



The effect of academic mobility on research performance: The case of Italy

Giovanni Abramo¹ , Ciriaco Andrea D'Angelo^{1,2} , and Flavia Di Costa¹

¹Laboratory for Studies in Research Evaluation, Institute for System Analysis and Computer Science (IASI-CNR), National Research Council of Italy (Italy)

²Department of Engineering and Management, University of Rome "Tor Vergata" (Italy)

an open access  journal



Citation: Abramo, G., D'Angelo, C. A., & Di Costa, F. (2022). The effect of academic mobility on research performance: The case of Italy. *Quantitative Science Studies*, 3(2), 345–362. https://doi.org/10.1162/qss_a_00192

DOI: https://doi.org/10.1162/qss_a_00192

Peer Review: https://publons.com/publon/10.1162/qss_a_00192

Received: 19 November 2021
Accepted: 4 April 2022

Corresponding Author:
Ciriaco Andrea D'Angelo
dangelo@dii.uniroma2.it

Handling Editor:
Ludo Waltman

Copyright: © 2022 Giovanni Abramo, Ciriaco Andrea D'Angelo, and Flavia Di Costa. Published under a Creative Commons Attribution 4.0 International (CC BY 4.0) license.



Keywords: bibliometrics, FSS, mobile academics, research performance, universities

ABSTRACT

This work investigates the effects of researchers' mobility on their research performance. The reference context is that of national intrasector mobility, in a country, Italy, characterized by a research system lacking the typical elements of an academic labor market. In particular, the analysis was conducted on 568 academics working at national universities and affected by mobility in the period 2009–2014. The effect of mobility on the variation of performance at the turn of the transfer was analyzed considering the interplay of demographic/sociological characteristics of the researchers, as well as contextual factors related to both the organization of origin and destination. Results show that it is the less productive academics who represent the larger share of those who move, and more than half of the mobile academics worsen their performance after the transfer.

1. INTRODUCTION

Mobility is a hallmark of a scientist's professional life. The phenomenon, especially in recent decades, has acquired important implications and has been the subject of numerous studies by scholars and interventions by policymakers.

The basic idea is that "researcher mobility" is a mechanism of knowledge diffusion able to generate positive spillovers on organizations, sectors, and territories (Song, Almeida, & Wu, 2003). In the private sector, inventor mobility underlies the performance dynamics of innovation processes of firms and regions (Breschi, Lenzi et al., 2010). Interfirm and interregion mobility have positive effects on inventors' performance, which in turn increases the innovation rates of companies (van der Wouden & Rigby, 2021). By determining the diffusion of ideas and new knowledge, the mobility of researchers can therefore be considered as a factor for the development of the whole research system (Fernández-Zubieta, Geuna, & Lawson, 2016) and, as a consequence, of countries' economies.

The policy implications are such that the European Commission has funded a number of studies over the years to collect detailed information and data on the mobility patterns and career paths of EU researchers, the latest being the MORE4 survey (European Commission Directorate-General for Research and Innovation, 2021). Also, within the EU, enhancing balanced mobility of researchers is a priority policy objective under the European Research

Area framework. The recent 2020 Communication on the ERA emphasizes the need to improve access to excellence and broaden talent capacity (e.g., by supporting mobility)¹.

Many scholars have investigated the relationship between mobility and academic careers, as the former impacts on the breadth and standing of a researcher's professional network; the quality of work experiences and scientific challenges faced; and the intensity of production of new scientific advances and their impact (Cañibano, D'Este et al., 2020; Horta, Jung, & Santos, 2020).

There are different types of mobilities, such as national vs. international, intrasector vs. cross sector, and single vs. multiple (El-Ouahi, Robinson-García, & Costas, 2021; Horta, Meoli, & Santos, 2022). Our study analyzes the effects of researchers' national intrasector mobility on research performance. Many scholars claim that these effects are influenced by the demographic/social characteristics of the researchers (Aksnes, Rørstad et al., 2013), as well as by contextual factors related to both the place of origin and the place of destination (Bäker, 2015; Deville, Wang et al., 2014). The effects of mobility on research performance are found to depend also on such other aspects as the field of research, or the frequency and duration of mobility (Franzoni, Scellato, & Stephan, 2014).

Some studies on the relationship between mobility and research performance distinguish between domestic and international mobility. As regards international mobility, a literature review by Guthrie, Lichten et al. (2017), which mainly analyzes studies of researchers moving to and from the United Kingdom, highlights the presence of a relation between international mobility and improvements in academic performance, although it is difficult to establish a true direct or reverse causal relationship. A more recent literature review by Netz, Hampel, and Aman (2020) reports that 19 out of 34 studies highlight positive effects of international mobility on scientific performance. Inbred scientists tend to pursue cozy research programs, while mobile scholars are risk takers and pioneer new scientific trajectories (Horta et al., 2021). At the same time there are several studies that find heterogeneous, no or negative effects (Gyorffy, Nagy et al., 2018; Halevi, Moed, & Bar-Ilan, 2016). The authors point out that the various studies use different indicators and nonhomogeneous measurement approaches, so it is clear that the framework for analyzing the relationship between mobility and performance is far from being consolidated.

Referring, instead, to the context of national mobility, a distinction must be made between those countries, typically Anglo-Saxon, where the researcher operates in a free labor market, and others, typically in continental Europe, where the researcher is a civil servant who moves within a strongly regulated and centrally governed context, in which individual organizations are in fact precluded from customizing the job offer. Italy falls into this second category. Its higher education system is a long-standing, classic example of a public and highly centralized governance structure, with low levels of autonomy at the university level and a very strong role played by the central state. The Ministry of Universities and Research (MUR) recognizes 96 universities as having the authority to issue legally recognized degrees. 94.9% of faculty are employed in public universities, which are largely financed by the government through mostly noncompetitive allocation of funds. There are no "teaching-only" universities, as all academics are required to carry out both research and teaching. At the end of 2020, there were 56,500 faculty members in Italy (full, associate, and assistant professors).

There is no tenure-track system in place. The recruitment and career advancement of academics are regulated by specific law and occur through public competition. Academics can transfer from a university to another, holding the same academic rank, upon clearance

¹ https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/era_en; accessed April 4, 2022.

by both institutions. Salaries are regulated at the central level and are calculated according to role (administrative, technical, or professorial), rank within the role (e.g., assistant, associate, or full professor), and seniority. An academic's salary does not depend on merit.

These conditions altogether create an environment and a culture that are completely noncompetitive, yet favoritism in recruitment and career progress flourishes. The overall result is a system of universities that are almost completely undifferentiated for quality and prestige, with the exception of the tiny Schools for Advanced Studies and a very small number of private special-focus universities. Top scientists are dispersed more or less uniformly among all Italian universities, along with the low performers, so that no single university reaches the critical mass of excellence necessary to develop as an elite university and compete at the international level (Abramo, Cicero, & D'Angelo, 2012b). Academics' mobility then is not the effect of competition among universities, trying to attract talents; rather, it occurs for career progress and/or family reasons.

For its peculiar characteristics, Italy is an interesting case study for the analysis of the relationship between mobility and research performance. Furthermore, observing the Italian case will allow us to apply a sophisticated research performance indicator at the individual level, as we can count on an extremely accurate authors' name disambiguation algorithm, and on a fine-grained field classification scheme of researchers by which we avoid distortions in comparative performance analysis.

The paper is organized as follows: in the next section, we review the relevant literature. Section 3 presents the methodology and describes the data and methods. In Section 4, we show the results of the analysis. Section 5 concludes the work, discussing some policy implications and identifying further research developments.

2. THEORETICAL BACKGROUND

The literature on the subject under investigation is vast. We will try to describe and comment on the main contributions, organizing them around each of the research hypotheses presented in Section 1.

2.1. Mobility Positively Impacts an Academic's Research Performance

The topic of the link between scientists' performance and science mobility (interorganizational) can be approached from two different perspectives. On the one hand, one can consider performance as a driver explaining mobility, as supported by the theory of competition in higher education (Jongbloed, 2004), universities search for a competitive advantage over competitors by attracting top-quality research staff. On the other hand, one can investigate if it is mobility that influences research performance, as supported by the theory of knowledge externalities (Ciccone & Peri, 2006), whereby institutions with higher research quality positively impact the performance of new recruits. The topic is still very open because the results are conflicting and have not yet come to a consolidated view.

Much of this variability may be attributable to the manner in which these studies were conducted and the chosen field of observation. Some of them focus on a single country (Aksnes et al., 2013; Allison & Long, 1990; Cañibano, Otamendi & Andújar, 2008; Cruz-Castro & Sanz-Menéndez, 2010; De Filippo, Casado, & Gómez, 2009; Ejerimo, Fassio, & Källström, 2020; Fernández-Zubieta et al., 2016; Jonkers & Tijssen, 2008; Tartari, Di Lorenzo, & Campbell, 2020). Others, however, have analyzed a single discipline (Albarrán, Carrasco, & Ruiz-Castillo, 2017; Bolli & Schläpfer, 2015; Dubois, Rochet, & Schlenker, 2014; Jonkers & Tijssen, 2008; Ryazanova & McNamara, 2019; Tartari et al., 2020).

Analyses conducted on the effects of mobility taking place on a global scale show mixed results. Franzoni et al. (2014) showed that foreign academics and those who have spent long periods abroad make higher impact publications; Jonkers and Tijssen (2008) found a positive correlation between international mobility and publication intensity of Chinese researchers, as labor mobility contributes to the scientific and technical human capital of scientists to the extent that it increases the number of collaborations and strengthens existing relationships. Halevi, Moed, and Bar-Ilan (2016), observing the top 100 authors between 2010 and 2015 in terms of publications in each of seven disciplines², showed that domestic interorganizational mobility induces an increase in both output and impact, while intercountry mobility does not seem to produce the same effects.

An in-depth analysis of the duality of the link between scientists' productivity and science mobility was carried out in particular by Fernández-Zubieta et al. (2016) on a sample of 171 UK research active academics, in "tenured type" positions, affiliated in 2005 to 53 different UK universities in four scientific fields (chemistry, physics, computer science, and mechanical, aeronautical, and manufacturing). The authors come to nondefinitive results, as they find an overall positive effect of mobility, although not significant, and a short-term negative effect (i.e., a drop in performance in the years following the job change, probably due to adjustment costs). De Filippo et al. (2009) analyzed the relationship between the mobility of researchers and their scientific performance in a medium-sized Spanish university (Carlos III University of Madrid-UC3M), which had 1,800 researchers distributed in the engineering, social sciences, and humanities disciplines. The results of their analyses show that there is a strong association between mobility, performance, and visibility: researchers "with mobility" show better performance indicators (higher average impact factor, a greater number of citations per document, lower percentages of noncited documents, and a higher rate of international collaboration) than their "without mobility" colleagues.

The most interesting studies for the purposes of this paper are those that address the issue by focusing on an entire national academic system. Included in this typology are the works of Aksnes et al. (2013) and Ejerme et al. (2020) on the Norwegian and Swedish academic systems respectively. In the first case, the analysis, conducted on a sample of about 11,000 scientists, revealed that researchers affected by mobility episodes tend to have slightly higher publication and citation rates than other researchers. However, the results are not unambiguous, so there is no strong evidence that mobility has beneficial effects on research performance. In the second case Ejerme et al. (2020) studied the effects of interuniversity mobility on the productivity of over 35,000 Swedish academic researchers for the period 2002–2012. The results indicate that the effect of mobility on performance is not found when considering career progress. In essence, career progression positively impacts a researcher's performance, whether this involves a physical transfer or not. It is interesting to test whether in Italy as well, mobility has slight or no positive impact on research productivity.

2.2. The Impact of Mobility on a Researcher's Performance Is Greater if the Transfer Is to Universities/Groups with Better Research Performance

As Yan, Zhu, and He (2020) found in their recent study of US academia, academics tend to move to institutions with higher research intensity. Earlier, Allison and Long (1990) had already showed that in correspondence with a change of institution, academic scientists who moved to more prestigious departments registered an increase in both the number of publications and the number of

² Neuroscience, Mechanical Engineering, Arts and Humanities, Oncology, Environmental Geology, Business, and Infectious Diseases.

citations, as opposed to their colleagues who underwent a downgrade. Fernández-Zubieta et al. (2016) also showed that researchers affected by upward mobility register significant increases in productivity, but not on citations, while downward mobility negatively affects the researcher's overall research performance. These results were confirmed by Tartari et al. (2020), who found that mobility has a positive effect on individual performance and this effect is strengthened if the movement takes place to better endowed institutions, although their analysis is limited to a sample of 348 academic scientists working in the biology departments of UK universities. According to Bolli and Schläpfer (2015), however, this hypothesis is rejected in the analysis they conducted with respect to a single field (economics). Deville et al. (2014) have instead observed that there is stratification in science whereby movement is predominantly horizontal rather than vertical: People from elite institutions are more likely to move to other elite institutions; similarly, people from lower rank institutions are more likely to move to peer institutions. In addition, when movement between groups occurs, it is observed that moving from elite to lower ranking institutions results in a modest decrease in scientific impact on average; The opposite event, however, does not result in gains in impact. Differently from the Anglo-Saxon higher education system, the Italian one is scarcely competitive and hardly differentiated. Therefore, to what extent the performance of universities/groups of destination impact on that of mobile academics is difficult to predict.

2.3. The Productivity of a Mobile Researcher Increases if He or She Joins a Larger Group

In addition to the prestige of the institution of origin and/or destination, some scholars have also investigated the influence of other factors related to the context of origin and destination of the mobile researcher, including the size of the department in which he or she works. The link between department/university size and research performance has been extensively dissected in the literature (Abramo, Cicero, & D'Angelo, 2012a; Aksnes, Piro, & Rørstad, 2018; Bauer, Schui et al., 2013), both in general terms and related to researcher mobility. Several studies have analyzed precisely this link between scientific performance and destination department following a mobility event, as it is believed that larger institutions and/or departments may offer more opportunities in terms of facilities and scientific collaborations. From the analysis of a large sample of German-speaking economists and management researchers, Bäker (2015) found that the larger the starting department, the more negative the impact on performance will be in the short run. This change determines a risk of having their social capital reduced for those who have more colleagues in their old department of origin. Deville et al. (2014), in their analysis of the relationships between career, mobility, geography, and scientific impact, observed that the institution size has little influence on publication intensity but is positively correlated with publication impact. This suggests that large institutions offer more opportunities for internal collaborations: Complex research needs complex collaborations, and the resulting publications, with more coauthors in the byline, may attract a higher number of citations. Dubois et al. (2014) found that for mathematicians, department size does matter: Larger departments attract better researchers, even after controlling for author-fixed effects. Moreover, specialized departments seem to stimulate the quality rather than the quantity of the scientific production of their researchers.

2.4. The Performance of a Mobile Researcher Increases if Associated with an Academic Rank Advancement

Scientific performance and mobility represent two of the determinants that influence the achievement of a permanent position and career progression towards the top of the academic hierarchy (Pezzoni, Sterzi, & Lissoni, 2012; Sanz-Menéndez, Cruz-Castro, & Alva, 2013). Particularly in continental European countries, including Italy, academics are civil servants,

so that mobility within national borders very often corresponds to career advancement. As mentioned earlier, Ejermo et al. (2020), in their study on the effects of national mobility on the performance of Swedish university researchers, showed that a move coupled with a promotion leads to a greater impact on productivity. However, these researchers do not have a statistically significant different publication rate compared to other moving researchers, so the observed effects are mainly attributable to the move. Furthermore, the results suggest that those who only achieved career advancement without being “mobile” are also able to increase their publications over time, although a slightly smaller effect on citations is observed. Finally, such an effect differs significantly across disciplines: It is rather evident in the technical-scientific disciplines, but absent in the social science and humanities. The different effects on publications and citations call for further investigation.

2.5. The Impact of Mobility on a Researcher’s Productivity Is Confounded by Certain Personal Traits of the Individual

The impact of mobility on a researcher’s productivity is confounded by certain personal characteristics (age, gender, previous academic rank, etc.) that need to be taken into account when modeling the phenomena and analyzing the results. Aksnes et al. (2013) note that in the Norwegian academic system, mobile researchers tend to have slightly higher publication and citation rates than their peers. However, regression analyses where such personal characteristics as gender, age, and academic position of the researchers were accounted for removed most of the independent effect that mobility may have on publication and citations. Our investigation should add more evidence on the role of personal factors on productivity variations.

In particular, concerning national intrasector mobility, the hypotheses that we find more interesting to test are as follows:

- Mobility positively impacts an academic’s research productivity.
- The impact of mobility on a researcher’s productivity is greater if the transfer is to universities/groups with better research performance.
- The productivity of a mobile researcher increases if he or she joins a larger group.
- The productivity of a mobile researcher decreases with the geographic-administrative distance of the transfer.
- The productivity of a mobile researcher increases if it is accompanied by academic rank advancement.
- The impact of mobility on a researcher’s productivity is confounded by certain personal characteristics, including age and gender.

If, on the one hand, we can affirm that these hypotheses are relevant to adequately support national policies and to evaluate their effects *ex post*, on the other hand, we can also affirm that only two studies related to similar contexts and, in particular, to Scandinavian countries, can be found in the literature (Aksnes et al., 2013; Ejermo et al., 2020). The major difference between ours and all previous studies, however, is the indicator and method of comparative measurement of research performance. As we will explain in more detail below, our indicator does not separate quantity and impact of scientific production, but includes both.

3. DATA AND METHODS

Our field of observation is made of all Italian academics on national mobility between 2009 and 2014. This time period will allow us to measure the bibliometric research performance

of individuals in the 5-year periods before and after the transfer. As an example, the performance of an academic who moved in 2014 is measured both in 2015–2019 and in 2009–2013, to contrast the two periods.

Data on the faculty at each university were extracted from the database of Italian university personnel, kept by the MUR³. This source contains, at December 31 of each year, information on each academic, including affiliation, academic rank, and field of research. All academics are classified in one, and only one, field, called a *Scientific Disciplinary Sector* (SDS), for 370 SDSs which are grouped into disciplines (called University Disciplinary Areas (UDAs), for 14 UDAs.

For the measurement of scientific productivity at individual level, we will consider the fractional scientific strength (FSS)⁴, defined as

$$\text{FSS} = \frac{1}{t} \sum_{i=1}^N \frac{C_i}{\bar{c}} f_i \quad (1)$$

where:

t = number of years of work of the academic in the period under observation

N = number of publications by the academic in the period under observation

C_i = citations received by publication i

\bar{c} = average of distribution of citations received for all cited publications in the same year and subject category of publication i

f_i = fractional contribution of the academic to publication i .

The fractional contribution equals the inverse of the number of authors in those fields where the practice is to place the authors in simple alphabetical order, but assumes different weights in other cases. For the life sciences, widespread practice in Italy is for the authors to indicate the various contributions to published research according to the order of names in the listing of the authors. Hence, according to Abramo, D'Angelo, and Rosati (2013), for life science SDSs we give different weights to each coauthor according to their position in the list of authors and to the character of the coauthorship (intramural or extramural).

The bibliometric data set was extracted from the Italian Observatory of Public Research (ORP), a database developed and maintained by the authors and derived under license from the WoS. Beginning from the raw data of the WoS and applying a complex algorithm to reconcile author's affiliation and disambiguation of the true identity of the authors, each publication (article, review, letter and conference proceeding) is attributed to the academic that produced it (D'Angelo, Giuffrida, & Abramo, 2011). Thanks to this algorithm, we can measure the FSS at the individual level on a national scale. For reasons of significance, we will limit the analysis to academics:

- working in hard sciences SDSs (201 in all, concerning 11 UDAs), where publications in international journals serve as a reliable proxy for overall research output⁵; and
- on staff for at least 1 year in the 5 years before and after the transfer.

³ <https://cercauniversita.cineca.it/php5/docenti/cerca.php>; accessed April 4, 2022.

⁴ A thorough explanation of the theory and assumptions underlying FSS can be found in Abramo and D'Angelo (2014).

⁵ Evaluative bibliometrics should not be applied to the arts and humanities, due to the scarce coverage of these areas in bibliographic repertories (Archambault, Vignola-Gagné et al., 2006; Hicks, 1999).

Applying this restriction, the final data set is composed of 568 academics involved in a transfer, 152 of which are characterized by career progression (from assistant to associate professor, or from associate to full professor).

With the aim of filtering out the effect of possible time patterns on the data, the individual productivity value will be normalized to the data expected at SDS level (i.e., to the average value of the FSS measured for all national SDS academics). From now on, the term *FSS* is to be interpreted as the normalized value of Eq. 1.

In turn, the productivity of the group of origin (composed of the academics from the SDS and university in which the academic was placed prior to transfer) and that of the destination group (composed of the academics from the SDS and university to which the academic transferred) will be measured through the average FSS of the individuals that compose the group.

4. RESULTS

The distribution of productivity measured over the 5-year period before transfer for the 568 academics in the data set is extremely skewed (Figure 1), given the presence of several outliers and, in particular, a maximum value of almost 23. The average value is 0.990, therefore slightly lower than the expected (unit) value, but the median is significantly lower and equal to 0.513, because 71% of academics show an FSS lower than the unit, among which 60 (over 10% of the total) are even unproductive. Thus, good research productivity would not seem to be a significant predictor of the likelihood of intrasector mobility of Italian academics. That could be the case, as Nascia, Pianta, and Zacharewicz (2021) argue, for young researchers at the beginning of their careers who migrate abroad in search of new and better opportunities.

Indeed, one would expect that the destination university would rather welcome high performers. At the same time, universities cannot force low performers to move to other institutions.

If we then analyze the difference in productivity at the turn of the transfer (Figure 2), we see that 54.8% of academics worsen their performance, while the remaining 45.2% improve it. So

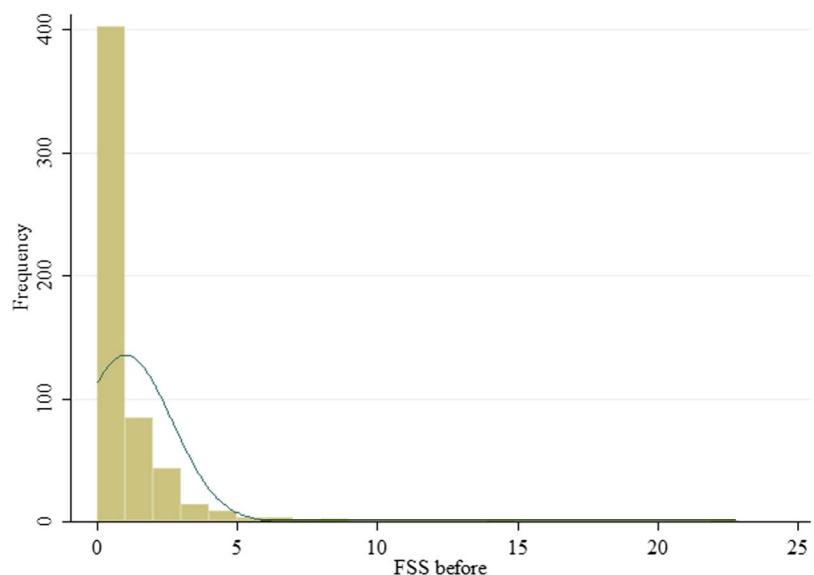


Figure 1. Distribution of the productivity of the mobile academics in the data set in the 5 years preceding their transfer.

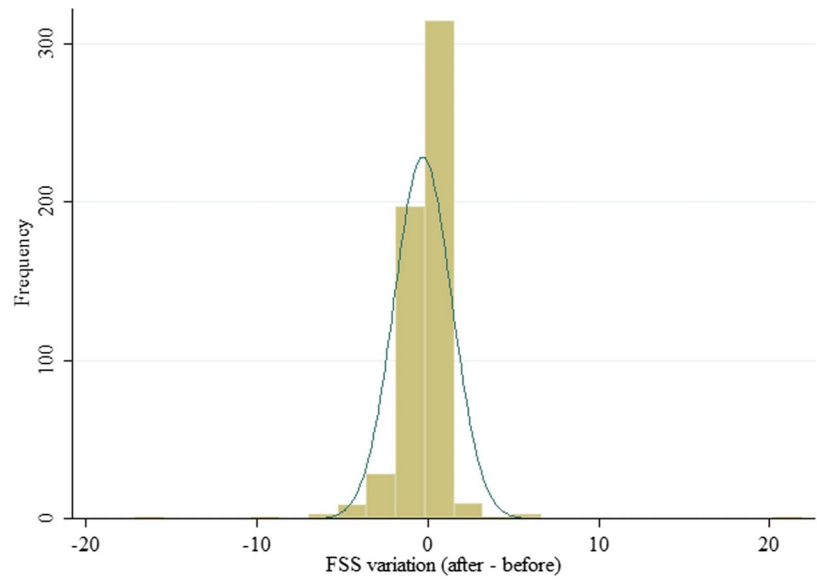


Figure 2. Distribution of the difference in productivity of the mobile academics in the data set, between the 5-year period following and that preceding their transfer.

not only are the least productive people moving out, but most of those people are also worsening their performance. Of the initial 60 unproductive academics, 20 remain so. The distribution of performance variation shows an almost normal trend (confirmed by the Shapiro-Wilk W test), with a negative mean and median (equal to -0.258 and -0.041 , respectively) and particularly long tails due to the presence of several outliers. Among these, two academics stand out, one who goes from an FSS of 22.9 in the 5-year period preceding the transfer to 5.8 in the one that follows it and, conversely, a second who presents an FSS of 5.0 before the transfer and 26.9 after it.

The change in productivity at the turn of the transfer and the productivity in the period before the transfer are inversely correlated, as shown by the scatterplot in Figure 3. The

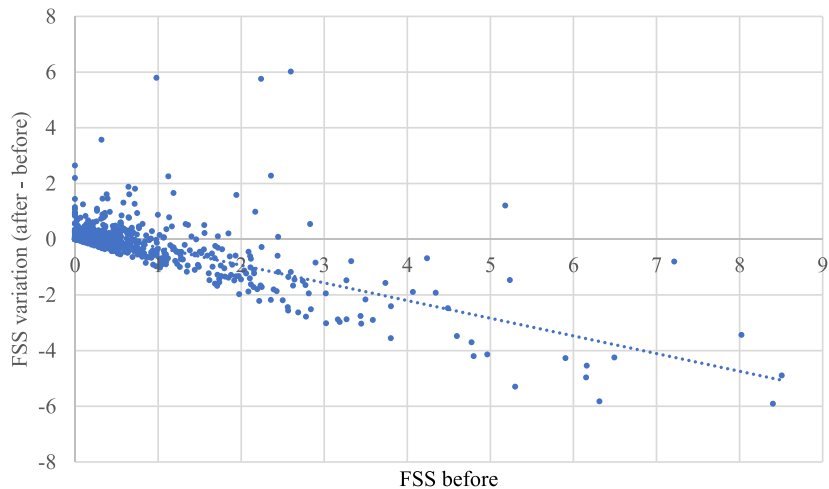


Figure 3. Scatterplot of the difference in productivity of academics in the data set, as a function of productivity in the five years preceding their transfer.

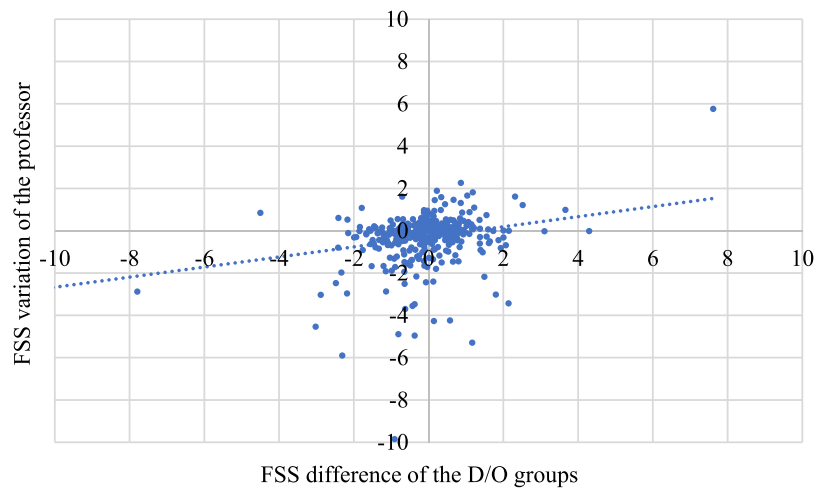


Figure 4. Scatterplot of the difference in productivity of academics in the data set at the turn of the transfer, as a function of the difference in productivity between the destination (D) and origin (O) groups.

Pearson's correlation coefficient ρ is equal to -0.700 (p -value 0.0000). It must clearly be difficult for the most productive academics to maintain their research performance, posttransfer, at levels similar to those recorded in the period before the transfer. Of course, there are exceptions: In particular, of the 164 academics with a pretransfer FSS of more than one, 24 (i.e., less than 15%) show an increase in productivity in the subsequent period.

In a nutshell, empirical evidence from national academic transfers seems to show no positive links between mobility and a scientist's research productivity after the transfer.

Coming to the second hypothesis of the work, Figure 4 represents the dispersion of the data on the change in productivity of each academic at the turn of the transfer, and the difference in productivity between the group in which he or she is being inserted and the one from which he or she comes. It should be remembered that by "group" we mean colleagues from the same SDS. The diagram shows data for 384 observations of the total 568, as we exclude those transfers involving source/destination locations with less than one FTE staff unit in the moving academic's SDS.

There is a weak correlation between the two variables (Pearson $\rho = 0.163$, p -value 0.0014), indicating that transfers accompanied by an increase in productivity concern destinations that perform better than those of origin and vice versa. Therefore, there is a positive link between the variation in productivity of a researcher and the difference in standing between the context that he or she leaves and the one that he or she moves to.

Regarding the link between performance and size (in terms of FTE) of the group in which mobile academics are inserted, the scatterplot in Figure 5 shows a total absence of correlation between the sizes of the groups of origin and destination and their variation in productivity in the periods at the turn of the transfer. The result is in line with the absence of returns to scale in Italian university research (Abramo et al., 2012a).

The question now arises of whether the possible effect of the change in performance following a transfer can be related to the fact that the transfer takes place following the award of a competition involving a change of academic rank (from assistant to associate professor, or

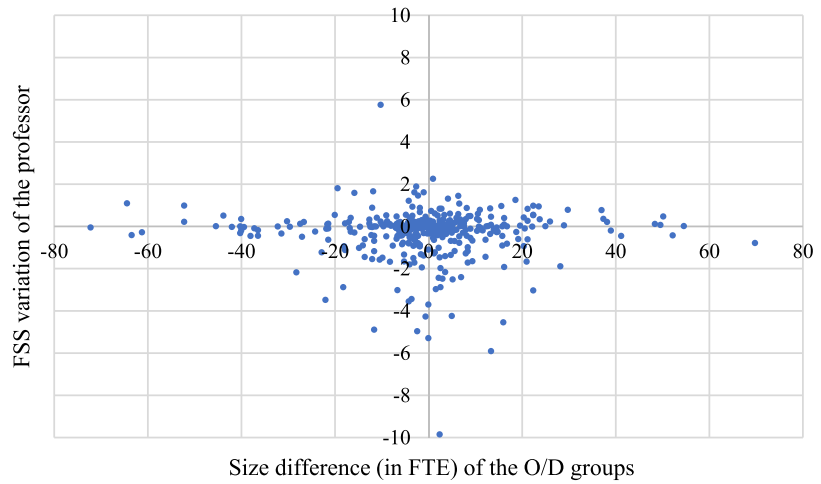


Figure 5. Scatterplot of the difference in productivity of the academics in the data set at the turn of the transfer, as a function of the difference in size between destination (D) and origin (O) groups.

from associate to full professor). There are 152 such cases in the data set, and in Table 1 we report the outcome of a *t*-test to check for differences in the productivity gap for such academics and the remaining 416 affected by a transfer without a change of academic rank. Although there is a smaller average reduction in productivity for the former (−0.138), the difference with respect to that recorded for the latter (−0.306) is not statistically significant. The same result is reached with the nonparametric Wilcoxon rank-sum Mann-Whitney test ($z = 1.239$; $\text{Prob} > |z| = 0.215$).

The same result is reached by considering the FSS as a function of

- a period dummy, which takes the value of 0 before the transfer and 1 after;
- a “treatment” dummy, which takes the value of 1 for transfers characterized by an academic rank change and 0 for others; and
- an interaction effect between the two dummies above.

The coefficient of this interaction effect takes the value of 0.168, but the relative *p*-value is 0.423. This means that academics in the treatment group (transferred because of an academic rank change) tend to record positive changes in FSS compared to their peers transferred without upgrade of academic rank, but this outcome is statistically nonsignificant.

Table 1. Two-sample *t*-test with equal variances for FSS variation at the turn of the transfer between academics moving for a career progression (vertical move) or not (horizontal move)

Type of move	Obs	Mean	Std Err.	Std Dev.	[95% Conf. Interval]	
Horizontal	416	−0.306	0.071	1.447	−0.446	−0.167
Vertical	152	−0.138	0.178	2.198	−0.490	0.214
Combined	568	−0.261	0.071	1.680	−0.400	−0.123
Difference		−0.168	0.159		−0.481	0.145

$t = -1.0567$; $\text{Pr}(T < t) = 0.1455$.

We then tried to investigate the correlation, if any, between the variation in academic performance and the geographic-administrative distance of the transfer that affected him or her. In fact, the transfer may have taken place between universities

- in the same city (46 cases, equal to 8.1% of the total);
- from different cities but from the same region (18.5% of total cases);
- from different regions but from the same macro geographical area of the country (i.e., north-east, north-west, central, south and islands) (24.8%); or
- from different macro areas (48.6%).

The geographical dimension of the transfer could have an impact on the so-called adjustment costs for the moving academic, who will face increasing “difficulties” as the geographical, administrative, and cultural distance between the place of origin and the place of destination increases. However, analysis of the data reveals the total absence of correlation between transfer distance and performance variation.

Finally, we investigated the influence of some personal characteristics, such as age, gender and academic rank at the time of transfer. To do so, we conducted an OLS regression in which the response variable (Y) is represented by the FSS variation recorded for the mobile academic at the turn of the transfer. The independent variables considered are

- Gender (X_1), specified by a dummy variable (1 for female);
- Age (X_{2-4}), specified with four classes through three dummies (baseline “40 or less”);
- Academic rank (X_{5-6}), specified by two dummies (baseline “Assistant professor”);
- Productivity before transfer (X_7), FSS measured for the mobile academic in the 5-year period preceding the transfer;
- Productivity difference of the destination/origin group (X_8) (i.e., difference in the average FSS of the research group (SDS) that the mobile academic joins with respect to the one the academic left); and
- Career progress (X_9), specified by a dummy variable (1 if the transfer is associated with career progression).

The results are reported in Table 2⁶ and indicate that gender is not statistically significant. The coefficient of this variable is negative and could indicate that, for a woman, adaptation to the new work environment is more complex than for a man; however, the p -value is very high and, therefore, this conclusion is not supported by statistically significant evidence. Age, on the other hand, shows a significant coefficient, for all classes considered. In particular, all other things being equal, compared to a young academic (under 40 years of age), one between 41 and 46 years old experiences a significant reduction in productivity after the transfer, and the reduction is further exacerbated for even older academics. The data therefore seem to show greater “flexibility” for young people, who are less affected by change than their older colleagues.

Regarding academic rank at the time of transfer, the coefficients of the two variables considered are both positive and significant. This indicates that compared to an assistant, the transfer of an associate (and even more in the case of a full professor) is accompanied by

⁶ The footnote indicates that the analysis is referred to 345 observations, because compared to the initial 568 transfers, we excluded those concerning places of origin/destination with less than one unit of FTE staff in the SSD of the moving professor and 39 transfers relating to professors whose age is not known.

Table 2. OLS regression on the possible drivers of FSS variation at the turn of the transfer of academics in the data set

		Coeff.	Std Err.	<i>t</i>	<i>P</i> > <i>t</i>	[95% Conf. Interval]	
	_cons	0.587	0.193	3.04	0.003	0.207	0.967
X_1	Gender	-0.165	0.189	-0.87	0.384	-0.537	0.207
X_2	Age: 41–46	-0.572	0.234	-2.44	0.015	-1.033	-0.111
X_3	Age: 47–53	-0.641	0.262	-2.44	0.015	-1.157	-0.124
X_4	Age: 54 or more	-0.961	0.290	-3.31	0.001	-1.532	-0.390
X_5	Rank: Associate	0.370	0.223	1.66	0.098	-0.069	0.810
X_6	Rank: Full	0.694	0.277	2.5	0.013	0.149	1.239
X_7	FSS before the move	-0.657	0.043	-15.46	0.000	-0.741	-0.574
X_8	FSS difference of the O/D groups	0.137	0.069	1.99	0.048	0.001	0.272
X_9	Career progress	0.201	0.211	0.95	0.341	-0.214	0.616

Number of obs = 345; $F(9, 335) = 28.96$; Prob > $F = 0.000$; R-squared = 0.438; Adj R-squared = 0.423; Root MSE = 1.451.

an increase in performance. Perhaps this could be explained by the fact that the higher the academic rank, the higher the value that the transferred academic brings to the new university in terms of social, professional, and instrumental capital, which the assistant professor has perhaps to (re)build after his or her transfer to the new university.

Finally, the data for the last three variables shown in Table 2 confirm what has already emerged in the univariate analyses presented earlier. The scientific standing of the academic matured before his or her transfer is not easily maintained and developed downstream of the transfer: The coefficient of this variable is negative (-0.657) and significant. Similarly, the significance of the contextual conditions in which the moving academic operates is confirmed. The positive and significant value of the variable X_8 (0.137) indicates that the transfer can have a positive link to the academic’s productivity if it takes place to a more productive groups than the source group, and vice versa. Finally, it is confirmed that any career progress accompanying the transfer does not have a significant link to the change in productivity of the mobile academic.

5. DISCUSSION AND CONCLUSIONS

The mobility of a researcher represents a mechanism of knowledge diffusion, able to generate relevant spillovers in organizations, sectors, and countries. As it leads to the dissemination of ideas and new knowledge, mobility is considered an important factor for the development of research systems and, consequently, of the economies of countries. All this explains the interest of policymakers, who are increasingly engaged in defining and implementing interventions to facilitate and support mobility, as well as the wealth of studies in the literature aimed at investigating motivations, drivers, and effects. In this paper, we have focused on this last aspect and, in particular, on the relationship between mobility and research performance, considering the confounding effect of the researchers’ personal traits, as well as contextual factors related to the origin/destination of their transfer. We limited the analysis to transfers between national universities and therefore to a particular type of mobility (i.e., one within a domestic domain, the Italian one, strongly regulated and centrally governed). A context in which the

researcher is in fact a *civil servant*, whose mobility is not determined by incentives typical of a real labor market, individual organizations being in fact precluded from the possibility of customizing the job offer (salaries, for example, are only a function of academic rank and seniority).

Data on Italian mobile academics in the 5-year period 2009–2014 reveal that good research productivity is not a significant predictor of the likelihood of transfer; rather, the opposite is true. The research performance of mobile academics is quite heterogeneous, but it is the less productive ones that represent the larger share of those who move, and cases of transfers of unproductive academics are very numerous. This evidence contrasts with the results of those who have analyzed the flows of young researchers going out of the country in search of better opportunities to exploit their potential (Nascia et al., 2021), especially to countries with *world-class* universities. This apparent contradiction is partly explained by rigged competitions for recruitment and career advancement, involving extensive favoritism: Talented young scientists who cannot enter the higher education system or whose career progress is halted by “favored” candidates are likely to emigrate to countries that better appreciate and reward merit (Abramo, D’Angelo, & Rosati, 2014, 2015). National mobility entrusted to researchers without a high scientific profile, combined with the presence of such consistent outflows and, at the same time, very modest inflows (less than 1% of academics in Italy are foreigners, with an average research productivity only slightly higher than that of Italians)⁷, does not bode well for the development of the Italian research system.

To complicate the picture, there is the fact that more than half of the academics affected by mobility worsen their performance after the transfer. This evidence is in line with that part of the literature that detects significant productivity decreases in the years after job changes, due to the so-called “adjustment costs” (Fernández-Zubieta et al., 2016), which do not seem to differ with the “geographical” relevance of the move. The absence of positive effects of mobility on research performance for the Italian case confirms what emerged from Aksnes et al. (2013) for the Norwegian academic systems, featured by low levels of mobility and differences in publication and citation rates of mobile researchers (as compared to other researchers) vanishing when demographic characteristics are accounted for. It must be said, however, that comparability between studies is always made complex by the different methodologies employed, in terms of both indicators and empirical strategy. In particular, the Norwegian study involves pure cross-sectional data (mobile vs. nonmobile academics’ performance), while ours is a longitudinal study (mobile academics’ performance before vs. after transfer). With respect to the second hypothesis of the paper, the analyses revealed a weak correlation between the change in performance at the turn of the transfer and the difference in performance of the two locations of origin and destination. Thus, it is not possible to establish a causal link, according to which upward mobility is associated with a significant increase in performance and vice versa; a link that is indicated in the literature in several papers, but almost all of which refer to Anglo-Saxon academic systems (Allison & Long, 1990; Fernández-Zubieta et al., 2016; Tartari et al., 2020; Yan et al., 2020).

Certainly, there is no correlation between the variation in performance of a mobile researcher and the size of the groups that he or she leaves/joins with his or her transfer, confirming the absence of returns to scale in Italian research (Abramo et al., 2012a). It should be noted that the result may be flawed by the inability to stratify the analyses by subject area, given the low number of observations. The overall analysis overlooks the possible existence of area effects and, in particular, the differences existing between scientific fields of an

⁷ For details, see Abramo, D’Angelo, and Di Costa (2019).

experimental nature and others of a theoretical nature, in terms of technologies, necessary infrastructural endowments, critical financial mass, etc. (He, Zhen, & Wu, 2019).

The presence of concurrent career advancement in an academic's transfer does not appear to impact his or her research performance, at least not in a statistically significant way. Related to this, the observation of the Italian case seems to return a similar result to that obtained by Ejerme et al. (2020) in their study on the effects of national mobility on the performance of Swedish researchers. More precisely, the authors report a positive effect of mobility on some bibliometric indicators, but not when mobility implies career advancement.

Regarding the confounding effect of the personal characteristics of the mobile researcher, the multivariate analysis conducted reveals that gender is not a variable that significantly impacts the variation in productivity at the turn of the transfer, while age is, all others being equal. Compared to an academic less than 40 years old, an older academic of the same academic rank shows a significant reduction in productivity after the transfer, a reduction that increases for the older age groups, indicating a greater "plasticity" in adapting to the new context on the part of young people compared to older colleagues. The effect of academic rank, all others equal, is also significant and positive. It is plausible that higher academic ranks correspond to infrastructural endowments and social capital that the mobile academic "transfers" to the destination location with less difficulties. An assistant professor needs more time/costs to adapt to the new working environment than a full professor, whose transfer is probably preceded by informal interactions with colleagues in the new university, which speed up the start-up.

The results of the work represent a relevant stimulus of certain interest for policymaking. The fact that mobile academics are not the most productive ones reveals the absence of adequate competitive mechanisms in the Italian higher education system, which should elicit competition among universities to attract talented academics. Furthermore, combining our results with those by Nascia et al. (2021) showing the brain drain reveals the failure of the national level competition exams (*concorsi*) for career progress. The ultimate question is whether national research mobility should be favored or not, given that it does not seem to be beneficial for research performance. Of course, there are benefits other than research performance (e.g. the territorial transfer of knowledge). Future research might investigate the effects of mobile academics on the research performance of colleagues in the hosting university.

By nature, this study is inevitably domestic in scope, as the cultural, sociological, and normative context of the country heavily affects results. Consequently, a certain caution is recommended in generalizing the results, or even comparing them with those of other national contexts. Nevertheless, compared to the state of the art, which can be composed through the merging of contributions typically referring in any case to individual national contexts or individual fields of interest, the contribution presented here is characterized by the robustness of the approach used to measure performance, compared instead to the heterogeneity of the approaches proposed in the literature, especially with reference to the partiality and nonhomogeneity of the indicators used, which could, at least in part, explain the nonconvergence of the evidence that has so far emerged on the subject.

We are aware of a few limits of the study. First of all, the intrinsic limits of evaluative bibliometrics approaches apply to this work: Publications are not representative of all knowledge produced (tacit knowledge is not captured); bibliographic repositories do not cover all publications; and citations are not always certification of real use and representative of all use. Furthermore, the scope of the work is limited to national mobility, as information on

international mobility was not available to us. Finally, results might be affected by confounding variables that we do not consider in our study (e.g. the frequency of mobility, or the variation in the disciplinary focus that mobility might entail).

AUTHOR CONTRIBUTIONS

Giovanni Abramo: Conceptualization; Methodology; Project administration; Supervision; Writing—Review & editing. Ciriaco Andrea D’Angelo: Data curation; Formal analysis; Investigation; Methodology; Validation; Visualization; Writing—original draft. Flavia Di Costa: Data curation; Formal analysis; Investigation; Visualization; Writing—original draft.

COMPETING INTERESTS

The authors have no competing interests.

FUNDING INFORMATION

The research project received no funding by third parties.

DATA AVAILABILITY

Being subject to Clarivate-WoS license restrictions, the raw data cannot be made publicly available but are available from the authors upon request by the reader for personal interest only.

REFERENCES

- Abramo, G., & D’Angelo, C. A. (2014). How do you define and measure research productivity? *Scientometrics*, 101(2), 1129–1144. <https://doi.org/10.1007/s11192-014-1269-8>
- Abramo, G., Cicero, T., & D’Angelo, C. A. (2012a). Revisiting size effects in higher education research productivity. *Higher Education*, 63(6), 701–717. <https://doi.org/10.1007/s10734-011-9471-6>
- Abramo, G., Cicero, T., & D’Angelo, C. A., (2012b). The dispersion of research performance within and between universities as a potential indicator of the competitive intensity in higher education systems. *Journal of Informetrics*, 6(2), 155–168. <https://doi.org/10.1016/j.joi.2011.11.007>
- Abramo, G., D’Angelo, C. A., & Di Costa, F. (2019). A nation’s foreign and domestic professors: Which have better research performance? (The Italian case). *Higher Education*, 77(5), 917–930. <https://doi.org/10.1007/s10734-018-0310-x>
- Abramo, G., D’Angelo, C. A., & Rosati, F. (2013). The importance of accounting for the number of co-authors and their order when assessing research performance at the individual level in the life sciences. *Journal of Informetrics*, 7(1), 198–208. <https://doi.org/10.1016/j.joi.2012.11.003>
- Abramo, G., D’Angelo, C. A., & Rosati, F. (2014). Career advancement and scientific performance in universities. *Scientometrics*, 98(2), 891–907. <https://doi.org/10.1007/s11192-013-1075-8>
- Abramo, G., D’Angelo, C. A., & Rosati, F. (2015). The determinants of academic career advancement: Evidence from Italy. *Science and Public Policy*, 42(6), 761–774. <https://doi.org/10.1093/scipol/scu086>
- Aksnes, D. W., Rørstad, K., Piro, F. N., & Sivertsen, G. (2013). Are mobile researchers more productive and cited than non-mobile researchers? A large-scale study of Norwegian scientists. *Research Evaluation*, 22(4), 215–223. <https://doi.org/10.1093/reseval/rvt012>
- Aksnes, D. W., Piro, F. N., & Rørstad, K. (2018). Does size matter? An investigation of how department size and other organizational variables influence on publication productivity and citation impact. *NIFU Working Paper*, 2018, 14. <https://www.nifu.no/en/publications/1649778/>
- Albarrán, P., Carrasco, R., & Ruiz-Castillo, J. (2017). Are migrants more productive than stayers? Some evidence from a set of highly productive academic economists. *Economic Inquiry*, 55(3), 1308–1323. <https://doi.org/10.1111/ecin.12430>
- Allison, P. D., & Long, J. S. (1990). Departmental effects on scientific productivity. *American Sociological Review*, 55(4), 469–478. <https://doi.org/10.2307/2095801>
- Archambault, É., Vignola-Gagné, É., Côté, G., Larivière, V., & Gingras, Y. (2006). Benchmarking scientific output in the social sciences and humanities: The limits of existing databases. *Scientometrics*, 68(3), 329–342. <https://doi.org/10.1007/s11192-006-0115-z>
- Bäker, A. (2015). Non-tenured post-doctoral researchers’ job mobility and research output: An analysis of the role of research discipline, department size, and coauthors. *Research Policy*, 44(3), 634–650. <https://doi.org/10.1016/j.respol.2014.12.012>
- Bauer, H. P., Schui, G., von Eye, A., & Krampen, G. (2013). How does scientific success relate to individual and organizational characteristics? A scientometric study of psychology researchers in the German-speaking countries. *Scientometrics*, 94(2), 523–539. <https://doi.org/10.1007/s11192-012-0760-3>

- Bolli, T., & Schläpfer, J. (2015). Job mobility, peer effects, and research productivity in economics. *Scientometrics*, 104(3), 629–650. <https://doi.org/10.1007/s11192-015-1625-3>
- Breschi, S., Lenzi, C., Lissoni, F., & Vezzulli, A. (2010). The geography of knowledge spillovers: The role of inventors' mobility across firms and in space. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 353–369). Chichester: Edward Elgar. <https://doi.org/10.4337/9781849806497.00025>
- Cañibano, C., D'Este, P., Otamendi, F. J., & Woolley, R. (2020). Scientific careers and the mobility of European researchers: An analysis of international mobility by career stage. *Higher Education*, 80(6), 1175–1193. <https://doi.org/10.1007/s10734-020-00536-z>
- Cañibano, C., Otamendi, J., & Andújar, I. (2008). Measuring and assessing researcher mobility from CV analysis: The case of the Ramón y Cajal programme in Spain. *Research Evaluation*, 17(1), 17–31. <https://doi.org/10.3152/095820208X292797>
- Ciccone, A., & Peri, G. (2006). Identifying human-capital externalities: Theory with applications. *Review of Economic Studies*, 73(2), 381–412. <https://doi.org/10.1111/j.1467-937X.2006.00380.x>
- Cruz-Castro, L., & Sanz-Menéndez, L. (2010). Mobility versus job stability: Assessing tenure and productivity outcomes. *Research Policy*, 39(1), 27–38. <https://doi.org/10.1016/j.respol.2009.11.008>
- D'Angelo, C. A., Giuffrida, C., & Abramo, G. (2011). A heuristic approach to author name disambiguation in bibliometrics databases for large-scale research assessments. *Journal of the American Society for Information Science and Technology*, 62(2), 257–269. <https://doi.org/10.1002/asi.21460>
- De Filippo, D., Casado, E. S., & Gómez, I. (2009). Quantitative and qualitative approaches to the study of mobility and scientific performance: A case study of a Spanish university. *Research Evaluation*, 18(3), 191–200. <https://doi.org/10.3152/095820209X451032>
- Deville, P., Wang, D., Sinatra, R., Song, C., Blondel, V. D., & Barabási, A.-L. (2014). Career on the move: Geography, stratification and scientific impact. *Scientific Reports*, 4(1), 1–7. <https://doi.org/10.1038/srep04770>, PubMed: 24759743
- Dubois, P., Rochet, J. C., & Schlenker, J. M. (2014). Productivity and mobility in academic research: Evidence from mathematicians. *Scientometrics*, 98(3), 1669–1701. <https://doi.org/10.1007/s11192-013-1112-7>
- El-Ouahi, J., Robinson-García, N., & Costas, R. (2021). Analyzing scientific mobility and collaboration in the Middle East and North Africa. *Quantitative Science Studies*, 2(3), 1023–1047. https://doi.org/10.1162/qss_a_00149
- Ejermo, O., Fassio, C., & Källström, J. (2020). Does mobility across universities raise scientific productivity? *Oxford Bulletin of Economics and Statistics*, 82(3), 603–624. <https://doi.org/10.1111/obes.12346>
- European Commission Directorate-General for Research and Innovation. (2021). *MORE4: Support data collection and analysis concerning mobility patterns and career paths of researchers: Annexes to the final report*. Publications Office. <https://data.europa.eu/doi/10.2777/117072>
- Fernández-Zubieta, A., Geuna, A., & Lawson, C. (2016). Productivity pay-offs from academic mobility: Should I stay or should I go? *Industrial and Corporate Change*, 25(1), 91–114. <https://doi.org/10.1093/icc/dtv034>
- Franzoni, C., Scellato, G., & Stephan, P. (2014). The mover's advantage: The superior performance of migrant scientists. *Economics Letters*, 122(1), 89–93. <https://doi.org/10.1016/j.econlet.2013.10.040>
- Gyorffy, B., Nagy, A., Herman, P., & Torok, A. (2018). Factors influencing the scientific performance of momentum grant holders: An evaluation of the first 117 research groups. *Scientometrics*, 117(1), 409–426. <https://doi.org/10.1007/s11192-018-2852-1>, PubMed: 30220748
- Guthrie, S., Lichten, C., Harte, E., Parks, S., & Wooding, S. (2017). *International mobility of researchers*. Santa Monica, CA and Cambridge, UK: RAND Europe. <https://doi.org/10.7249/RR1991>
- Halevi, G., Moed, H. F., & Bar-Ilan, J. (2016). Researchers' mobility, productivity and impact: Case of top producing authors in seven disciplines. *Publishing Research Quarterly*, 32(1), 22–37. <https://doi.org/10.1007/s12109-015-9437-0>
- He, Z., Zhen, N., & Wu, C. (2019). Measuring and exploring the geographic mobility of American professors from graduating institutions: Differences across disciplines, academic ranks, and genders. *Journal of Informetrics*, 13(3), 771–784. <https://doi.org/10.1016/j.joi.2019.05.001>
- Hicks, D. (1999). The difficulty of achieving full coverage of international social science literature and the bibliometric consequences. *Scientometrics*, 44(2), 193–215. <https://doi.org/10.1007/BF02457380>
- Horta, H., Biroolini, S., Cattaneo, M., Shen, W., & Paleari, S. (2021). Research network propagation: The impact of phd students' temporary international mobility. *Quantitative Science Studies*, 2(1), 129–154. https://doi.org/10.1162/qss_a_00096
- Horta, H., Jung, J., & Santos, J. M. (2020). Mobility and research performance of academics in city-based higher education systems. *Higher Education Policy*, 33, 437–458. <https://doi.org/10.1057/s41307-019-00173-x>
- Horta, H., Meoli, M., & Santos, J. M. (2022). Academic inbreeding and choice of strategic research approaches. *Higher Education Quarterly*, 76, 76–101. <https://doi.org/10.1111/hequ.12328>
- Jongbloed, B. (2004). Regulation and competition in higher education. In P. Teixeira, B. Jongbloed, D. Dill, & A. Amaral (Eds.), *Markets in higher education. Higher education dynamics*, vol. 6. Dordrecht: Springer. https://doi.org/10.1007/1-4020-2835-0_5
- Jonkers, K., & Tijssen, R. (2008). Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics*, 77(2), 309–333. <https://doi.org/10.1007/s11192-007-1971-x>
- Nascia, L., Pianta, M., & Zacharewicz, T. (2021). Staying or leaving? Patterns and determinants of Italian researchers' migration. *Science and Public Policy*, 48(2), 200–211. <https://doi.org/10.1093/scipol/scab007>
- Netz, N., Hampel, S., & Aman, V. (2020). What effects does international mobility have on scientists' careers? A systematic review. *Research Evaluation*, 29(3), 327–351. <https://doi.org/10.1093/reseval/rvaa007>
- Pezzoni, M., Sterzi, V., & Lissoni, F. (2012). Career progress in centralized academic systems: Social capital and institutions in France and Italy. *Research Policy*, 41(4), 704–719. <https://doi.org/10.1016/j.respol.2011.12.009>
- Ryazanova, O., & McNamara, P. (2019). Choices and consequences: Impact of mobility on research-career capital and promotion in business schools. *Academy of Management Learning & Education*, 18(2), 186–212. <https://doi.org/10.5465/amle.2017.0389>
- Sanz-Menéndez, L., Cruz-Castro, L., & Alva, K. (2013). Time to tenure in Spanish universities: An event history analysis. *PLOS ONE*, 8(10), e77028. <https://doi.org/10.1371/journal.pone.0077028>, PubMed: 24116199
- Song, J., Almeida, P., & Wu, G. (2003). Learning-by-hiring: When is mobility more likely to facilitate interfirm knowledge transfer? *Management Science*, 49(4), 351–365. <https://doi.org/10.1287/mnsc.49.4.351.14429>

Tartari, V., Di Lorenzo, F., & Campbell, B. A. (2020). "Another roof, another proof": The impact of mobility on individual productivity in science. *Journal of Technology Transfer*, 45(1), 276–303. <https://doi.org/10.1007/s10961-018-9681-5>

van der Wouden, F., & Rigby, D. L. (2021). Inventor mobility and productivity: A long-run perspective. *Industry and Innovation*,

28(6), 677–703. <https://doi.org/10.1080/13662716.2020.1789451>

Yan, E., Zhu, Y., & He, J. (2020). Analyzing academic mobility of US professors based on ORCID data and the Carnegie Classification. *Quantitative Science Studies*, 1(4), 1451–1467. https://doi.org/10.1162/qss_a_00088