MAX PLANCK INSTITUTE
FOR DEMOGRAPHIC RESEARCH

Konrad-Zuse-Strasse 1 · D-18057 Rostock · Germany · Tel +49 (0) 3 81 20 81 - 0 · Fax +49 (0) 3 81 20 81 - 202 · www.demogr.mpg.de

MPIDR Working Paper WP 2026-009 I March 2026
https://doi.org/10.4054/MPIDR-WP-2026-009

# Internationally mobile researchers contribute to scientific production far beyond their share in the population

**Aliakbar Akbaritabar** I akbaritabar@demogr.mpg.de
**Andres F. Castro Torres**
**Emilio Zagheni**

# Internationally mobile researchers contribute to scientific production far beyond their share in the population

Aliakbar Akbaritabar[a,b,*], Andres F. Castro Torres[a,c], and Emilio Zagheni[a]

[a]Department of Digital and Computational Demography, Max Planck Institute for Demographic Research, 18057 Rostock, Germany.
[b]Institute of Sociology and Demography, University of Rostock, 18057 Rostock, Germany.
[c]Computational Social Sciences and Humanities Laboratory, Barcelona Supercomputing Center (BSC), Barcelona, 08034, Spain.
[1]([*]Corresponding author, Email: akbaritabar@demogr.mpg.de)

Current version: March 23, 2026

**Abstract**

Scientists move internationally in search of opportunities, because of push factors in the origin countries, for family-related, personal, or other reasons. Regardless of what prompts international relocations of researchers, mobility (or lack of it) has macro-level implications for scientific production that are often not fully visible because they have not been quantified. We analyzed bibliometric data on 30+ million publications, indexed by Scopus, and written by 19+ million scholars between 1996 and 2021, to measure the contribution of internationally mobile scholars to scientific production in their country of residence. We found that, across countries, scientific fields, and genders, internationally mobile scholars consistently contribute far more publications than their share of the population of scientists would imply. In advanced economies, mobile scholars account for approximately 20% of all publications, compared to 14–15% in non-advanced economies; in both cases their contribution far exceeds their share of the scholarly population. Smaller countries show a distinct pattern of hosting a larger fraction of scholars with international mobility experience (up to 60%) who are highly productive (in some cases contributing to up to 80% of the publications of the country). Standard bibliometric metrics of national scientific production are analogous to Gross Domestic Product (GDP) accounting: they capture what is produced within a country's borders regardless of who produced it. Our results quantify a dimension invisible in such metrics—the contribution of internationally mobile scholars—and motivate complementary measures of scientific production that account for scholar's country of origin and mobility history.

**Keywords**: International migration; Scientific mobility; Scientific productivity; Bibliometric data

# 1 Introduction

Migrants make significant contributions to society, fostering lasting economic, cultural, and social ties between regions with diverse historical and socioeconomic backgrounds (Hirschman, 2005). In light of recognition of the importance of migrants, there have been attempts to measure migration's impact on various aspects of host societies, including population diversity, urban development and economic growth (Hirschman, 2005). In the context of migration of scientists, the studies that have addressed the measurement of internationally mobile researchers' contribution to host societies have focused primarily on individual trajectories, at the micro level (Sugimoto et al., 2017). What we do not know is the extent to which migrant scientists, at a macro or aggregate level, contribute to the scientific production of host countries, and how that varies across fields, genders, countries, and related dimensions.

In this article, we assess the contribution of scientists who move across international borders. We know that they tend to be more productive and have more citations (Sugimoto et al., 2017), which could be due, in part, to the positive selectivity of migrants, and to expanded collaboration networks (Akbaritabar, Castro Torres, & Larivière, 2024). However, we do not know the extent to which mobile scientists, as a group, contribute to scientific production in the host society, and in comparison to the local scientists who have not been mobile.

Researchers' contribution to scientific production in a given year is typically attributed to the country of their affiliation in that year. We add another dimension, by assessing the scientific production also based on the country of academic origin, which we define as the country of the institutional affiliation for the first publication of the scientist. Then we assess the relative importance of internationally mobile scholars for the scientific production of host societies. Evaluation of countries' scientific production typically relies on metrics that consider scientific articles published by researchers with institutional affiliations in the respective country, regardless of their country of origin. In an analogy with the assessment of economic production of countries, standard metrics can be seen as the equivalent of Gross Domestic Product (GDP) for scientific production. As a matter of fact, GDP includes production in the country irrespective of who produced the goods and services in the country. In the System of National Accounts, the Gross National Product (GNP) represents a complementary measure of economic production that focuses on assessing the economic production of nationals of a country, regardless of where they are located. To the best of our knowledge, there is no such thing as a quantity analogous in spirit to the GNP for scientific production.

We argue that considering complementary metrics of scientific production that account for international mobility is an insightful exercise that can be carried out with existing bibliometric data. Quantifying the contribution of scholarly mobility is relevant for a number of reasons, including: i) improving our understanding of how host countries benefit from diverse intellectual input; ii) designing immigration policies that attract high-impact researchers and enable them to be productive via appropriate funding schemes; iii) evaluating the return on investment of welcoming international talent.

We offer a way to unveil and quantify the contribution of scholarly mobility in the context of scientific production. We achieve this goal by (i) mapping country-level differences in the share of mobile scholars, (ii) measuring the contribution of mobile scholars to scientific production worldwide across countries, fields, genders, and in comparison to non-mobile scholars, while also controlling for collaboration networks. Additionally, we present similar results after standardizing the measures for academic age and seniority, highlighting that our findings are not attributable to scholars at a particular career stage. We present empirical results that rely on bibliometric data indexed by Scopus on publications since 1996.

## 1.1 Background

Migration, research evaluation systems, and global inequalities in scientific production are interrelated and affect each other. This interrelation is understudied. The relevant literature is split across these topics.

**Migration**. We live in the age of migration (de Haas et al., 2014). Technological developments in transportation and communication have boosted domestic and international migration worldwide (Czaika & de Haas, 2014; Czaika & Orazbayev, 2018), while the relative share of migrants to population has remained consistent (Abel & Sander, 2014). Not surprisingly, in this context, international scholarly mobility has depicted growing patterns (Akbaritabar, Theile, & Zagheni, 2024; Sanliturk et al., 2023; Zhao et al., 2023). Individual preferences, gender norms, official policies, cross-national agreements, and wars are among the main driving factors for the mobility of scholars (Appelt et al., 2015; Chinchilla-Rodríguez et al., 2018).

Scholarly mobility can be viewed as a distinct form of economic migration. Scholars seek better scientific and economic opportunities in the academic market (Appelt et al., 2015; Portes, 1976). Considering their credit and credentials, they have better odds of successfully moving and settling in new contexts (Ganguli, 2015; Sanliturk et al., 2023).

**Evaluation**. Research assessment systems use different data, indicators, and methodologies (Sugimoto & Larivière, 2018; Wilsdon et al., 2015). Some assessment methodologies rely solely on bibliometric data (Akbaritabar et al., 2021; Arnold et al., 2018). Some others use quantitative indicators in combination with qualitative peer review (Abramo & D'Angelo, 2011; Bertocchi et al., 2015; Zacharewicz et al., 2019). Additionally, some rely solely on the latter, for example, the Research Excellence Framework in the UK (Traag & Waltman, 2019; Wilsdon et al., 2015). These assessment methodologies have been criticized for not covering the breadth and depth of academic activities (Robinson-Garcia et al., 2023). In addition, the literature supports the idea that international scholarly migration improves research productivity and impact (Scellato et al., 2017; Sugimoto et al., 2017). This academic mobility could influence research evaluation outcomes. These influences are difficult to measure. For example, a few national or regional evaluation systems, such as the South Korean, Chinese, and Latin American, incorporate bibliometric and international mobility indicators in scholars' evaluation to incentivize the return of migrated academics (Qian Song & Zai Liang, 2019; Song & Song, 2015; Wiesel, 2014; Zweig & Wang, 2013; Zweig et al., 2006).

**Inequalities**. Global inequalities in knowledge production are pervasive. They affect how countries' scientific production is perceived and recorded in quantitative databases (Stahlschmidt et al., 2019; Stephen et al., 2020). The concentration of resources in universities and research and development departments in the Global North (Akbaritabar, 2021; Balland et al., 2020) is entrenched in inequalities in knowledge production, visibility, and impact (Nielsen & Andersen, 2021). It also affects the public and governmental use of scientific results (Yin et al., 2022).

In light of this background, our aim in this paper was to leverage large-scale bibliometric data from Scopus to show the unequal contribution of internationally mobile scholars to scientific production worldwide by fields, gender, and after controlling for collaboration. We leverage the International Monetary Fund's classification of advanced and non-advanced economies as a systematic proxy for differences in research infrastructure and financial resources, to examine whether global inequalities in resources translate into quantifiable differences in the role of mobile scholars in scientific production. We also discuss the implications of current research evaluation exercises and indicators in use that neglect mobility history of scholars.

## 2 Data and Methods

We use articles and reviews, 30+ million, by 19+ million authors indexed by a 2021 snapshot of Elsevier's Scopus (Baas et al., 2020). We assign a binary gender to authors' first names (Akbaritabar, Theile, & Zagheni, 2024). This approach based on first and last names (to also account for country differences by using the full names) is standard practice in the field and enables large-scale studies. However, we acknowledge its limitation of producing binary classifications only. We use Scopus' field classifications of publications in three macro categories (described further below). We tested different measures for productivity (Akbaritabar, Castro Torres, & Larivière, 2024) and for simplicity, since results were consistent, we present the results based solely on the fractional number of publications. We count fractional publications (e.g., a paper with two authors counts half a paper for each), and classify them into two groups based on the authors' locations: origin and destination publications, using the affiliation of an author's first and last publication, respectively, which are assessed at the individual author level and then aggregated for countries to facilitate visualization. This aggregation allows us to calculate the share of contributions to publications made by mobile and non-mobile (i.e., local) scholars for each country. We identify mobility events based on changes in academic affiliation addresses in the publications (Akbaritabar, Theile, & Zagheni, 2024; Akbaritabar et al., 2025) using the most occurring affiliation address, i.e., the mode (Akbaritabar, Theile, & Zagheni, 2024; Sanliturk et al., 2023; Zhao et al., 2023), which also considers multiple affiliations.

**Assigning fields of science to authors**. For fields of science, we used Scopus' All Science Journal Classifications (ASJC) that assigns publications to disciplines. We use a mapping of ASJC codes to six OECD macro fields of sciences (OECD, 2007): Agricultural Sciences, Engineering and Technology, Humanities, Medical and Health Sciences, Natural Sciences, and Social Sciences. In this study, we further categorize these six categories into three groups of closely related fields, i.e., "Agricultural, Engineering, & Natural Sciences", "Humanities and Social Sciences", and "Medical and Health Sciences". We assign a field to each researcher based on the field to which the highest proportion (above 70%) of their publications is assigned, following (Akbaritabar, Castro Torres, & Larivière, 2024; Akbaritabar et al., 2025). Please note that our results, based on the six and three categories of fields of science, were extremely similar and consistent. Consequently, to ease visualization, we present the three categories.

**Measuring productivity**. For the author's productivity, we tested different measures of productivity (Akbaritabar, Castro Torres, & Larivière, 2024; Akbaritabar et al., 2018), e.g., the number of publications per author, the number of publications as the first author, the inverse number of publications per count of authors (fractional counting), and the number of co-authored publications. We found similar results using these different measures. In the results section, for simplicity, we present the results based solely on the fractional number of publications. It also considers field differences in co-authorship and tendencies for collaborative work to control for collaboration networks, e.g., larger teams are more prevalent in the Natural Sciences than in the Social Sciences. In a separate measurement, we used citations as a measure of impact and found similar results to those presented here based on productivity.

**Standardizing productivity by academic age**. We are aware that academic age could have an effect on how productive scholars are (Akbaritabar et al., 2018). In the results, which were based on a fractional count of publications (to control for collaborative works), we count "all publications throughout one's career". This could be considered as prone to the effect of "shorter" versus "longer" career spans and active publication periods. To control for this, and in a comparative set of analyses, we considered three different measures for academic age: a) the years of difference between the first publication year and the latest publication year, b) the count of unique and distinct years of active publication which is not necessarily continuous as

some authors do not publish in some years in between. The usual practice in using this data for scholarly migration is to backward fill these missing years by two years (Akbaritabar, Theile, & Zagheni, 2024). Our goal here was to see if a higher count of distinct years in publishing activity could signal academic age. c) the first year of publication of the author subtracted from the latest year in our observation, i.e., 2021. We then standardized productivity relative to these three distinct measures of academic age in separate attempts. Our results using all three measures were in line with the non-age-standardized results presented below. Hence, we present age in the results below, but interpret them with caution, since these results could be prone to left-censoring issues (see more details in Akbaritabar, Theile, and Zagheni, 2024; Akbaritabar et al., 2025) in the observed publications and measurement of age.

**Mobility event identification and calculated measures**. We identify mobility events based on changes in academic affiliation addresses in the publications (Akbaritabar, Theile, & Zagheni, 2024; Akbaritabar et al., 2025) using the "mode" affiliation address (Akbaritabar, Theile, & Zagheni, 2024; Sanliturk et al., 2023; Zhao et al., 2023). Our method also considers authors who hold multiple affiliations in one publication and/or in different publications in a given year (see more details in supplementary information of Akbaritabar et al., 2025). This method reduces these affiliations to the most frequently occurring affiliation address, i.e., the mode. We use this mode as the country of residence for that year. We then check if this mode affiliation address has changed compared to the previous and next years. We limit the mobility events to those lasting at least one year. This definition approximately matches the United Nations definition of a migrant (Department of Economic and Social Affairs Statistics Division, 2022; Economic Commission for Europe, 2011), which requires a change of at least one year in the usual place of residence.

We use each mobile author's location at the time of the first and last recorded publication as their place of "origin" and "destination", respectively. Using this origin and destination categorization, we compute two measures at the individual author level. We then aggregate these measures to the country level: (i) the share of the total number of fractional publications per country due to mobile scholars and (ii) the share of mobile scholars in the population. A country-level correlation of these two measures will reveal the potential role of scholarly mobility in influencing scientific outputs. We highlight that our measurement does not account for intermediary mobility events between the origin and destination. While differentiating between mobile and non-mobile (or native) scholars, it does not consider travelers or short-term residents in a science system (Ghorbanpour et al., 2025).

In our results and the maps showing the contribution of mobile scholars, some countries are missing due to not having any mobile scholars, such as Andora (AND, ISO 3-letter code), Dominica (DMA), Equatorial Guinea (GNQ), Palau (PLW), Solomon Islands (SLB), and Tonga (TON). There are also some countries whose ISO codes do not match the ISO codes used in geographical data and the map. These are excluded, such as Guadeloupe (GLP), Martinique (MTQ), and Svalbard and Jan Mayen (SJM).

We use the International Monetary Fund classification scheme of countries with advanced and non-advanced economies. According to this scheme, advanced economies include Andorra, Australia, Austria, Belgium, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Macao SAR, Malta, The Netherlands, New Zealand, Norway, Portugal, Puerto Rico, San Marino, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom, and the United States of America. All other countries are non-advanced economies.

# 3 Results

The map in Fig. 1 shows the share of mobile scholars per country's population of scholars. It shows that only in some rare cases of smaller countries this share goes above 20% and in most large science systems, this share stays below 20% of the population of scholars.

The top panel in Fig. 2 shows that, in virtually all countries and continents, internationally mobile scholars' contributions exceed what would be expected based on their relative sizes. More specifically, the figure shows the share of publications by internationally mobile scholars in each country (y-axis) against the share of mobile scholars in the respective countries (x-axis), across fields of science and genders. In all fields of science, there is a positive correlation between the country-level share of mobile scholars and their relative contribution to the count of publications. This is in line with the literature that scholars with international mobility experience are more productive (Sugimoto et al., 2017). Most of the data points lay above the identity line, indicating that the mobile scholars' share of published papers is larger than their share in the population of scholars. This finding holds for both men and women, with male scholars being, on average, more internationally mobile than women, as previously observed in the literature (Zhao et al., 2023). Going beyond that, here we also observe that internationally mobile men have a higher number of publications compared to internationally mobile women, even after controlling for collaboration networks.

This gender difference is maximal in the Agricultural, Engineering, and Natural Sciences and minimal in the Humanities and Social Sciences. The majority of countries shown on the top panel in Fig. 2 with large numbers of scholars (i.e., above 250 thousand, indicated by marker size) follow the same trend: the internationally mobile scholars' share in publications exceeds their relative size in the population. In addition, they mostly cluster around the bottom left of the figure, meaning that the share of mobile scholars is relatively small with respect to the country's size. Countries with relatively small populations of scientists (i.e., below 5 thousand) are more heterogeneous. We observe that, on average, internationally mobile scholars play a more important role in the science production of these small countries. For instance, in some of these countries, the share of scholars with international mobility experience is close to 60% of the population, and their contribution to scientific production is close to or above 80%. These countries are often understudied in the bibliometric literature, as a substantial number of studies only consider countries with populations of scholars above a certain threshold. Fields of science have noticeable differences. For example, on the one hand, the Humanities and Social Sciences, disciplines with smaller shares in both scientific production due to mobile scholars and the share of mobile scholars, while having the points above the identity line, show smaller fraction of production contributed by mobile scholars. On the other hand, Agricultural, Engineering, & Natural Sciences, and Medical and Health Sciences, which are the fields with the highest share of scientific production and the largest sizes of scholars' population, also show a more prevalent role for mobile scholars. This indicates that, in both relative and absolute terms, they have a larger population of mobile scholars who are highly productive.

While points for both genders are above the identity line, most sub-plots and fields of science show that male mobile scholars dominate the highest share of scientific production, and the points for female scholars (with some notable exceptions) cluster around the bottom left of the panels. This is more evident from the rectangles that show the country's mean per gender. In all disciplines, the rectangle for female scholars has a smaller area and fits inside the one for male scholars. This shows a lower mean in the share of population and in scientific production. Nonetheless, the points for female mobile scholars also stay above the identity line, indicating that despite their lower share in the population of scholars and in productivity, they produce a higher number of publications than their share in the population.

The bottom panel in Fig. 2 shows the same results but standardized by academic age (described in data and methods section). Overall, the trends observed by age-standardized measures of fractional count of publications are very similar to the non-age-standardized results in the top panel of this figure. This further highlights that our findings is not due to scholars in certain career stages.

While Fig. 2 shows the overall trends per field of science, gender, and continent along two dimensions, it does not provide a global geographical perspective. To address this, Fig. 3 provides a global geographical perspective on the contribution of internationally mobile scholars to countries' scientific production. The values on the map are obtained by dividing the share of publications due to mobile scholars (y-axis in Fig. 2) by the share of mobile scholars in the population (x-axis in Fig. 2). The values thus provide a measure of the "relative importance of mobile scholars for each country", which, in almost all countries, is higher than 1. This means that internationally mobile scholars contribute beyond their share in the population of scientists for the respective countries. A value of 2, for example, indicates that internationally mobile scholars in the given country contribute twice as much, in terms of publications, as their share in the population of scientists would imply. Some striking patterns are observed: countries with green and yellow colors (such as China, India, and Brazil, to name a few) are highly dependent on internationally mobile scholars for their publications, with values on the map above 2, and up to 4.5. While most science systems with large numbers of researchers in Europe and North America have values that range between 1 and 2 in terms of mobile scholars' relative importance, there are also notable cases in these regions, such as Germany, Spain, and Russia, which reach values between 2 and 3. This could indicate different levels of migrant selectivity or different institutional settings that enable mobile scholars to be particularly productive.

Table 1 shows the differences between advanced and non-advanced economies, as defined by the International Monetary Fund (IMF), in their dependence on mobile scholars for total and fractional counts of publications presented as percentages. The IMF classification is useful because advanced economies have better infrastructure and financial resources to support research than non-advanced economies.

In the total count of publications, we use a whole counting (Akbaritabar, Castro Torres, & Larivière, 2024) to assign a publication to all authors involved. Additionally, we use fractional counting to highlight the stark difference in disciplinary collaboration culture. The proportions due to mobile scholars based on both the total count of publications and fractional counts show that in most disciplines, except for the Social Sciences and Humanities, advanced economies have a higher reliance on mobile scholars for their scientific production. The overall sum of publications in all disciplines also follows this trend.

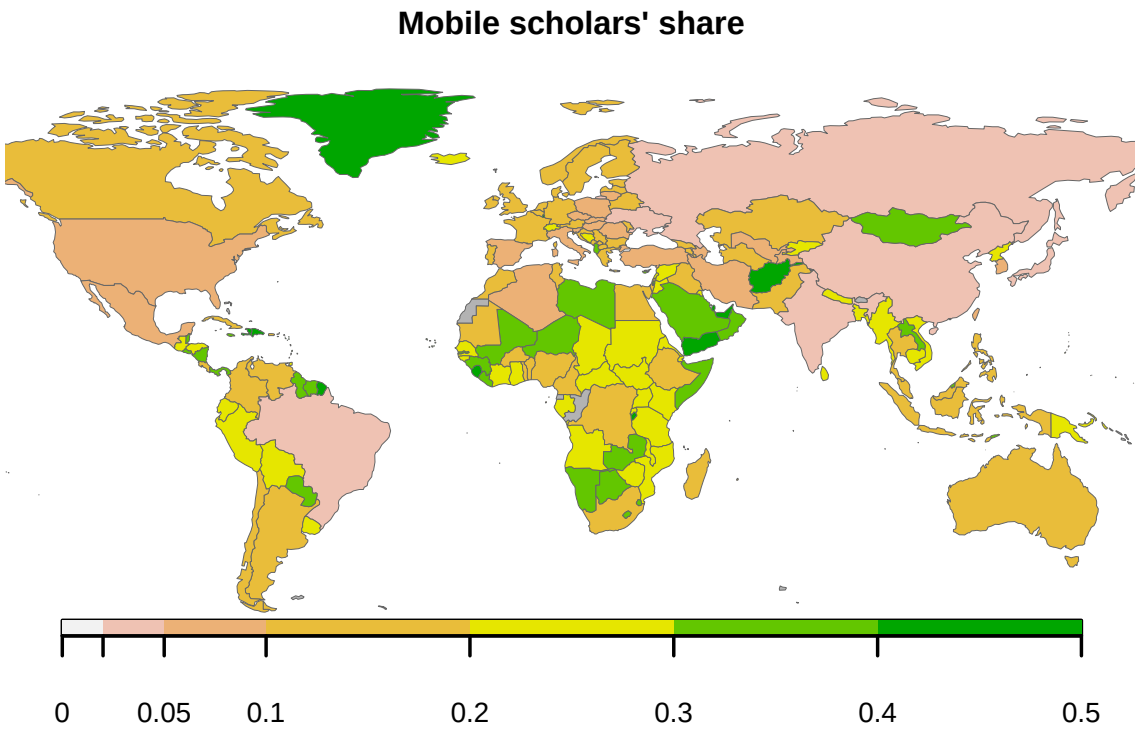


Fig. 1: **Share of internationally mobile scholars per country's population**. Western European countries, Canada and Australia show a share from 10 to 20% of mobile scholars. The US shows a below 10% share.

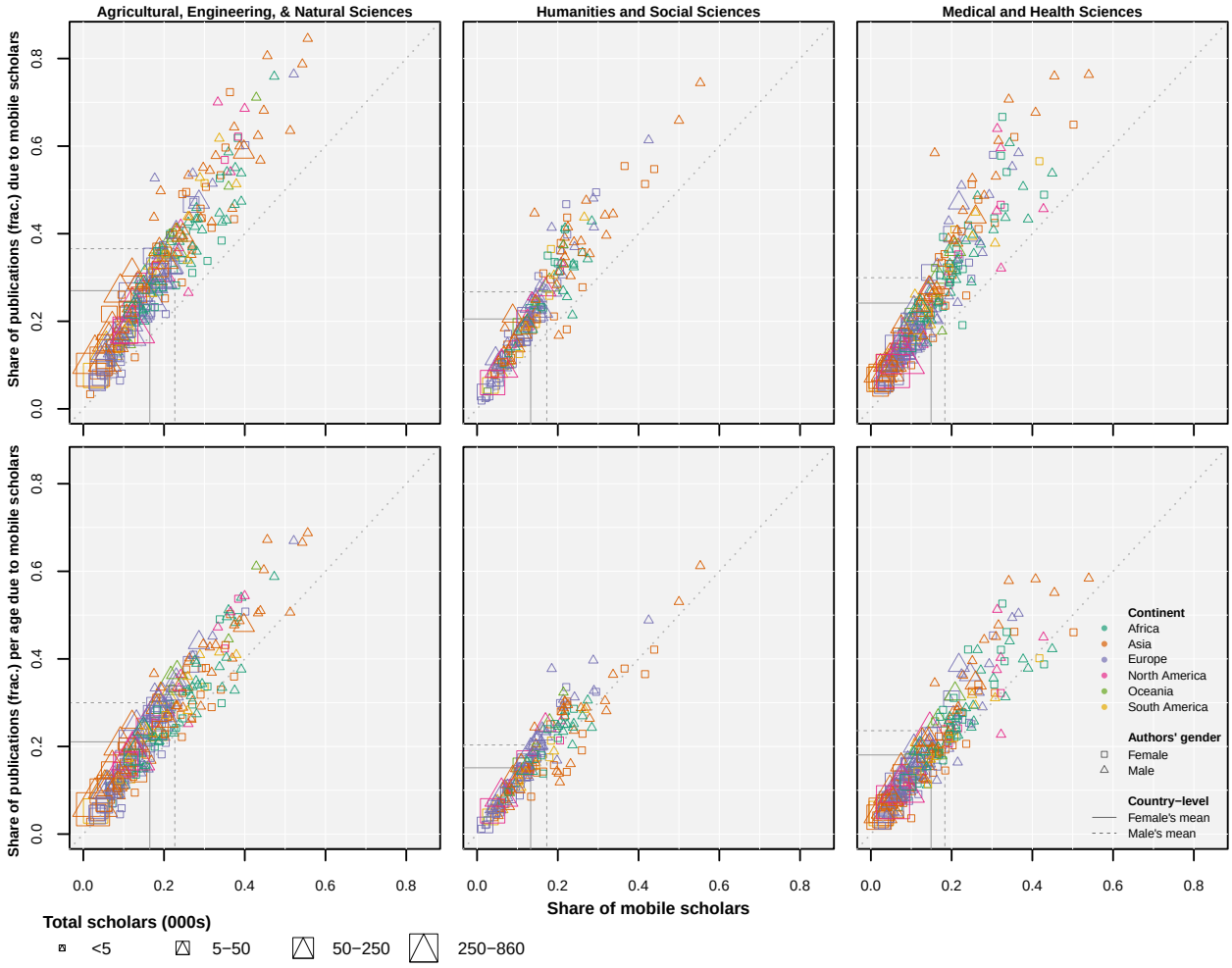


Fig. 2: **Internationally mobile scholars publish more than their share in their country of residence would imply**. **Top panel**: The share of internationally mobile scholars (x-axis) against the share of publications contributed by them (y-axis), by gender (shape of points) and continent of affiliation (color). The markers' size is proportional to the number of scholars (in thousands). Country-level means by gender are shown as solid (women) and dashed (men) rectangles. The 45-degree line indicates the identity of proportions in the x- and y-axes. **Bottom panel**: shows the same results standardized by academic age. In both panels, most points are above the identity line, across the three vertical sub-plots that show the relationship for three main macro fields of science.

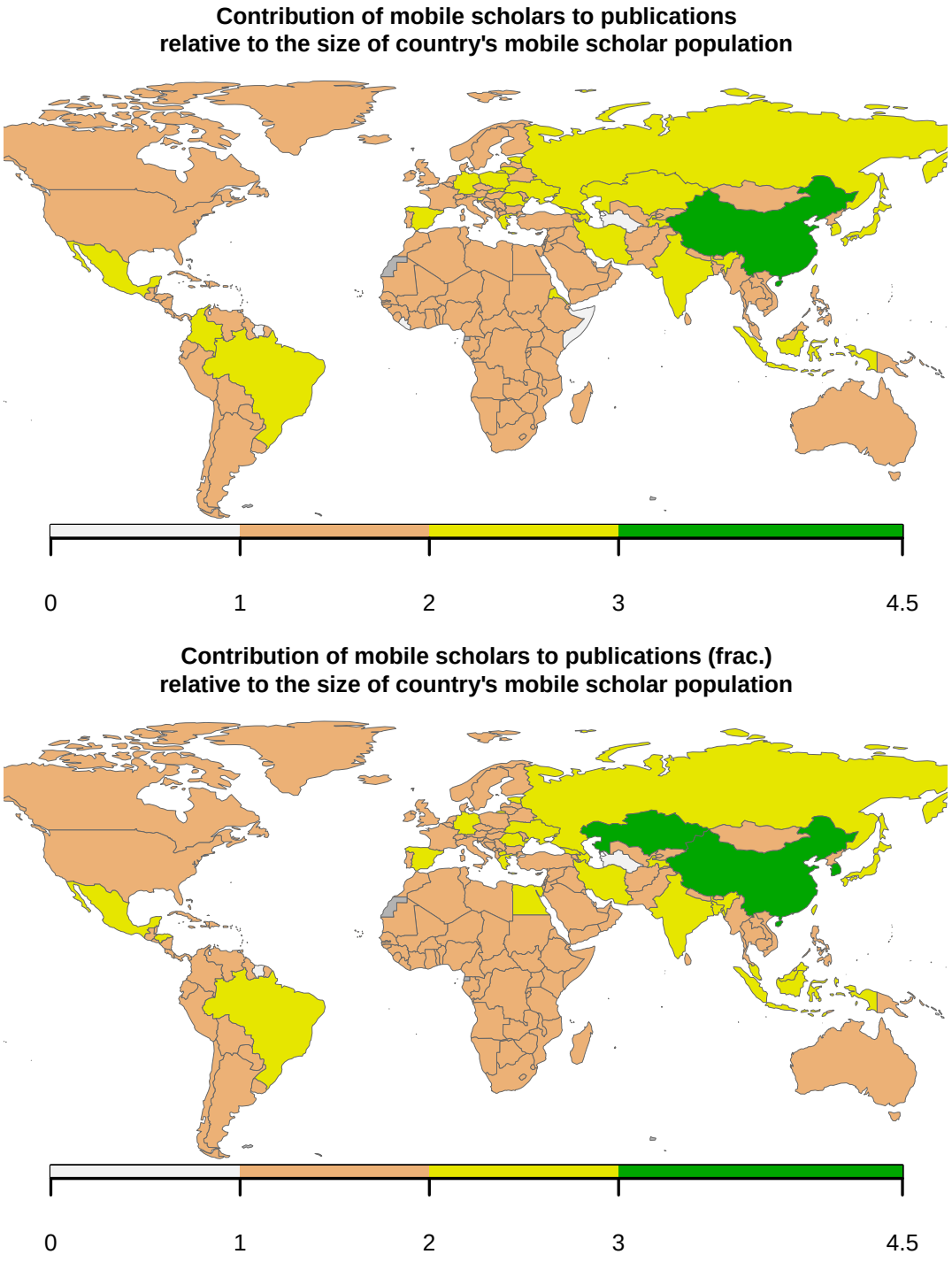


Fig. 3: **Internationally mobile scholars are highly productive in virtually all countries**. For each country, the values on the map are obtained by dividing the values on the y-axis of Fig. 2 by those on the x-axis of that same figure. A value of 2, for example, indicates that internationally mobile scholars in the given country contribute twice as much, in terms of publications, as their share in the population of scientists would imply.

Table 1: Count of publications with whole (third column) and fractional counting (considers co-authorship effect, fourth column), and proportions (fifth and sixth columns, respectively), due to mobile scholars by advanced and non-advanced economies in the three fields of science, and for authors without a discipline assignment. The **underlined, bold blue font** indicates a higher proportion for advanced economies.

| Field | Advanced economies? | Publications | Publications (frac.) | Publication share due to mobile scholars | Publication share due to mobile scholars (frac.) |
|---|---|---|---|---|---|
| **Agr-Eng-Nat** | Yes | 42,609,562 | 11,079,235 | **0.24** | **0.23** |
| | No | 26,345,183 | 7,362,628 | 0.14 | 0.15 |
| **Hum-Soc** | Yes | 4,095,867 | 2,356,204 | 0.15 | 0.16 |
| | No | 725,160 | 389,969 | 0.15 | 0.16 |
| **Med-Heal** | Yes | 30,610,910 | 7,933,082 | **0.14** | **0.15** |
| | No | 8,752,195 | 2,069,131 | 0.11 | 0.13 |
| **No-Disc** | Yes | 8,426 | 1,572 | **0.03** | **0.03** |
| | No | 14,431 | 4,782 | 0.01 | 0.01 |
| **Total** | Yes | 77,324,765 | 21,370,093 | **0.20** | **0.19** |
| | No | 35,836,969 | 9,826,511 | 0.14 | 0.15 |

**Notes:** Agr-Eng-Nat: Agricultural Sciences, Engineering and Technology, and Natural Sciences; Hum-Soc: Humanities and Social Sciences ; Med-Heal: Medical and Health Sciences; No-Disc: No discipline assigned.

# 4 Discussion

We aimed at quantifying the impact of internationally mobile scholars on the scientific production of host countries. Our results reveal global heterogeneity in the share of mobile scholars and their contribution to publications, across countries, fields of science, and genders, while controlling for collaboration networks. The central finding is that internationally mobile scholars consistently contribute far beyond their relative size in the scholarly population, and this holds across continents, scientific fields, and for both men and women.

Building on the GDP/GNP analogy introduced in the Introduction, we highlight the practical relevance of our findings. Standard bibliometric assessments of national scientific production resemble GDP: they count what is produced within a country's institutional boundaries, regardless of scholars' country of origin. Our results quantify the magnitude of a dimension that is invisible in such metrics: the contribution of internationally mobile scholars to the host country's scientific output. For advanced economies, mobile scholars account for approximately 20% of all publications; in non-advanced economies this share is around 14–15%. In both cases, mobile scholars contribute well above their population share. Across virtually all countries the ratio of mobile scholars' publication share to their population share exceeds 1, and in countries such as China, India, and Brazil it reaches values between 2 and 4.5. Evaluation systems and ranking exercises that assign all of this output to the host country, without accounting for scholars' origins, produce a picture of national scientific production that obscures the role of international talent flows. This supports the case for developing complementary metrics of scientific production that take scholar origin and mobility into account—an endeavour that is feasible with existing large-scale bibliometric data, as we show here.

Some striking heterogeneity is observed for small science systems. In countries with fewer than approximately 5,000 researchers, mobile scholars can constitute up to 60% of the scholarly population and account for up to 80% of publications. These science systems are structurally dependent on internationally mobile researchers, or the return of their previously emigrated scholars (Ghorbanpour et al., 2025), to sustain any substantial scientific output—a form of dependence that reinforces rather than reduces global inequalities in knowledge production (Nielsen & Andersen, 2021). Policies that incentivize the return of scholars trained abroad, or that create welcoming conditions for incoming researchers, could have outsized positive effects on the scientific capacity of small science systems. Conversely, barriers to international mobility—such as visa restrictions, hostile immigration policies, or inadequate research infrastructure—may disproportionately harm these systems. Advanced economies show a higher aggregate reliance on mobile scholars (20%) compared to non-advanced economies (14–15%), reflecting their better capacity to attract and retain international talent in most fields.

Gender differences in scholarly mobility and their relationship to scientific production deserve careful interpretation. We showed that male scholars are, on average, more internationally mobile (Zhao et al., 2023) and produce more publications than female scholars. The gender gap in publications between mobile men and women is widest in the Natural Sciences and narrowest in the Humanities and Social Sciences. However, a nuanced finding is that mobile female scholars also consistently publish above their share in the population. This indicates that, among women who are internationally mobile, productivity is particularly high. This pattern likely reflects stronger positive selection among female mobile scholars, or it could signal increased publication pressure in international academic environments. The finding can have a policy implication that reducing structural barriers to female international mobility may yield strong aggregate returns in scientific production.

Our study has several limitations that we would like to acknowledge. First, we use the affiliation at each scholar's first and last recorded publication as their country of origin and destination respectively, which

does not account for intermediate moves or return migration (Ghorbanpour et al., 2025). Second, Scopus coverage is uneven across regions and disciplines (Baas et al., 2020), likely leading to underestimates of the scholarly population in non-advanced economies and the Humanities and Social Sciences. Fourth, gender is assigned using a binary name-based classifier that misclassifies some names and does not capture non-binary identities. Fifth, academic age estimates are subject to left-censoring (Akbaritabar et al., 2025) given that publications prior to 1996 are not observed; we therefore interpret the age-standardized results with caution and present them solely to emphasize that higher productivity among mobile scholars is not a characteristic of a particular career stage.

The manuscript provides initial findings that open up a number of opportunities for the development of new research lines. These include, among others: (i) assessing and understanding the mechanisms that explain the productivity premium of internationally mobile scholars, including the role of positive selectivity, expanded collaboration networks, and institutional and funding mechanisms that favor productivity, within a unified theoretical framework integrating mobile and non-mobile scholars; (ii) measuring and theorizing on the extent to which international mobility of individuals generates positive externalities in terms of scientific production for *both* the countries of origin and destination; (iii) modeling the implications of different national research evaluation systems for how the contributions of mobile scholars are attributed and rewarded, given that current metrics provide an incomplete picture; and (iv) examining how changes in migration policy regimes—such as visa restrictions, travel bans, and bilateral agreements—alter the share and productivity of mobile scholars over time, using the present framework as a baseline.

## Acknowledgements

Bibliometric data by "Kompetenznetwerk Bibliometrie" is funded by Bundesministerium für Bildung und Forschung (BMBF, 16WIK2101A). We thank Tom Theile for technical support in downloading raw bibliometric data, and Vincent Larivière and Cassidy R. Sugimoto for their comments.

## Conflict of interest

Authors declare that they have no conflicts of interest.

## Data Availability

All scripts and data to replicate presented results will be deposited in a public repository.

## Author Contributions

AA: Conceptualization, Data curation, Investigation, Methodology, Validation, Writing - original draft, Writing - review & editing.
AFCT: Conceptualization, Formal Analysis, Investigation, Methodology, Software, Validation, Visualization, Writing - review & editing.
EZ: Conceptualization, Writing - review & editing.

## References


Abel, G. J., & Sander, N. (2014). Quantifying Global International Migration Flows. *Science*, *343*(6178), 1520–1522. https://doi.org/10.1126/science.1248676

Abramo, G., & D'Angelo, C. A. (2011). Evaluating research: From informed peer review to bibliometrics. *Scientometrics*, *87*(3), 499–514. https://doi.org/10.1007/s11192-011-0352-7

Akbaritabar, A. (2021). A quantitative view of the structure of institutional scientific collaborations using the example of Berlin. *Quantitative Science Studies*, *2*(2), 753–777. https://doi.org/10.1162/qss_a_00131

Akbaritabar, A., Bravo, G., & Squazzoni, F. (2021). The impact of a national research assessment on the publications of sociologists in Italy. *Science and Public Policy*, *48*(5). https://doi.org/10.1093/scipol/scab013

Akbaritabar, A., Casnici, N., & Squazzoni, F. (2018). The Conundrum of Research Productivity: A Study on Sociologists in Italy. *Scientometrics*, *114*(3), 859–882. https://doi.org/10.1007/s11192-017-2606-5

Akbaritabar, A., Castro Torres, A. F., & Larivière, V. (2024). A global perspective on social stratification in science. *Humanities and Social Sciences Communications*, *11*(1), 1–10. https://doi.org/10.1057/s41599-024-03402-w

Akbaritabar, A., Dańko, M. J., Zhao, X., & Zagheni, E. (2025). Global subnational estimates of migration of scientists reveal large disparities in internal and international flows. *Proceedings of the National Academy of Sciences*, *122*(15), e2424521122. https://doi.org/10.1073/pnas.2424521122

Akbaritabar, A., Theile, T., & Zagheni, E. (2024). Bilateral flows and rates of international migration of scholars for 210 countries for the period 1998-2020. *Scientific Data*, *11*(1), 816. https://doi.org/10.1038/s41597-024-03655-9

Appelt, S., van Beuzekom, B., Galindo-Rueda, F., & de Pinho, R. (2015, January). Chapter 7 - Which Factors Influence the International Mobility of Research Scientists? In A. Geuna (Ed.), *Global Mobility of Research Scientists* (pp. 177–213). Academic Press. https://doi.org/10.1016/B978-0-12-801396-0.00007-7

Arnold, E., Debackere, K., Sivertsen, G., Spaapen, J., Sturn, D., European Commission, & Directorate-General for Research and Innovation. (2018). *Mutual Learning Exercise: Performance-based funding of university research : Horizon 2020 Policy Support Facility*. Retrieved April 16, 2020, from http://publications.europa.eu/publication/manifestation_identifier/PUB_KIAX18003ENN
OCLC: 1111248976.

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies*, *1*(1), 377–386. https://doi.org/10.1162/qss_a_00019

Balland, P.-A., Jara-Figueroa, C., Petralia, S. G., Steijn, M. P. A., Rigby, D. L., & Hidalgo, C. A. (2020). Complex economic activities concentrate in large cities. *Nature Human Behaviour*, *4*(3), 248–254. https://doi.org/10.1038/s41562-019-0803-3

Bertocchi, G., Gambardella, A., Jappelli, T., Nappi, C. A., & Peracchi, F. (2015). Bibliometric evaluation vs. informed peer review: Evidence from Italy. *Research Policy*, *44*(2), 451–466. https://doi.org/10.1016/j.respol.2014.08.004

Chinchilla-Rodríguez, Z., Bu, Y., Robinson-García, N., Costas, R., & Sugimoto, C. R. (2018). Travel bans and scientific mobility: Utility of asymmetry and affinity indexes to inform science policy. *Scientometrics*, *116*(1), 569–590. https://doi.org/10.1007/s11192-018-2738-2

Czaika, M., & de Haas, H. (2014). The Globalization of Migration: Has the World Become More Migratory? *International Migration Review*, *48*(2), 283–323. https://doi.org/10.1111/imre.12095

Czaika, M., & Orazbayev, S. (2018). The globalisation of scientific mobility, 1970–2014. *Applied Geography*, *96*, 1–10. https://doi.org/10.1016/j.apgeog.2018.04.017

de Haas, H., Miller, M. J., & Castles, S. (2014). *The Age of Migration: International Population Movements in the Modern World*. Red Globe Press.

Department of Economic and Social Affairs Statistics Division. (2022). *Handbook on measuring international migration through population censuses*. United Nations. Retrieved December 11, 2023, from https://unstats.un.org/unsd/demographic-social/Standards-and-Methods/files/Handbooks/international-migration/2022-UNSD-Handbook-Meas-Intern-Migration-E.pdf

Economic Commission for Europe. (2011). Statistics on international migration a practical guide for countries of eastern europe and central asia. Retrieved November 12, 2023, from https://unece.org/info/publications/pub/21838

Ganguli, I. (2015). Immigration and Ideas: What Did Russian Scientists "Bring" to the United States? *Journal of Labor Economics*, *33*(S1), S257–S288. https://doi.org/10.1086/679741

Ghorbanpour, F., Malaguth, T. Z., & Akbaritabar, A. (2025). Differentiating Emigration from Return Migration of Scholars Using Name-Based Nationality Detection Models. *Proceedings of the International AAAI Conference on Web and Social Media*, *19*, 636–652. https://doi.org/10.1609/icwsm.v19i1.35836

Hirschman, C. (2005). Immigration and the American century. *Demography*, *42*(4), 595–620. https://doi.org/10.1353/dem.2005.0031

Nielsen, M. W., & Andersen, J. P. (2021). Global citation inequality is on the rise. *Proceedings of the National Academy of Sciences*, *118*(7). https://doi.org/10.1073/pnas.2012208118

OECD. (2007). Revised Field of Science and Technology (FOS) classification in the Frascati Manual (Classification, Field of science and technology classification, FOS, Frascati, Methodology, Research and development). Retrieved December 7, 2020, from https://one.oecd.org/document/DSTI/EAS/STP/NESTI(2006)19/FINAL/fr/pdf

Portes, A. (1976). Determinants of the Brain Drain. *The International Migration Review*, *10*(4), 489–508. https://doi.org/10.2307/2545081

Qian Song & Zai Liang. (2019). New Emigration from China: Patterns, Causes and Impacts. *Modern China Studies*, *26*(1), 5–31. Retrieved November 1, 2021, from https://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=134111618&site=ehost-live&scope=site

Robinson-Garcia, N., Costas, R., Nane, G. F., & Leeuwen, T. N. v. (2023). Valuation regimes in academia: Researchers' attitudes towards their diversity of activities and academic performance. *Research Evaluation*, *32*(2), rvac049. https://doi.org/10.1093/reseval/rvac049

Sanliturk, E., Zagheni, E., Dańko, M. J., Theile, T., & Akbaritabar, A. (2023). Global patterns of migration of scholars with economic development. *Proceedings of the National Academy of Sciences*, *120*(4), e2217937120. https://doi.org/10.1073/pnas.2217937120

Scellato, G., Franzoni, C., & Stephan, P. (2017). A mobility boost for research. *Science*, *356*(6339), 694–694. https://doi.org/10.1126/science.aan4052

Song, H. Z., & Song, E. (2015). Why Do South Korea's Scientists and Engineers Delay Returning Home? Renewed Brain Drain in the New Millennium. *Science, Technology and Society*, *20*(3), 349–368. https://doi.org/10.1177/0971721815597140

Stahlschmidt, S., Stephen, D., & Hinze, S. (2019). Performance and Structures of the German Science System. Retrieved July 28, 2020, from https://www.e-fi.de/fileadmin/Assets/Studien/2019/StuDIS_05_2019.pdf

Stephen, D., Stahlschmidt, S., & Hinze, S. (2020). Performance and Structures of the German Science System 2020. https://www.e-fi.de/fileadmin/Assets/Studien/2020/StuDIS_05_2020.pdf

Sugimoto, C. R., & Larivière, V. (2018). *Measuring Research: What Everyone Needs to Know*. Oxford University Press.

Sugimoto, C. R., Robinson-Garcia, N., Murray, D. S., Yegros-Yegros, A., Costas, R., & Larivière, V. (2017). Scientists have most impact when they're free to move. *Nature*, *550*(7674), 29–31. https://doi.org/10.1038/550029a

Traag, V., & Waltman, L. (2019). Systematic analysis of agreement between metrics and peer review in the UK REF. *Palgrave Communications*, *5*(1), 29. https://doi.org/10.1057/s41599-019-0233-x

Wiesel, T. (2014). Fellowships: Turning brain drain into brain circulation. *Nature*, *510*(7504), 213–214. https://doi.org/10.1038/510213a

Wilsdon, J., Allen, L., Belfiore, E., Campbell, P., Curry, S., Hill, S., Jones, R., Kain, R., Kerridge, S., Thelwall, M., Tinkler, J., Viney, I., Wouters, P., Hill, J., & Johnson, B. (2015). The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management. https://doi.org/10.13140/RG.2.1.4929.1363

Yin, Y., Dong, Y., Wang, K., Wang, D., & Jones, B. F. (2022). Public use and public funding of science. *Nature Human Behaviour*, *6*, 1–7. https://doi.org/10.1038/s41562-022-01397-5

Zacharewicz, T., Lepori, B., Reale, E., & Jonkers, K. (2019). Performance-based research funding in EU Member States—a comparative assessment. *Science and Public Policy*, *46*(1), 105–115. https://doi.org/10.1093/scipol/scy041

Zhao, X., Akbaritabar, A., Kashyap, R., & Zagheni, E. (2023). A gender perspective on the global migration of scholars. *Proceedings of the National Academy of Sciences*, *120*(10), e2214664120. https://doi.org/10.1073/pnas.2214664120

Zweig, D., Chung, S. F., & Vanhonacker, W. (2006). Rewards of technology: Explaining China's reverse migration. *Journal of International Migration and Integration*, *7*(4), 449–471. https://doi.org/10.1007/BF02934904

Zweig, D., & Wang, H. (2013). Can China Bring Back the Best? The Communist Party Organizes China's Search for Talent. *The China Quarterly*, *0*(215), 590–615. Retrieved November 1, 2021, from https://www.jstor.org/stable/23510804