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Article

Researchers' institutional mobility: bibliometric evidence on academic inbreeding and internationalization

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Abstract

We propose institutional mobility indicators based on researchers' mobility flows in 22 major fields of science across 1,130 Leiden Ranking institutions from 64 countries. We base our indicators on data from the Dimensions database and Global Research Identifier Database. We use researchers' first and last affiliations to estimate the extent authors have moved across institutions as well as countries. For each institution, we quantify the shares of researchers with the same affiliation (*insiders*), those who came from another institution within the country (*domestic outsiders*), and those coming from a different country (*foreign outsiders*). Institutions in Central, Eastern, and Southern Europe have the highest share of insiders, whereas institutions in Northern America and Western and Northern Europe have a higher share of foreign outsiders. Foreign outsiders are most common in small and wealthy countries. No disciplinary differences are observed, as captured by the field classification scheme of Dimensions.

Key words: institutional mobility; internationalization; bibliometrics; Dimensions; research system; research policy.

1. Introduction

There is an increasing need to account for how institutions internationalize (Hoekman 2012; Robinson-Garcia et al. 2019). Evidence suggests that cross-national mobility flows are increasing (Sugimoto et al. 2017) as is the strengthening of global collaborative research networks (Wagner and Leydesdorff 2005). Research institutions foster internationalization as they compete to attract and retain foreign talent in a global market (Hazelkorn 2011; Seeber et al. 2016), with foreign-born researchers accounting for 43 per cent of life sciences postdoctoral research in Europe and 56 per cent of these coming from outside the European Union (Moguérou and Di Pietrogiacomo 2008). As a result, there is a policy interest in monitoring and understanding the process of academic mobility and internationalization of universities (OECD 2008; European Commision 2012; Jacob and Meek 2013; Sugimoto et al. 2017).

The lack of global and harmonized datasets has been a persistent challenge in developing global indicators of mobility (Sugimoto et al. 2016; Welch et al. 2018). This is especially problematic at the institutional level, which besides functioning author-disambiguation mechanism requires clear institutional identification (Donner et al. 2020). Recently, bibliometric databases have significantly improved the consistency of publication metadata, particularly author–affiliation linkages, allowing to track affiliations of individual researchers and opening up new opportunities for studying long-term mobility patterns at scale (Moed and Halevi 2014; Sugimoto et al. 2016). Previous work has been concerned exclusively with the quantification of the movement of scholars across countries and disciplines (Aref et al. 2019; Robinson-Garcia et al. 2019). However, evidence on institutional mobility has been lacking.

In this paper, we aim to help in closing this gap by delivering novel insights on the composition of the academic workforce of universities and national research systems worldwide. We base our results on the Dimensions database and the Global Research Identifier Database (GRID). We propose three indicators by which institutional workforces can be characterized based on researchers' first and most recent institution of affiliation. By comparing the institution to which researchers were affiliated in their first publications with their most recent one, we distinguish between:

(1) *Insiders*, defined as researchers who are currently affiliated to the same institution to which they were affiliated in their first publications;
(2) *Domestic outsiders*, that is, those who were originally affiliated to a different institution within the same country from their current one; and
(3) *Foreign outsiders*, researchers who were originally affiliated to an institution located in a different country from their current one.

The paper is structured as follows. First, we review the existing literature on academic mobility and the related concept of inbreeding. Then, we describe the mobility indicators with a description of how we built the dataset. Next, we present the empirical findings from an aggregate perspective and analyze the heterogeneity of universities with regard to researchers' institutional mobility between countries and across the world. We conclude by discussing the implications of our results, limitations of this approach, and future research lines derived from this study.

2. Literature review

Academic mobility is widely perceived as beneficial to the scientific enterprise (European Commission/EACEA/Eurydice 2015; Wagner and Jonkers 2017). It is considered important to promote the dissemination of knowledge, acquirement of experience in different research environments, career advancement, and for the creation of opportunities for collaboration (e.g. Stephan and Levin 2001; Sugimoto et al. 2017; Wagner and Jonkers 2017). Mobile researchers serve as important bridges between countries (Meyer 2001); they reinforce existing or create new ties with other national and foreign institutions, thus generating collaborative research networks that span the globe. When researchers move, they bring with them knowledge and ideas that differ from natives, which are essential for knowledge recombination and interactive learning, which in turn may lead to innovation (Stephan and Levin 2001; Ganguli 2015).

Another important advantage of this connectivity is that it enables the division and coordination of labor and knowledge (Bettencourt 2014). This is important as the search for scientific discovery becomes more complex, it increasingly requires a greater diversity of skills. These connections thus become vital to updating tasks, where a combination of different expertise is essential to ensure the completion of increasingly complex research projects. However, this also may lead researchers to become narrow specialists (Robinson-Garcia et al. 2020) who are less able to recognize relationships between separate groups of phenomena. The increased specialization of researchers combined with the need for attracting new knowledge and skills increases research institutions' pressure to attract global talent. Despite the importance of mobility in science, much of the global characteristics of human capital distribution in the context of science remain underexplored.

The notion of academic mobility is closely related to the concept of internationalization (Wagner and Jonkers 2017). The process of internationalization has become an essential part of universities' strategic planning as it involves the implementation of programs that support the periodic movement of researchers, building ties with top universities and improving visibility. The increasing orientation towards internationalization is in part due to strategic considerations in the context of a global competition for talents (Seeber et al. 2016). Internationalization strategies are particularly used by universities in developed countries (Lepori et al. 2015), which are increasingly dependent on the movement of researchers as a way of maintaining their attractiveness and international reputation.

When deciding on which institution to go next, researchers tend to not only value the quality of prospective institutions but also the attractiveness of the countries where those institutions are located play a significant role (Lepori et al. 2015). As a result, high-income countries are much more likely to attract foreign researchers than developing ones (Chinchilla-Rodríguez et al. 2018). Socio-economic imbalances between receiving and sending locations have raised concerns among policy-makers that researchers' preferences and mobility may lead to further marginalization of peripheral countries in the scientific landscape (Scott 2015). The concern of human capital flight in 'source' countries (Stephan and Levin 2001) has sparked the 'brain drain' (the loss of high-skilled workers) and 'brain gain' (the gain of knowledge workers) debate and is therefore a critical concern for policy-makers (OECD 2010).

The lack of institutional internationalization—which translates into low workforce mobility in a given institution—is thought to be decisive in influencing academic productivity and improving researchers' performance (Horta et al. 2010; Horta 2013; Franzoni et al. 2014) and citation impact (Ganguli 2015; Sugimoto et al. 2017). A recent large-scale bibliometric study reported that mobile researchers (more than one affiliation to different countries) were more cited than non-mobile researchers (Sugimoto et al. 2017). A similar finding was reported by Ganguli (2015) who found that Russian scientists who have migrated to the USA have been more cited by US scientists than those who have not migrated. In the US context, foreign-born faculty has also been found to publish more (Mamiseishvili and Rosser 2010) and publish more breakthroughs (Stephan and Levin 2001) than their US-born counterparts. One explanation for lower levels of impact and productivity of immobile researchers is that this kind of faculty has less access to varied information and exchange dynamics that may explain their lower scientific productivity (Horta 2013).

Other studies suggest that academic mobility may or may not have a negative effect on the researchers' careers. For example, Melin (2005) has shown that mobile scholars returning to Sweden after a postdoctoral period abroad do not necessarily benefit from their foreign experience. Cruz-Castro and Sanz-Menéndez (2010) have found that non-mobile careers are a strong predictor of the timing of rewards in the form of early permanent positions in Spain, while mobile careers in the USA increase researchers' chances of obtaining tenure. This suggests that the relationship between mobility and scientific performance varies widely across national research systems (Cruz-Castro and Sanz-Menéndez 2010).

A related stream of literature contrasts mobility with the practice of having Ph.D. graduates employed by the university that also trained them. This is known as 'academic inbreeding' (Caplow and McGee 1958; Berelson 1960; Yudkevich and Sivak 2012) or 'institutional inbreeding' (Horta 2013). Similar to the lack of mobility and internationalization, inbreeding is seen as negative for both the institution and researchers and has also been an indication of poor institutional performance (Horta 2013). For example, academic inbreeding has been associated with lower output (Horta et al. 2010), fewer articles published in peer-reviewed journals than non-inbred (Horta 2013), and fewer foreign co-authors (Scellato et al. 2012), effectively slowing down the career development of scholars (Inanc and Tuncer 2011). Low productivity levels of inbred scholars emphasize the need for mobility and call for policies to curtail academic inbreeding (Horta 2013).

The university's reliance on insiders among its workforce producing scientific results can be interpreted as the university's tendency to academic inbreeding. Empirical evidence on publication activity of Ph.D. students indicates that even though differences between disciplines matter, the first papers' affiliation can be used as a proxy for Ph.D. granting institution of the individual researcher. For example, Lee (2000), Larivière (2012), and Waaijer et al. (2016) found that Ph.D. students publish their first article before graduation quite frequently in natural and health sciences although less so in social sciences and humanities. Nevertheless, Ph.D. students may acknowledge affiliation to their *alma mater*, even if the dissertation research is published only after leaving the university because of publication delays in peer-review journals.

Macháček and Srholec (2020) directly explored this measurement issue in a random sample of 90 researchers affiliated to major Western and Central European universities derived from the Scopus citation database. They found out from publicly available sources, from which university the researcher graduated, and compared that with outcomes of the bibliometric approach outlined below. The conclusion on whether the researcher is currently based on her alma mater matched by 77 per cent in biochemistry, genetics, and molecular biology, 90 per cent in physics and astronomy, and 87 per cent in social sciences. There was the same number of seven false positives and false negatives, which tend to offset each other; thus, the impact in aggregated data is even more limited.

3. Data and methodology

Recent developments in bibliometric databases have made it possible to study career trajectories and aggregated patterns at the level of institutions, cities, and countries (Vaccario et al. 2020; Sugimoto et al. 2017; Robinson-Garcia et al. 2019; Murray et al. 2020). These developments include the implementation of advanced approaches for affiliation harmonization such as the Leiden Ranking approach or, more recently, the Global Research Identifier Database, which currently covers more than 98,000 research institutions worldwide.

The availability of these harmonized registries makes it possible to identify changes in the affiliations of scholars (Moed and Halevi 2014; Sugimoto et al. 2016). When authors publish a paper with a certain affiliation, they signal that they are associated with that institution. This information allows us to track researchers' trajectories across institutions.

We use the Dimensions database version from June 2019 that is available in the database system of Centre for Science and Technology Studies on Leiden University (CWTS), including data on publications, affiliations, researchers, as well as disciplines (Herzog et al. 2020), which in total contain data for more than 100 million documents. Dimensions cover slightly more documents than Scopus, but many publications lack affiliation links (Guerrero-Bote et al. 2021). Thelwall (2018) reports similar coverage of Dimensions to Scopus for publications with a digital object identifier (DOI), which are predominantly journal articles but also book chapters, conference proceedings, and others.

The Dimensions database has its own author name disambiguation procedure. In general, author name disambiguation algorithms attempt to group citation records of the same author by finding some similarity among them or try to directly assign publications to the individual who wrote them (Caron and van Eck 2014). The Dimensions author name disambiguation algorithm is a two-step procedure. First, it uses 'affiliation data, co-authorship and citation patterns as well as subject area traits' (Hook et al. 2018: 8) to produce clusters of publications that belong to potential individuals. These clusters are then connected using Open Researcher and Contributor ID (ORCID) and DOIs. Each disambiguated author is then assigned a researcher ID, which is a unique identifier, producing almost 20 million researchers. Researcher IDs have been successfully assigned to about 87 per cent of publications–authors combinations (Hook et al. 2018).

However, author-disambiguation algorithms (including the ORCID) are prone to errors (Gurney et al. 2012; Levin et al. 2012; Caron and van Eck 2014), and there is a need to establish a balance between precision (i.e. *How many identified publications truly belong to the same researcher?*) and recall (*Are all researchers' publications correctly identified?*). The Dimensions algorithm favors precision over recall (Bode et al. 2018), which is particularly relevant for us, since mobility events can cause splitting researchers into multiple IDs, and the precision preference can lead to the under-estimation of mobility events. For example, the publications of a researcher are split in disconnected clusters across her affiliations because the algorithm may not be able to merge them together.

Dimensions combines publication metadata with its own database of harmonized research institutions—the GRID. This allows us to easily track the movements of scholars from one institution to the next. Aside from the unique institution identifier, GRID provides detailed geographical information, such as coordinates and city, region, and country names and codes. Other attributes include the institution's year of establishment and its type, which is divided into eight categories, one of which identifies educational institutions and universities.

Dimensions also includes a field-classification scheme for publications based on Australian and New Zealand Standard Research Classification (Australian Bureau of Statistics 2008), which is a three-level hierarchical system of categories. Because more detailed disaggregation leads to a limited number of observations in the sub-disciplines, we use the top level of this classification (FoR division) in this paper, which refers to 22 major disciplines across all fields of sciences.

We used *2018* as the reference year to identify researchers affiliated with specific institutions. Furthermore, we only include researchers with sufficiently long publication histories (i.e. more than 6 years since their first publication). The year of first publication is used as a proxy for measuring academic age (Nane et al. 2017), preventing researchers with very short publication histories from driving the results. All researchers publishing their first paper in 2012 or later are excluded from the analysis.[1]

Consider researcher r is affiliated to institution u and publishing in discipline d in the reference year. Each researcher r can belong to multiple sets as researchers can be affiliated to multiple universities and publish in multiple disciplines. She has a set of publications $P \subset p_{p,t}$ where at least one $p_{p,t>6}$ in which p is the publication index and t is the index for the number of years since the first publication (t is calculated from the publication calendar year). To determine where the researcher r started her career, we select a subset of her initial publications published in the first two calendar years of her publication history, where

$$P^{start} = |p_{p,t} \, where \, t < 2|$$

Based on P^{start}, we derive indicators on whether researcher r started her publication career at the same university ($r^{start,u}$) and country ($r^{start,c}$):

- *Started on the same university?* $r^{start,u} = 1$ if r is affiliated to u in any publication in P^{start}; otherwise $r^{start,u} = 0$.
- *Started in the same country?* $r^{start,c} = 1$ if r is affiliated to any institution in country c in any publication in P^{start}; otherwise $r^{start,c} = 0$.

This allows us to split researchers into three mutually exclusive categories. For each university u and discipline d, we report the share on the total number of researchers of:

1. *Insiders*: Researchers starting at the same university—$\{r|r^{start,u} = 1\}$
2. *Domestic outsiders*: Researchers starting at another institution in the same country—$\{r|r^{start,u} = 0 \text{ and } r^{start,c} = 1\}$
3. *Foreign outsiders*: Researchers starting abroad—$\{r|r^{start,c} = 0\}$

We would like to include in this study only universities with significant research activities. The GRID category of 'educational institutions' is far too broad for this purpose. Therefore, we use the Leiden Ranking methodology to identify the most productive research universities worldwide (Waltman et al. 2012). We use the Leiden Ranking 2020 data (see van Eck 2020), which includes a total of 1,176 universities, only seven of which we were unable to match with the initial set of GRID identifiers. While most of these universities have been created before World War II and only about a tenth of them in the mid-1970s or later, there are some universities in that were established in 1998 or later according to the GRID database. We removed those universities from our sample since younger, less established universities have had less time to employ their own graduates.[2] The final sample includes 1,130 universities.

It is important to note that academic inbreeding is distinct from mobility. Our analysis explore the composition of an institution's workforce based on their initial and most recent affiliation, regardless of affiliation changes within the study period. This means that researchers labeled as *insiders* may have been mobile between those two points in time, but at the moment of the analysis they were linked back to their original institution. Adding a separate category for 'returnees' could be insightful, but also complicated to define, and we leave that as a topic to explore in future research. Not accounting for returnees, however, is likely to overestimate the share of insiders particularly in environments with highly mobile researchers that are well connected to the global job market and thus reduce the differences presented below.

Also, we rely solely on author–affiliations linkages as reflected in researchers' publication record. That means that researchers will be labeled as *insider* regardless of the type of position they have at a given institution. Conversely, researchers are considered *foreign outsiders* for as many universities as they are linked as reflected by their publication record. Unfortunately, there is no easy way to identify all this diversity of affiliation linkages, unless one connects the bibliometric records with administrative data, which is not feasible at the global scale.

The share of foreign outsiders indicates the degree of internationalization of the university. Since researchers are more likely to circulate within the same area, because of institutional, cultural, or personal obstacles for moving faraway, this distinction is probably more robust than between the insiders and domestic outsiders. If a researcher published early in her career solely with affiliation to a foreign institution, she was not likely to get research training in the same country, where she is based now. It is important to realize, however, that foreign outsiders may not necessarily be foreigners in terms of citizenship. It may well be that some of them only began their research career abroad and eventually returned to their homeland.

4. Results and discussion

Table 1 provides a descriptive overview of the dataset. The sample contains universities of different sizes but even the smallest one has enough authors to reliably compute the indicators of our interest.[3]

Overall, the share of insiders in total researchers differs markedly across the universities. On an average, in a university, nearly half of researchers hold the insider status, but this share ranges from less than a third in about one-fifth of the universities to more than three-quarters in a tenth of them, with some notable outliers at both ends of the spectrum. The tendency to employ initial outsiders also varies significantly with a clear predominance of locals over foreigners. Only about a tenth of the universities maintain more than a third of researchers who started publishing with affiliations abroad.

Figure 1 displays the share of insiders in universities worldwide. Each node denotes one university. The size of the node is proportional to the number of researchers in the respective university. The intensity of the color reflects the share of insiders. Areas with the highest share of insiders are concentrated in the South and East regions, while low shares of insiders predominate in the North and West regions. Oceania, namely Australia and New Zealand, are the only exceptions. We also observe an overrepresentation of North American

Table 1. Descriptive overview.

	Mean	Median	SD	Min	Max	Number of universities
Number of researchers	1,585	1,067	1,539	90	12,927	1,130
Institutional age in years	138	92	147	21	1,042	1,130
Percentage of insiders	49.0	46.2	18.1	5.3	92.0	1,130
Percentage of domestic outsiders	35.6	35.9	15.7	0.1	78.4	1,130
Percentage of foreign outsiders	15.4	13.4	10.9	0.5	91.1	1,130

Note: Only Leiden Ranking universities that were established before 1998.

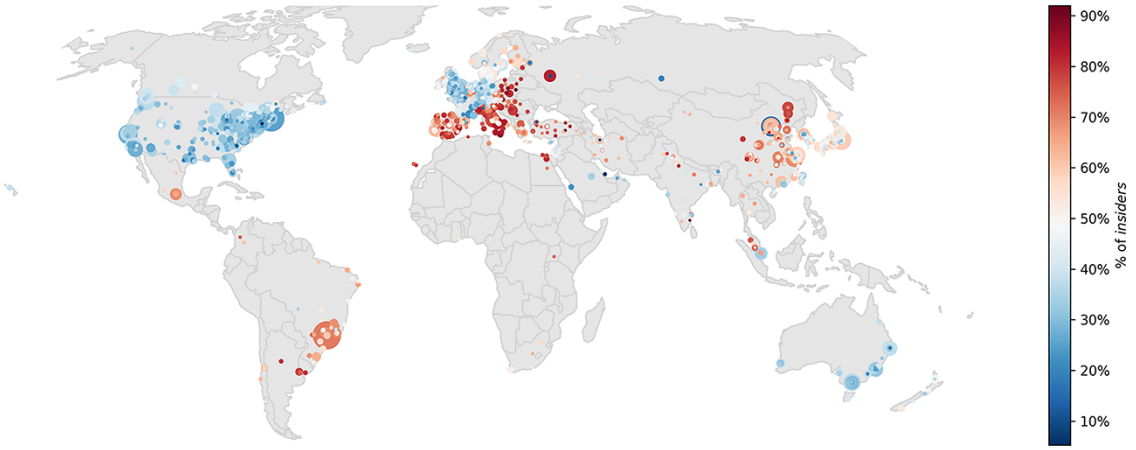

Figure 1. Share of insiders by university.

Note: Only universities included in the Leiden Ranking and established before 1998 are included. Nodes denote universities. The size of nodes denotes the number of researchers identified. Color reflects the share of insiders. Red indicates higher shares and blue lower shares of insiders.

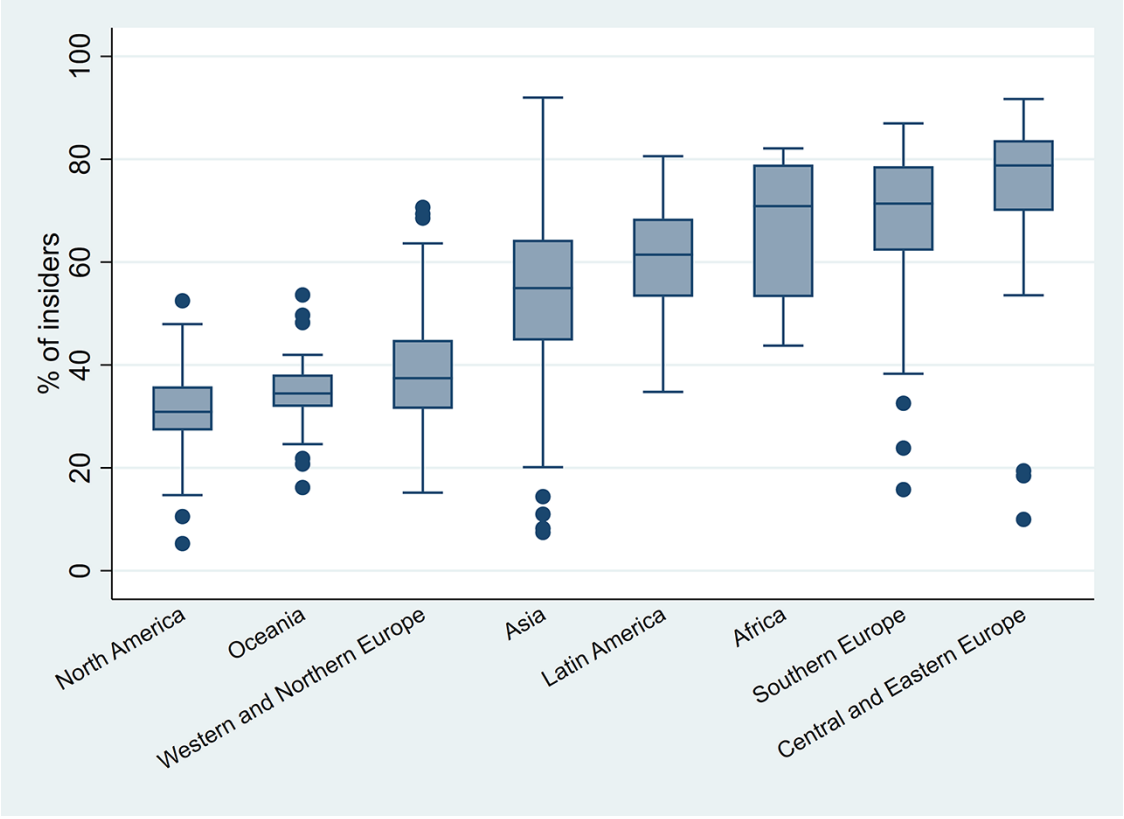

Figure 2. Distribution of the share of insiders in universities by geographic region.

Note: Only Leiden Ranking universities that were established before 1998. The box-plots depict median, boxes for interquartile range, whiskers with the length of 1.5 times that range, and black dots for outliers falling outside of the whiskers.

and European universities in contrast with other regions of the world such as Africa, Southeast Asia (except for China and Japan), and South America.

Figure 2 shows the distribution of universities based on the share of insiders in each geographic region. Europe, which is well represented in the sample, is further subdivided into three sub-regions (Western and Northern Europe, Southern Europe, and Central and Eastern Europe). The lowest proclivity to hire researchers originating from inside exhibit universities in the traditionally advanced countries of North America, Western and Northern Europe, and Oceania. Within North America and Oceania, there is relatively little variation; half of the universities are boxed in a fairly narrow range, indicating that this is a systemic feature of how labor markets for researchers operate therein. Universities in Western and Northern Europe appear to be more diverse, with some high values, particularly in Scandinavian and Benelux countries.

In contrast, a higher share of insiders is typical for universities in former soviet countries from Central and Eastern Europe, as well as in Southern Europe, where the tendency to

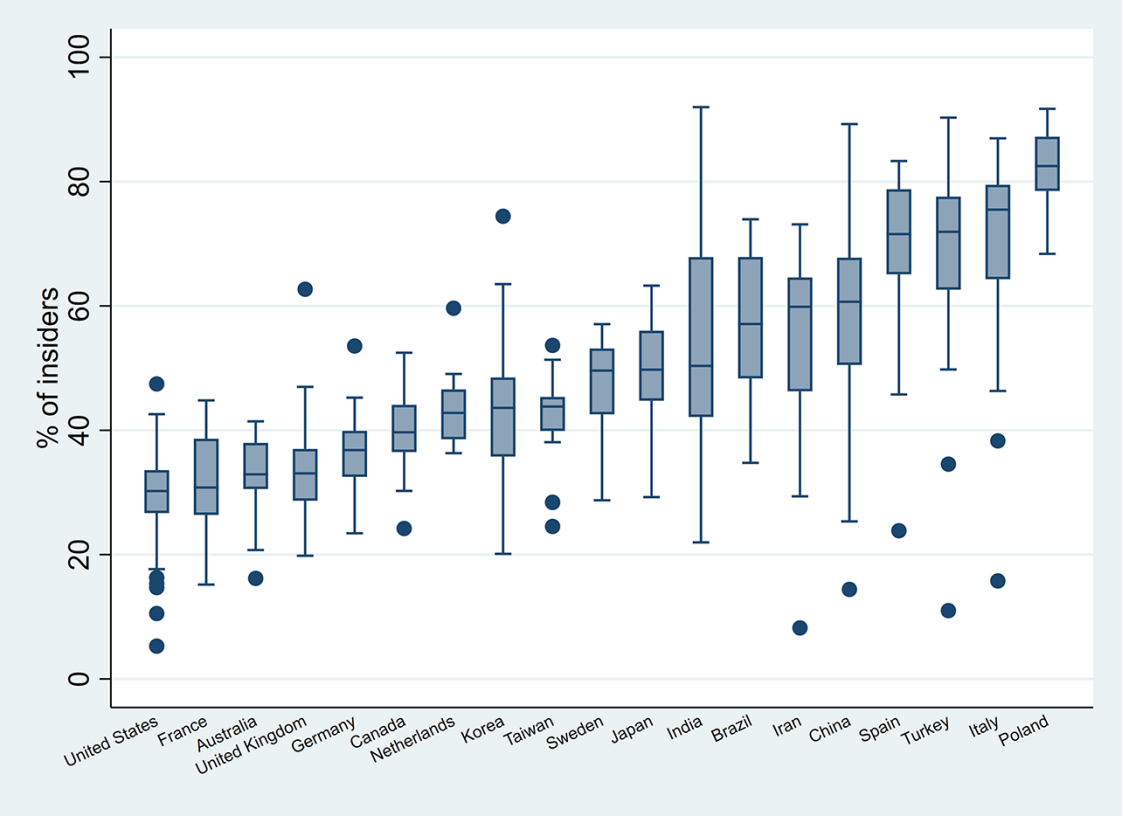

Figure 3. Distribution of the share of insiders in universities by country.

Note: Only Leiden Ranking universities that were established before 1998. Only countries with results at least 10 universities. The box-plots depict median, boxes for interquartile range, whiskers with the length of 1.5 times that range and black dots for outliers falling outside of the whiskers.

employ insiders is roughly twice as high as in the Northern and Western parts of the continent. This shows that there are lingering differences within the European Research Area (ERA), even among the 'old' member countries. In fact, Southern, Central, and Eastern European universities have a propensity to employ insiders that is above of what is common in developing countries, including Africa, although evidence from the latter should be taken with a grain of salt due to a low number of observations from this continent.

For example, only one out of every four researchers currently affiliated to Harvard University, the University of Chicago, the University of Warwick, and the Humboldt University of Berlin and also the University of South Carolina, the Coventry University, or the University of Paderborn, started their career at the same institution. However, more than three out of every four currently affiliated researchers started publishing at Sapienza University of Rome, the University of Seville, the University of Warsaw, the University of Szeged, or the Moscow State University.

When we rank the continents by the median, Latin America and Asia fall between the two extremes. However, this masks vast differences within Asia, which is an amalgam of diverse countries ranging from advanced Japan to emerging China to developing India, but which proves difficult to divide by geography or other lines due to a low number of observations in the potential constituent parts and because the majority of them would be dominated by the largest countries. As illustrated below, the diversity within Asia is best understood by examining evidence from individual countries.

The outliers below the lower limit of the whiskers are predominantly elite local universities that seem not to follow the suit in the higher shares of insiders that is common in their national environments. For example, this includes National Research University Higher School of Economics and ITMO University in Russia, Pompeu Fabra University in Spain, University of Cyprus and the University of Chinese Academy of Sciences. On the other end of the spectrum, with the share of insiders above the upper limit of the whiskers, the main outliers include Ghent University and University of Liège in Belgium or Åbo Akademi University in Finland.

Figure 3 complements these patterns by providing details on individual countries, for which results for at least 10 universities are available. Poland comes out clearly at the top of the list: more than four out of five researchers are typically classified as insiders and none of Polish universities goes below two-thirds of insiders. Next are Italy, Turkey, and Spain with below the lower limit of the whiskers lower rates than Poland but far more variability of the values. The largest variability is detected in China and India; both big countries with emerging and diverse university systems, where the share of insiders ranges from the highest figures in the world to the minimums observed in advanced countries. The USA, France, Australia, the UK, and Germany appear at the bottom of the list, which confirms that there is a strong developmental dimension in this ranking.

Table 2 provides the median values and numbers of universities by geographic region and for countries featured in Fig. 3,

Table 2. Median by country, sorted by the share of insiders (shares of total researchers).

	Insiders	Domestic outsiders	Foreign outsiders	Number of universities
Country groups:				
Central and Eastern Europe	78.8	14.7	5.8	59
Southern Europe	71.4	20.9	5.6	95
Africa	70.9	11.8	19.8	17
Latin America	61.4	27.5	7.8	44
Asia	54.9	32.1	9.2	448
Western and Northern Europe	37.4	40.9	22.6	204
Oceania	34.5	34.1	30.3	37
North America	30.9	52.9	16.1	226
Selected countries (10 or more observations):				
Poland	82.5	10.3	5.3	27
Italy	75.5	20.6	4.5	39
Turkey	71.9	20.4	6.1	30
Spain	71.6	21.4	6.7	41
China	60.7	30.2	8.9	201
Iran	59.9	33.4	8.5	36
Brazil	57.1	36.1	7.1	30
India	50.4	33.7	8.1	33
Japan	49.7	47.1	4.0	51
Sweden	49.6	23.2	25.6	12
Taiwan	43.8	44.1	13.4	21
Korea	43.6	36.2	19.3	42
Netherlands	42.8	34.2	21.8	13
Canada	39.7	32.2	25.1	30
Germany	36.8	45.2	19.1	53
United Kingdom	33.1	41.3	26.3	58
Australia	32.9	35.6	29.7	31
France	30.8	56.0	11.1	21
United States	30.2	53.6	15.3	196

Note: Only Leiden Ranking universities that were established before 1998.

along with the share of domestic and foreign outsiders. The numbers of universities may appear disproportionate—even between countries of roughly similar sizes like China or India, and some large countries that are known to maintain extensive university systems are underrepresented in our dataset (e.g. Mexico and Russia).

Shares of outsiders are negatively associated with the share of insiders, as they jointly add up to the total. More interesting is the proportion of domestic to foreign outsiders, and especially figures for the latter that provide insights on internationalization of the university system. Again, Southern, Central, and Eastern European universities stand out with low shares of foreign outsiders as opposed to their Western and Eastern European counterparts. Likewise, developing countries reported in the table invariably show a relatively low share of foreign outsiders, while advanced countries generally exhibit the largest shares.

The share of foreign outsiders is negatively correlated to the size of national research systems Thus, in large national research systems with many researchers, universities can draw from a large pool of domestic candidates; hence, their chances to find a suitable candidate at home are naturally higher than in small research systems with a limited supply. For example, a university in Iceland is just for this reason likely to display a far higher share of foreign outsiders than otherwise similar universities operating in the USA. Hence, one should compare in this regard universities from countries with research systems of a roughly similar size.

Figure 4 illustrates this point. On the vertical axis is the total number of researchers, regardless of the type of institution, used as a proxy for the size of the national research system. On the horizontal axis is the median share of foreign outsiders. All countries, which have at least one university in the sample, are displayed. The upper-right corner is empty and there is no country with a relatively large research system that displays more than a third of foreign outsiders, which confirms that there is a natural limit for large systems to attract foreigners over locals.

Size is clearly not all that matters. For example, Swiss universities are more internationalized, in terms of having foreign outsiders, as compared to other countries of similar size like Poland and Turkey and also interestingly Israel, Portugal, Belgium, and Denmark. Some high-income countries, such as Japan, Italy, and Spain also have a remarkably low share of foreign outsiders in their universities. The case of Japan is noteworthy (Table 1) although it has an overall modest share of insiders in its universities (49.7 per cent on median), the largest share of their outsiders are domestic (47.1 per cent on median), while they exhibit the lowest share of a foreign outsider (4 per cent on median).

The largest differences are observed for countries with small research systems. Universities in countries like Slovenia, Croatia, Slovakia, Romania, Lithuania, Algeria, Pakistan, and Uganda seem not to attract researchers who started their careers abroad, which is in contrast to Iceland, Cyprus, Lebanon or Jordan. Arabic oil-rich countries in the Persian

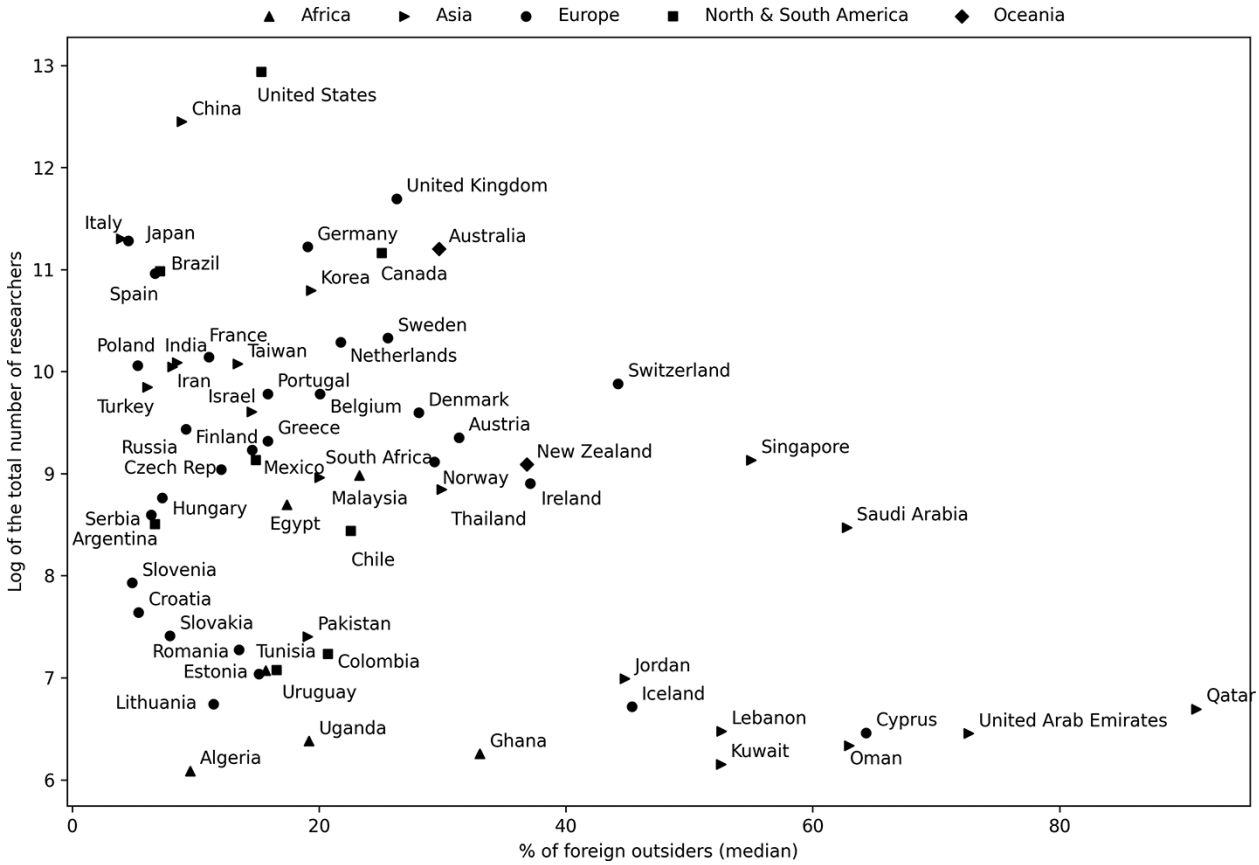

Figure 4. Size of the domestic research system (log of the total number of researchers) and the share of foreign outsiders (median).

Note: Only Leiden Ranking universities that were established before 1998.

Gulf, namely Kuwait, Oman, United Arab Emirates (UAE), Qatar, and Saudi Arabia stand out with high shares of foreign outsiders.[4] This reflects their development strategy based on attracting foreign researchers (Schmoch et al. 2016), but this can also reflect the controversial strategy of universities in Saudi Arabia and elsewhere of offering secondary affiliations to highly cited researchers from abroad to boost their bibliometric profiles and ascend in rankings (Gingras 2014). Arguably, this reiterates the limitation already mentioned above that we do not have any information on the parameters of contracts that underpin the affiliations of researchers in the published papers although in practice these researchers contribute to the production (and visibility) of these universities.

Finally, we examine how the results differ by disciplines and thus to which extent these underlying differences could affect the patterns detected above. Using the Dimensions database, we can distinguish between 22 major disciplines across all fields of sciences, including social sciences and humanities. In order to present robust evidence, we narrow the sample only to universities with at least 30 authors in the respective discipline and present the results only for disciplines, for which such data are available in at least 30 universities. On these grounds, we eliminated from the analysis three disciplines (*Law and Legal Studies; Philosophy and Religious Studies*; and *Studies in Creative Arts and Writing*). The resulting dataset contains information on 10,408 pairs of university disciplines of 1,129 universities across 19 disciplines.

Figure 5 displays the box-plots for the share of insiders by disciplines. The main finding is that there is little variability across disciplines but a large diversity within them. The central tendencies are limited to a narrow range, the interquartile ranges are highly overlapping, while the whiskers tend to reach from close to zero to almost 100 per cent in most disciplines. Arguably, this picture is in contrast to the significant differences that we have observed between universities across the national research systems above.

Table 3 further supports the conclusion that the university (and country) is the dominant level of the analysis with the help of variance components analysis. More specifically, we derive the intra-class correlation coefficient from intercept-as-outcome mixed-effects linear model fitted via restricted maximum likelihood (Stata 2009: 302–354). Stratifying the sample by disciplines explains less than 4 per cent of the variability in the data, regardless of the indicator, while differences between universities account for more than 70 per cent and dividing the sample by countries explains more than 60 per cent, respectively.

From this follows that organizational routines of universities for hiring, evaluating, and promoting of researchers, which to a large extent reflect 'rules of the game' given by national institutional frameworks, make the main difference, while particulars of individual disciplines do not matter that

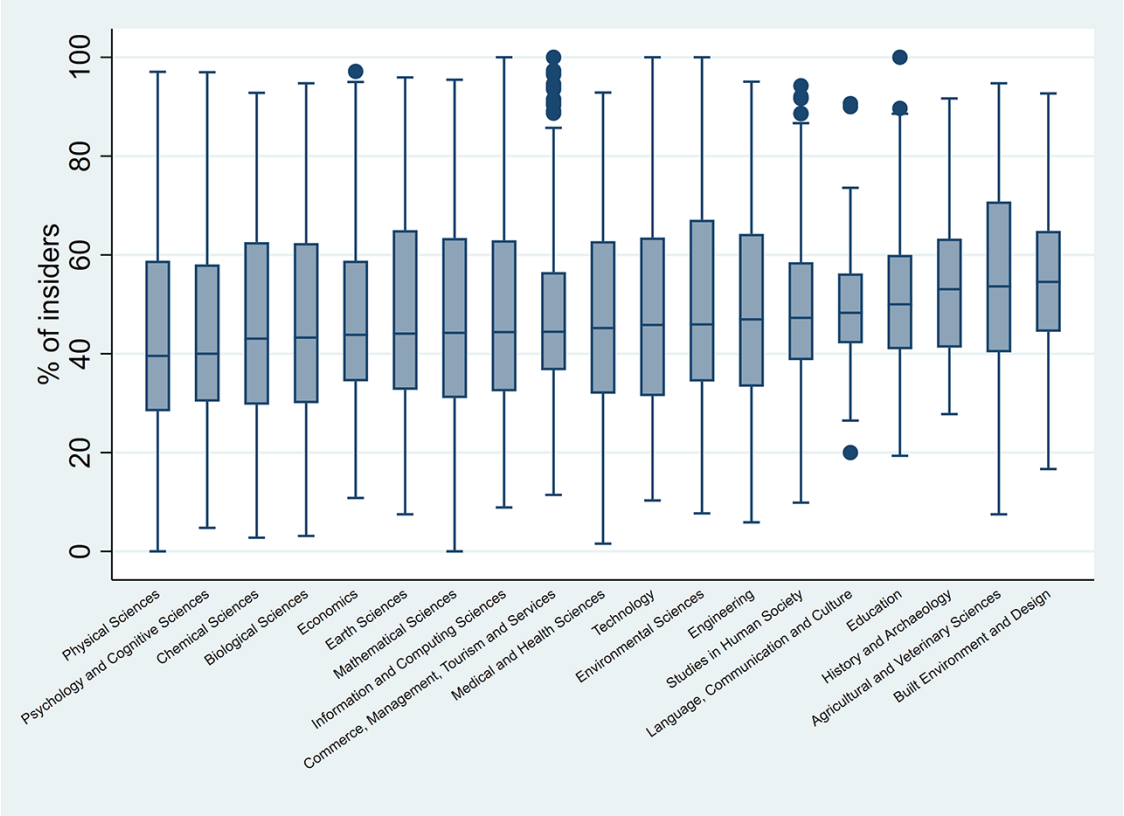

Figure 5. Distribution of the share of insiders by discipline.

Note: Only Leiden Ranking universities that were established before 1998 with at least 30 authors in the respective discipline. Only disciplines with results for at least 30 universities are included. The box-plots depict median, boxes for interquartile range, whiskers with the length of 1.5 times that range, and black dots for outliers falling outside of the whiskers.

Table 3. Variance components analysis by country and discipline (percentage of total variance explained).

Grouping	Insiders	Domestic outsiders	Foreign outsiders	Number of groups
Discipline	2.1	3.5	3.9	19
University	82.2	81.8	73.1	1,129
Country	67.2	60.3	83.3	64

Note: Only Leiden Ranking universities that were established before 1998 with at least 30 authors in the respective discipline. Only disciplines with results for at least 30 universities. Number of observations, i.e. university disciplines, is 10,408.

much. This also suggests that the main conclusions should be robust to differences in publishing practices between disciplines, including the propensity of Ph.D. students (and graduates) to publish with affiliation to their *alma mater* that is important for the interpretation of the results, as discussed above. Hence, the university as a whole, not necessarily the more nuanced university discipline, is confirmed to be the most relevant unit of analysis.

5. Conclusions

This paper demonstrates how bibliometric data can provide valuable insights into the institutional mobility of researchers. The empirical analysis reveals noticeable differences along the north versus south and west versus east geographical dimensions. The gulf between universities in Central, Eastern, and Southern Europe, on the one hand, and universities in North America, Western, and Northern Europe, on the other, is striking, pointing to systemic differences in how labor markets for researchers operating in the respective areas. Most developing countries fall between the two extremes, but there is significant variation within them. The findings also show that differences between universities and national research systems are the most important, while disciplinary differences might be only marginally important.

The main findings on cross-country differences are broadly consistent with the growing body of empirical literature on geographical mobility of researchers, such as the MORE3 survey in Europe conducted by IDEA Consult, WIFO and Technopolis (2017) and the bibliometric analysis of mobility between European countries and the USA (Science Europe 2013). Nevertheless, evidence on (a lack of) institutional mobility has been limited to qualitative analyses, surveys of particular contexts and/or case studies of individual countries (Inanc and Tuncer 2011; Morichika and Shibayama 2015; Tavares et al. 2015; Yudkevich et al. 2015; Horta and Yudkevich 2016; Seeber et al. 2016), whereas broad comparative evidence based on harmonized data has been

lacking. In this regard, the approach developed in this paper opens up new avenues for quantitative research as well as policy analyses on this topic.

The glaring differences between member countries of the European Union provide a sobering reminder that, even after two decades, the ERA agenda, which aims to create a single, borderless labor market for researchers with merit-based hiring, continental competition, and free movement of talent, still has a long way to go (European Commission 2018). It remains to be seen whether, for instance, expanding the EURAXESS network services or granting the so-called HR Excellence in Research badge to institutions that pledge to implement the best practices will make a tangible difference, or whether far deeper structural reforms of university systems will be necessary to break the deadlock in the most autarkic countries.

Limited internationalization may reflect a lack of attractiveness of the national research system for relevant job candidates from abroad, which may be due to a relatively low national wage level in the first place. Nevertheless, in Central, Eastern, and Southern European countries domestic labor markets for researchers do not seem to work well either, which is daunting, especially in large countries with dozens of universities that produce a number of research job candidates who could circulate at least within the national system. Not only is the share of foreign but also domestic outsiders far lower in countries like Poland, Italy, and Spain than in France or Germany. These differences may point to excessively inward-looking hiring practices and general closeness to outsiders regardless of the extent to which these outsiders would be interested in getting the job. The larger presence of insiders in some countries may be explained by the combination of both endogenous (e.g. local research hiring practices, national career paths, etc.) and exogenous reasons (e.g. lack of attractiveness for foreign candidates, low visibility for foreign researchers, etc.).

As far as the developing countries are concerned, the results more than anything point to a large diversity, not only between them but most prominently to uneven development within some of the largest emerging national research systems. The main cases in point are China and India, but to a lesser extent also Iran and Brazil, where coexist universities with widely different profiles of researchers' institutional mobility. It will be interesting to observe which of these research systems converge toward the Northern and Western models of predominantly low academic inbreeding, or the Southern and Eastern models characterized by the opposite or whether they continue to be internally heterogeneous in a similar fashion as members of the ERA as the whole, and how this will change along the overall trajectory of their economic development.

Nevertheless, we cannot rule out the possibility that academic inbreeding could be beneficial in some circumstances, such as in newly forming fields of research carried out in institutional and national contexts, when the stock of relevant outsiders may be limited, or in countries at low levels of development, for which attracting outside talent may not be feasible. Some research suggests that there can be upsides of academic inbreeding because local connections increase social capital of researchers, which benefit their careers (Yamanoi 2005; Gorelova and Yudkevich 2015). As Woolcock and Narayan (2000) and other contributors to the literature on social capital point out; however, strong connections between people may well benefit them, but do not per se guarantee socially desirable outcomes. What becomes evident from this study is that scientometric approaches provide a fertile ground for quantitatively testing such hypotheses. The proof of concept presented in this study clearly illustrates this literature would greatly benefit from taking this evidence more seriously.

The main takeaway from this paper for policy-makers is perhaps that it is informative to use scientometric evidence for analyses of researchers' institutional mobility and that this line of enquiry ought to be deepened and extended along a number of lines. Admittedly, this study represents only a first glimpse into this direction. As already hinted above, future research should examine how these patterns evolve over time and what is the impact of research policies on the mobility profiles of universities. Monitoring perspectives, which can be relatively easily implemented by repeating the same computational exercise for different periods, would be possible and advisable in the future, complementary to other approaches (e.g. MORE-4[5] and related surveys, etc.). Moreover, the broad comparative perspective presented in this paper serves as a basis for asking more refined questions about what explains these differences and what are their consequences at various levels of analysis spanning from individual researchers to universities and whole countries, e.g. how is mobility linked to career development? What management practices and policy instruments lead to higher mobility and diversity of academic workforces? And what are the impacts of inbreeding in national research systems?

Future research using this approach also needs to address some methodological limitations. The most pressing need is for examining in more detail the assumption that Ph.D. students start to publish with affiliation to their *alma mater* that is crucial for interpretation of the insiders as inbreeders. We need to find out to which extent this assumption holds for researchers with different characteristics and from different contexts, for instance, with regard to multiple affiliations or part-time affiliations, to nail down the main sources of discrepancies and refine the computations accordingly. Another challenge that needs to be addressed is how to expand the coverage of the analysis beyond universities covered in the Leiden Ranking to bring forward even broader evidence, especially from developing countries, but without compromising the coherence of the sample in the sense of mixing in the analysis academic institutions with excessively different missions.

Finally, it is important to remark that the approach presented in this paper follows a *backward-looking* perspective, studying the set of researchers currently publishing at a given university and looking backward at where they started to publish. A different perspective would be a *forward-looking* approach to studying mobility, in which universities would be characterized by the researchers who started to publish in them and finding out whether this set of *alma mater* researchers continue at the same university afterward or move elsewhere.[6] Although both approaches are complementary, it can be argued that both will capture different aspects of mobility, albeit with a different interpretation and

implications, thus deserving future research about how they can be combined for a more complete picture about global academic inbreeding.

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Notes

1. Excluding researchers with short publication histories, and hence limited availability of relevant data, also mitigates the problem that researchers could be mistakenly broken down into multiple researcher IDs by the disambiguation algorithm.
2. A total 39 observations were dropped for this reason, of which six have the number of insiders equal to 0 and 5 exhibited less than 5 per cent of insiders, which is below the minimum observed in the rest of the sample.
3. The number of authors with at least one publication affiliated with a university in 2018 (who published their first paper in 2012 at latest) could be used as a conservative estimate of its current number of researchers (i.e. its productive workforce). In fact, the actual headcount of researchers based at the university is likely to be significantly higher, as not everybody publishes every year.
4. In Fig. 1, Saudi Arabia is notably one of the countries with more foreign outsiders. This country, together with Qatar, UAE, and Kuwait, has been described as 'attracting countries' of researchers from abroad to their universities (El Ouahi et al. 2020).
5. https://www.more-4.eu/.
6. Suppose a university that trained a lot of researchers in the past, half of them went abroad and the other half were employed by the same university, and that the university was not able to attract any other external researchers from other universities. In our *backward-looking* calculation, this university would have a high share of insiders. Thus, our *backward-looking* approach would not capture the fact that the university has sent abroad half of its trained researchers.

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Appendix

GitHub repository with source codes and public dataset: https://github.com/vitekzkytek/ResearchersInstitutionalMobility