3	2.9	100.0	33.3	3.7
SPAIN	31.1	40.4	28.4	100.0	23.2	45.1	31.7	100.0	15.1	7.1
TOTAL	34.4	15.4	50.2	100.0	28.6	16.8	54.6	100.0	12.4	23.2

Table D. Graduate education of economists born in each country

	% Ph.D. obtained in:				
	Own country	**U.S.**	**Other countries**	**No Ph.D.**	**Total**
U.S.	98.4	-	1.6	-	100.0
Open countries					
UK	62.7	25.0	11.9	0.4	100.0
CANADA	22.3	75.0	2.3	-	100.0
AUSTRALIA	28.6	42.9	28.5	-	100.0
SWITZERLAND	65.0	5.0	30.0	-	100.0
Closed countries					
BELGIUM	66.7	23.1	10.2	-	100.0
NETHERLANDS	79.0	9.7	11.3	-	100.0
DENMARK	78.1	12.5	9.4	-	100.0
SWEDEN	75.0	20.0	5.0	-	100.0
GERMANY	51.8	30.5	17.1	-	100.0
FRANCE	78.4	14.3	7.3	-	100.0
ITALY	26.1	33.2	18.5	12.2	100.0
Brain circulation countries					
GREECE	12.0	46.0	42.0	-	100.0
PORTUGAL	18.6	62.8	18.6	-	100.0
TURKEY	4.2	84.5	11.3	-	100.0
BRAZIL	33.9	61.3	4.8	-	100.0
ARGENTINA	4.5	81.8	13.7	-	100.0
CHILE	2.1	79.2	18.7	-	100.0
CHINA	0.0	83.5	16.5	-	100.0
ISRAEL	25.3	73.5	1.2	-	100.0
Other countries					
MEXICO	2.9	74.3	22.8	-	100.0
SPAIN	35.4	41.5	23.1	-	100.0
TOTAL	58.0	30.3	10.6	10.0	100.0

Table E. Average productivity and average experience for individuals working in 2007 and nationals from each country

	WORKING IN 2007			NATIONALS		
	Mean Q	Mean Exp	Mean Q/Exp	Mean Q	Mean Exp	Mean Q/Exp
U.S.	387.3	21.7	17.7	409.2	25.0	16.3
Open countries						
UK	229.5	17.6	11.9	316.8	22.0	13.9
CANADA	214.9	19.3	8.3	379.7	23.9	15.4
AUSTRALIA	134.6	17.6	6.7	139.1	16.4	10.2
SWITZERLAND	183.3	17.1	10.7	205.1	20.9	10.2
Closed Countries						
BELGIUM	91.1	16.6	5.4	116.1	16.5	6.8
NETHERLANDS	162.7	15.8	10.1	189.3	16.8	11.5
DENMARK	101.1	16.5	7.6	106.4	15.0	8.7
SWEDEN	168.8	14.9	10.5	230	16.2	12.3
GERMANY	148.3	17.7	8.8	136.1	13.4	10.8
FRANCE	113.5	16.1	6.2	157.8	15.8	9.1
ITALY	55.7	17.4	3.7	95.5	14.4	7.5
Brain circulation countries						
GREECE	70.3	19.0	3.9	108.6	17.7	6.6
PORTUGAL	61.6	13.4	5.2	85.6	13.5	6.7
TURKEY	48.0	14.3	4.2	97.2	11.5	10.1
BRAZIL	60.6	14.6	4.7	77.3	12.8	7.0
ARGENTINA	72.2	14.3	5.4	128.4	13	10.6
CHILE	34.3	16.5	2.8	87.7	14.7	5.6
CHINA	166.8	15.5	10.1	196.5	13.1	15.0
ISRAEL	390.0	24.8	15.2	439.0	21.5	18.7
Other countries						
MÉXICO	43.6	13.1	3.0	42.0	12.8	4.4
SPAIN	98.3	13.7	6.9	119.8	14.9	8.1
TOTAL	250.0	18.9	12.3	251.5	12.0	13.0

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

	Individuals working in each country	Nationals from each country
Country variables:		
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)
% Ph.D. in:		
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**

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

	% Ph.D. in:								Years of experience	% Female	Ind. Q index	GDP per capita
	Harvard & MIT	Next 8 U.S.	Next 15 U.S.	Next 27 U.S.	Other U.S.	UK, Can, Austr.	Rest Europe and Israel	Rest of the World				
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)	
<u>Open Countries</u>												
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)	
<u>Closed Countries</u>												
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)	
NETHERL.												
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)	
<u>Brain Circ. Countries</u>												
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)	
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)	
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)	
<u>Other Countries</u>												
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)	
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 H. Mean values (standard deviations) for individuals born in the different countries

	% PH.D. IN:								*YEARS OF EXPERIENCE*	*% FEMALE*	*IND. Q INDEX*	*GDP PER CAPITA*	
	Harvard & MIT	**Next 8 U.S.**	**Next 15 U.S.**	**Next 27 U.S.**	**Other U.S.**	**UK, CAN, AUSTRAL**	**Rest Europe and Israel**	**Rest of the World**					
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)	
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)	
NETHERL.													
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)	
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)	
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)	
OTHER 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)	
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)	