

# The international flow of academics and its impacts on the scientific performance of scholars

*Keywords:* academic mobility, international flow, academic performance, inequality, bibliometrics

## Background

Academic mobility plays an important role in fostering communication, collaboration, and knowledge exchange between scientific communities [1]. Understanding the flows of scientists—tracing where they originate and where and when they make a career move, how their trajectories vary by field, and how the mobility impacts their careers—is critical for the scientific community. From the perspective of brain drain, academic mobility is the driving force of the global redistribution of knowledge, for highly skilled migrant academics carry with them the promise of innovation, scientific development, regional competitiveness, and economic growth [2, 3].

Nevertheless, studying the cross-border flow of scientists remains difficult and, to date, has mostly relied on self-reported surveys, government records, or single-source data [4]. The literature shows evidence of academic mobility in countries such as Russia [5], China [6, 7], Greece [8], Italy [9, 10], and Mexico [11], as well as in specific fields such as physics [12], mathematics [13], artificial intelligence [14], and the life sciences [15]. However, with the development of bibliometric approaches, we can now track the current and longitudinal global mobility of academics on large scales. Using the feature of author name disambiguation, several studies have examined the international flow of academics as a multiscale measurement of academic mobility [16] and the level of gender inequality therein [1].

Even so, academic mobility’s multiple facets and impact on scholars’ academic performance remains underexamined. In response, our study elucidates mobility in academia with several novel aspects. First, we used a comprehensive dataset covering wider-ranging fields and countries, which contributes to the generalizability of the findings. Second, we developed an inclusive taxonomy for mobility (i.e., non-mobile, migrant, visiting, and joint affiliation) at different career stages. We also leveraged statistical matching methods that pair mobile with non-mobile researchers in order to examine the effect of international mobility on scientific performance. Overall, we aimed to answer two research questions:

- **RQ1:** To what extent are individual factors (i.e., country of origin, gender, career stage, and field of research) associated with scholars’ international mobility?
- **RQ2:** To what extent does international mobility affect scholars’ scientific performance in terms of productivity, collaboration, disruption, and research impact?

## Methods

**Data.** The open-source dataset OpenAlex [17], used as our primary source for data, includes five scholarly entities that are hierarchically related: authors, publications, institutions, disciplines, and venues. From data updated through November 2022, we extracted authorship data with complete information about authors, works, and institutions from 1970 to 2020. Only authors who began their academic careers after 1970 were analyzed. We also used publications indexed in OpenAlex to map the international mobility of scholars, the accuracy of which was cross-validated by using the ORCID dataset, a smaller dataset that uniquely identifies scholars and their self-reported employment and educational histories. Last, the discipline of authors

was identified using the classification scheme (called as “concept”) of Microsoft Academic Graph.

**Detecting Mobility.** We used the institutional affiliation listed in publications to track the flow of authors. Of the 261,503,376 authors with publication records on OpenAlex, those who published at least two articles and whose academic age exceeded 2 years were analyzed. The author’s country of origin was based on the country of the author’s affiliation listed in their first publication. Based on the literature [1, 16], we developed four comprehensive, inclusive categories of academic mobility: *non-mobile* (i.e., scholars who have remained in their country of origin throughout their academic careers), *migrant* (i.e., scholars who have left their country of origin), *visiting* (i.e., scholars with a foreign affiliation lasting less than 2 years and who returned to or maintained their primary affiliation), and *joint affiliation* (i.e., scholars with a foreign affiliation lasting at least 2 years and who maintained their primary affiliation). The 2-year gap was decided by matching our mobility detection results with ORCID data.

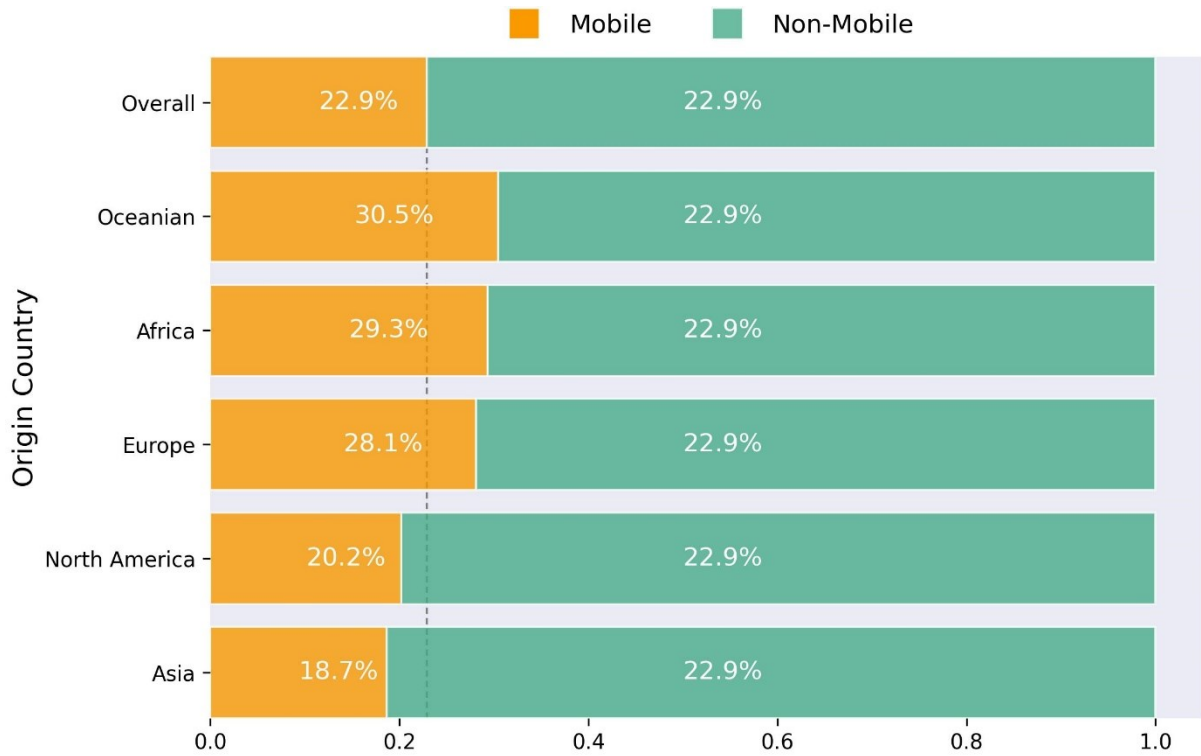
**Academic Performance.** Following a prior review study [18], we examined how international mobility affects (1) productivity, measured by the number of publications; (2) international collaboration, measured by number and diversity of collaborations; (3) novelty, measured by the extent to which a paper integrates topics that rarely appear together [19]; (4) and research impact, measured by the *AR*-index [20].

## Descriptive Statistics

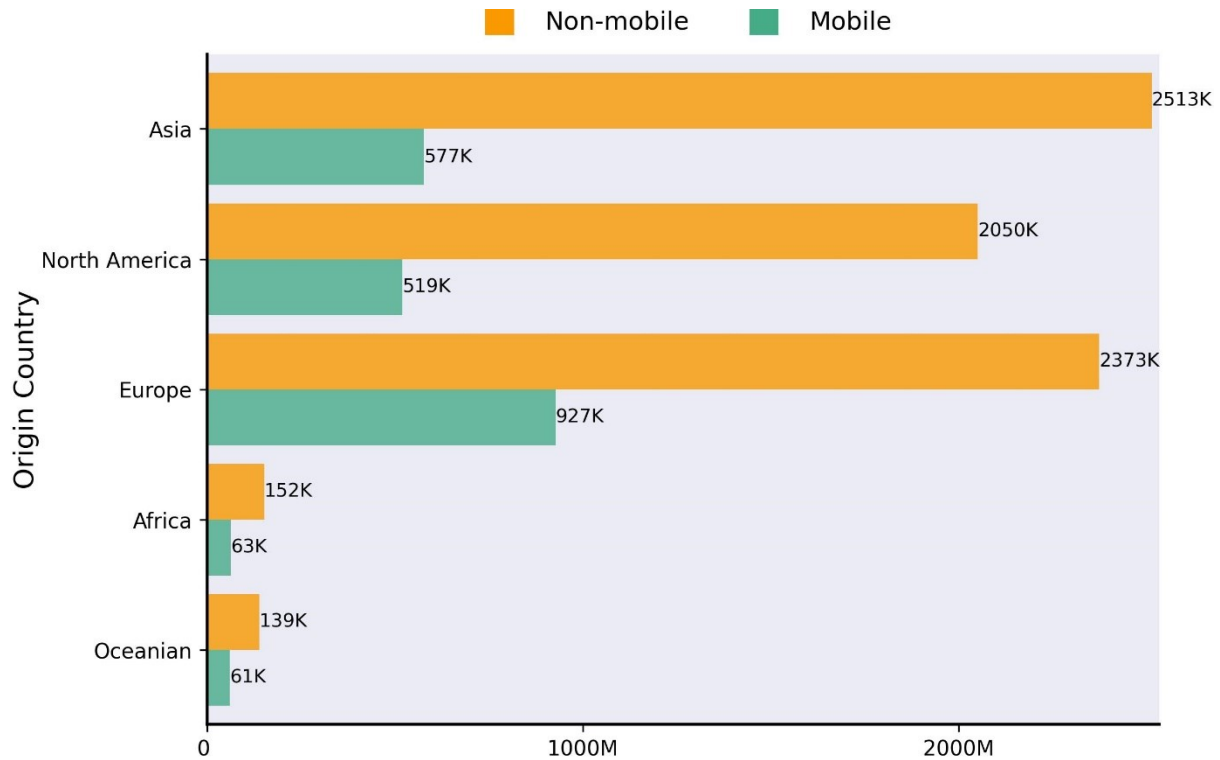
Our mobility analysis included a final sample of 9,658,666 scholars who meet our criteria (i.e., having published at least two articles from 1970 to 2020). Most (77.3%) were non-mobile whereas 22.7% showed international mobility, most often migration (14.9%) and short-term visit (12.9%), followed by joint affiliation (5.0%). Among the migrants, most moved for the first time early in their careers (i.e., between 4<sup>th</sup> and 7<sup>th</sup> academic year). The mobility rate, which is calculated by the proportion of mobile authors among authors delivered publication in the year, keeps raising through the scholar’s whole academic career. By comparing the original country of scholars, we found that scholars originating from Europe ( $M = 1.58$ ,  $SD = 0.87$ ) and Oceania ( $M = 1.56$ ,  $SD = 0.87$ ) countries showed higher level of international mobility, while scholars from North America ( $M = 1.49$ ,  $SD = 0.83$ ) and Asian ( $M = 1.50$ ,  $SD = 0.77$ ) showed lower level of international mobility. In future work, we will analyze factors associated with mobility and how international mobility impacts scholars’ career development.

## References

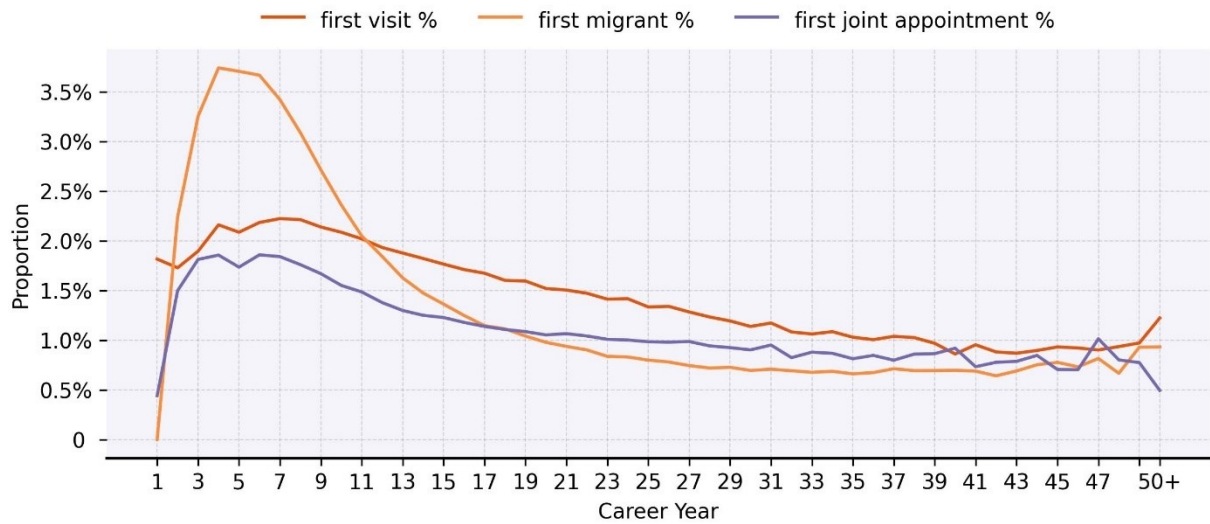
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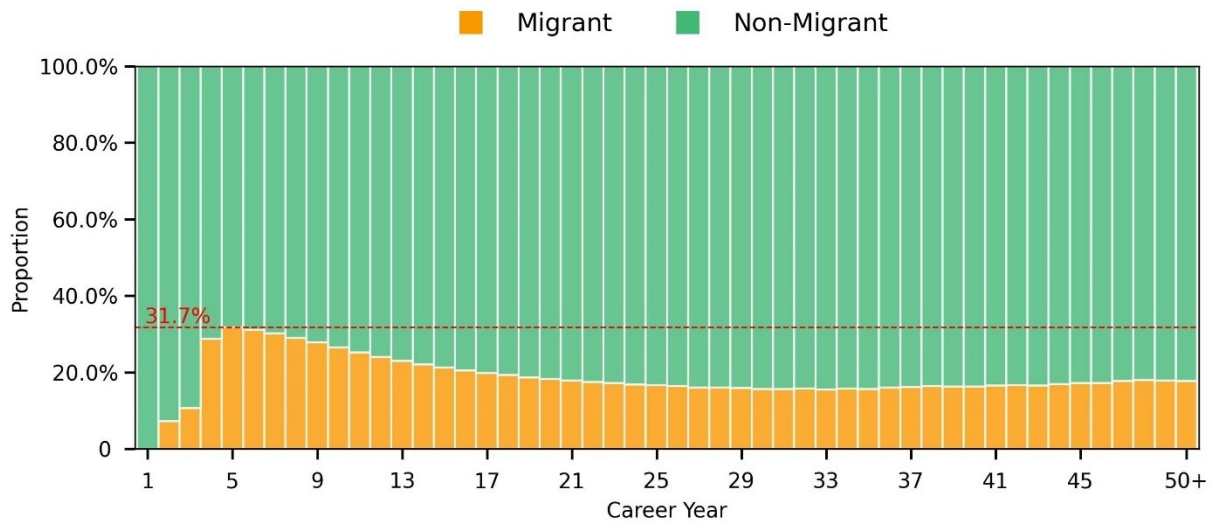
**Figure 1. Proportion of mobile and non-mobile scholars in different areas.** Scholars originating from Oceanian, Africa, and Europe countries showed higher level of international mobility while Asia and North America scholars showed lower level of mobility.



**Figure 2. The number of mobile and non-mobile scholars in different areas.** Europe nurtured larger number of scholars with international mobility while Asia nurtured large number of scholars with non-mobility.



**Figure 3.** First career year of visit, migrant and joint appointment. The proportions are based on the total number of authors who delivered publications in that year.



**Figure 4.** The proportion of authors who migrate to another affiliation during different career year.