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Postdoctoral Mobility and Returnees' Career in Italian Academia

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Abstract

This paper investigates the relationship between international postdoctoral stays and academic career advancement among researchers returning to the Italian university system. Using a unique dataset of Italian PhD holders observed over a 30-year period, we analyze how international postdoctoral stays are associated with two key career outcomes: (i) the duration between PhD completion and first appointment as Assistant Professor (*time-to-entry*), and (ii) the duration between Assistant Professor appointment and promotion to Associate Professor (*time-to-promotion*). We identify international postdoctoral stays through bibliometric indicators by tracing foreign affiliations in researchers' publication records and examine how their association with career progression is moderated by institutional inbreeding, home-country linkages, and the persistence of international research networks. To explore these relationships, we apply a Cox proportional hazards model combined with entropy balancing. We validate the results of our analysis using curriculum vitae information for a subsample of researchers. Our findings show that international postdoctoral stays are associated with slower entry into the academic system but are positively related to shorter time-to-promotion. Notably, this association is strongest for researchers promoted at universities different from their alma mater. We also observe that maintaining a strong home-country publishing network is associated with quicker entry, while high persistence in postdoc-period co-author networks is linked to faster promotion.

JEL Classification: I21, I23, J61, J45, M51.

Keywords: Academic career; International postdoctoral mobility; Social capital; Inbreeding.

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1. Introduction

When scientists are mobile across national borders knowledge is disseminated, and new combinations of knowledge are created (Lissoni & Miguelez, 2024). From an individual perspective, international mobility of scientists is increasingly seen as a strategy to enhance academic success (Netz et al., 2020). International mobility is a phenomenon that gained increasing importance in shaping public policies (Stephan, 2015). The evidence regarding the ability of international mobile academics to provide benefits both to the host countries and their own countries in terms of knowledge circulation (Ackers, 2005; Saxenian, 2005) fosters policy initiatives aimed at encouraging national scholars to go abroad and migrant academics to return (Hunter et al., 2009).

Whether international mobility influences scientists' careers is a question that has been explored by several studies focusing mainly on productivity and network creation (Cañibano et al., 2020; Kotsemir et al., 2022; Liu & Hu, 2022; Tartari et al., 2020) while very little attention has been given directly to career progress. Only few studies have been carried out, the empirical evidence is still fragmented, and results are not univocal (Netz et al., 2020). For example, Cruz-Castro & Sanz-Menéndez (2010) and Sanz-Menéndez et al. (2013) focus on Spain and find a negative effect of extended stays abroad on occupational outcomes. On the other hand, studies focusing on Germany (Lutter & Schröder, 2016; Zhao et al., 2022), Russia (Kotsemir et al., 2022), or Japan (Lawson & Shibayama, 2015) find a significant positive impact of experience abroad on the attainment of a tenured position in the respective academic systems.

Previous literature has highlighted that the early phase of a scientist's career has an important impact on their future development, mostly focusing on the study of PhD granting universities (Clauset et al., 2015; Hottenrott & Lawson, 2017; Kim et al., 2020). Furthermore, postdoctoral researchers play a key role in the production of new scientific knowledge, and postdoctoral training positions represent a critical step on the academic career ladder (Heggeness et al., 2018; Kahn & Ginther, 2017). Nonetheless, little attention has been given to the postdoctoral training period, possibly due to heterogeneity in contracts and lack of comparable data. In certain countries there are differences between postdocs and contract researchers, as there are differences between self-financed grant-based postdocs such as the Marie Skłodowska-Curie postdoctoral fellowship, and a PI funded postdoctoral contract. Notwithstanding the differences, most scientists' careers start with an untenured (temporary contract usually of 12/18 or more months) research period, for simplicity we refer to it as a postdoctoral (PD) stays.

Postdocs have become extremely common in all scientific systems, and the average length has increased (Musselin, 2005; NSF, 2024; Stephan & Ma, 2005). Although comparable statistics are not available, evidence across university systems points to an increasing share of academic scientists starting their career with a PD appointment (OECD, 2019; Sarrico, 2022). For example, in the US in most STEM fields the postdoc rate for doctorate recipients varies between 50% and 80% of PhD graduates, while in Social Science and Humanities it has reached 30% in more recent years (NSF, 2024). Data from the Survey of Doctorate Recipients also shows a decrease in tenure-track academic jobs, with less than 50% of scientists employed in academia being tenured or on a tenure-track position 10 years after receiving their doctoral degree. In Finland, Germany, and Switzerland, between 70% and 80% of early career researchers were on fixed-term contracts (OECD, 2021). In the case of Italy, based on four cohorts (2008, 2010, 2012, 2014) of the ISTAT survey on PhD holders' occupational outcomes, the share of fixed-term contracts in academia was 62% for male and 76% for female scientists four to six years after graduation (Carriero & Naldini, 2022). Still, we know little about such a formative step in the scientist's career. While there is some evidence that the PD period has become important (even more than the PhD, as postdocs generally operate with greater autonomy, responsibility, and independence compared to doctoral students) in shaping future careers of scientists (Duan et al., 2025; Horta, 2009; Lawson & Shibayama, 2015) there is also discussion of postdocs being cheap labor in laboratories (OECD, 2021; Stephan, 2013).

In most recent years international PD mobility has become a common phenomenon across countries (Kim, 2025) but due to the lack of longitudinal data with clearly identified type and length of mobility (except for a few universities or the statistical agency survey-based type of data that allow a limited identification of individuals) only a handful of studies have tried to examine the relationship between international PD mobility and career outcomes (Cruz-Castro & Sanz-Menéndez, 2010; Dias Lopes & Hancock, 2024; Sanz-Menéndez et al., 2013).

In this paper, we study how international PD stays correlate to job outcomes at different career stages: time-to-entry as Assistant Professor and time-to-promotion to Associate Professor positions. We focus on returnees to the home country and compare their career path to that of non-mobile and mobile postdoc within the home country. International PD stays may help or harm in speeding up career entry and progression; this effect can be moderated by the PD researcher's social capital. The time to re-entry in the home system might be linked to the ties with the PhD-granting institution and, more generally, with other universities of the home country (Bauder, 2020). The time to promotion may be related to the preservation of the linkages developed during the PD period abroad, as these connections can facilitate

involvement in international research groups and projects upon return (Baruffaldi et al., 2020; Cañibano et al., 2008).

The setting of our paper is relevant as the Italian academic system is not too different from that of other large EU countries such as France, Germany, and Spain. In the last thirty years, these relatively closed academic systems have undergone a series of reforms to introduce more competition and evaluation, and they have tried to open their academic markets introducing policies for attracting returnees and foreign researchers (Bassetto & Ippedico, 2023; Coda Zabetta et al., 2024). The Italian scientific system has always been internationally well connected especially in the STEM fields, and traditionally, Italian researchers have spent periods abroad. However, the system is little inward open, with only a tiny percentage of foreign nationals working in the Italian university system (Carriero et al., 2024; Franzoni et al., 2012). Moreover, Italy is among the top large countries in terms of academic research performance as proxied by bibliometric indicators (with the well-known limitations). For example, ranking above France and Germany for percentage of scientific publications in the world's top 10% and top 1% most cited papers, just after the US and the UK in most recent years and showing positive trends in the last thirty years (BEIS, 2016; European Commission, 2024).

In this paper, we built a unique dataset of doctorate holders in all disciplines who obtained their degrees in Italian universities from the first created PhD cycle (1986) until 2006. We identified doctorates who pursued an academic career in Italy by matching them with academics in the official archives of the Italian Ministry of University and Research and followed their career until 2015. From this dataset, we identified those researchers who undertook a PD stay before entering the Italian academic system as Assistant Professor. We used affiliation information reported in scientific publication data from Scopus to classify mobility in the postdoc period. Approximately 20% of the researchers in our sample undertook an international stay during their PD period. For a subsample, we also collected and codified their CVs, validating our identification of PD mobility abroad.

We use a Cox-proportional hazard model with Entropy Balancing to estimate the correlation between having had a PD stay abroad (independent variable) and the time to entry as Assistant Professor and the time to promotion to Associate Professor (dependent variables). We qualify the postdocs in terms of length of stay (shorter/longer than 18 months) and ranking of the host university to better capture human and social capital enhancing potential of the mobility. We provide evidence that international PD stays while being related to a slower entry into the academic system, have a positive correlation with career advancement. We also show

that academic entry and progression is moderated by three dimensions of social capital: inbreeding, home-country linkages, and persistence in the composition of the co-author network. The shorter time to promotion to Associate Professor is more pronounced for cases where the promotion occurs at a university different from the researcher's PhD-granting institution (i.e., non-inbred promotions).

Our study contributes to the literature in several ways. First, this is the first longitudinal study focused on international PD mobility that uses a large sample of scientists from all disciplines. Previous evidence for Italy, other large European countries and the US was based on limited time frames, a subset of fields and considered only marginally international PD stays (Cruz-Castro & Sanz-Menéndez, 2010; Dias Lopes & Hancock, 2024; Duan et al., 2025; Sanz-Menéndez et al., 2013). The long-time longitudinal data we use allowed us to do a split period analysis with interesting results. For the most recent period (PhD cohorts 1997-2006) that was influenced by the various changes of regulations implemented in the country, we provide evidence of the development of a more efficient academic labour market as the positive correlation with non-inbreed promotion is stronger and more significant. Second, building on previous qualitative studies and partial findings (Caplow & McGee, 1958; Holding et al., 2024), we provide evidence that the length of the stay and the ranking of the hosting institution ("quality" of the stay) are associated with faster promotion for non-inbreed scientists. Third, while the literature on early career researchers has mostly focused on a single type of mobility – in particular, international mobility (Netz et al., 2020) – our paper considers both national and international mobility. This allows us to provide a more comprehensive view of international PD stays and to investigate their relationship with career advancement, while also accounting for other forms of mobility. Finally, from a methodological point of view, we contribute to the debate in the literature on the use of bibliometric indicators to trace scientists' mobility (Aman, 2018; Laudel, 2003; Robinson-Garcia et al., 2019). Thanks to the collection of scientists' CV data, we can confirm the results obtained using the bibliometric proxy for international PD stays and validate the accuracy of this proxy by comparing it to CV-reported mobility information (see Appendix G).

2. International postdoctoral mobility, social capital, and academic careers

The sociology and economics of science have devoted quite some attention to studying how international mobility relates to skill investment and to its impact on scientific productivity,

notably through the enhancement of scientific and technical human capital (Bozeman et al., 2001). While most studies report positive associations, the literature also highlights mixed outcomes depending on country, discipline, and institutional context. Mobility is linked to enhanced access to research resources, exposure to new methods, and increased opportunities for high-quality collaborations (Baruffaldi et al., 2020; Franzoni et al., 2014; Jonkers & Cruz-Castro, 2013; Jonkers & Tijssen, 2008; Scellato et al., 2015; Tartari et al., 2020). Recent studies using large bibliometric global data reinforce these findings confirming that international mobility is strongly correlated to research productivity (Finocchi et al., 2023). However, there is also evidence that although internationally mobile researchers have a larger academic network this does not translate into better academic performance (Paraskevopoulos et al., 2021).

Comparatively less attention has been directed towards the assessment of the influence of international mobility on academic career trajectories (for a recent literature review, see Netz et al., 2020) and results are conflicting depending on country, discipline, and institutional context. Some studies have investigated the time to tenure or promotion for internationally mobile scientists and have found mixed results. Jonkers (2011) examines the time to promotion of Argentinian scientists who had extended stays abroad and finds no significant effect after controlling for productivity. (Seeber & Mampaey, 2022) report that in some European university systems, international mobility and foreign nationality can reduce the chances of internal promotion. Yu (2024) using large-scale survey data on China presents mixed results on the time to promotion to Associate and Full Professor with some more robust evidence of a positive correlation for the latter while negative or not significant for the former.[1] Also Cañibano et al. (2020) using data from the large-scale survey of a sample of EU countries find mix results and highlight that timing of returning to the home country might affect the positive effect of mobility for mid-career researchers. A few studies find instead a positive correlation between international mobility and career progression. Schulze et al. (2008) provide evidence for Germany that international mobility is correlated to shorter time to getting a tenured professorship. Lawson & Shibayama (2015) investigate extended stays abroad among Japanese scientists and observe a significant positive effect on the time to promotion. Similarly, Lutter & Schröder (2016) analyze international stays of German PhDs and find a significantly positive impact on attaining tenured positions, attributed mainly to increased publication output. Finally, a few papers have examined the interaction between international

[1] There is a sizable literature on Chinese returnees most likely due to the very large number of Chinese scientists abroad and returned at home during the last 20 years. The return mobility has been associated to the development of the Chinese science system, however there is no space in this paper to discuss this stream of literature, see Yu (2024) for review of the literature and main findings.

mobility and career with qualitative detailed case studies, usually based on small samples, providing mix evidence on advantages, shortcomings and limitations (Bauder, 2020; Gill, 2005).

In most recent years, a handful of quantitative studies have focused specifically on PD mobility and career effects. Duan et al. (2025) analyzed bibliometric data of over 45,000 researchers spanning 25 years and across disciplines, revealing that PD productivity, especially the production of highly cited papers during the postdoc phase, strongly predicts academic retention. Shaaban et al. (2022) using US data of one university found that health sciences postdocs who moved institutions had higher probability of securing tenure-track faculty positions within three years compared to those who stayed at the same institution, underscoring the role of diverse training environments and expanded networks in fostering independence and career progression. Kahn & Ginther (2017) provides evidence for biomedicine in the US showing correlation between having done a postdoc and securing tenured-track positions. Wang & Main (2021) examine career outcomes for PD researchers in social sciences and STEM fields in the US. Their findings indicate that PD training increases the likelihood of securing tenure-track faculty positions within 7 to 9 years after PhD completion. This effect is particularly pronounced in social sciences. Only a few have looked specifically at international postdocs. Sanz-Menéndez et al. (2013) explore the time to tenure for Spanish scientists who underwent a PD period abroad and discover a significant and negative impact on the time to achieving Associate Professorship positions. Dias Lopes & Hancock (2024) reported that UK doctoral graduates that had a PD stay abroad reported higher rates of academic employment 3.5 years after graduation for both those that stayed abroad and those that returned to the UK compared to doctoral graduates who remained continuously in the UK.

In the literature there are several definitions of international mobility, from short-term visits to long-term migration that can happen in different periods of the scientist career. In some countries entry is associated with tenure, while in others tenure is granted only after several years and it is connected to the promotion to Associate Professor. Such a high level of heterogeneity makes it very difficult to compare the results of the different studies.

The timing of international mobility within one's career likely affects subsequent career outcomes differently. Additionally, the nature of mobility – such as short-term visits versus extended research stays – can produce distinct impacts. International mobility, particularly in the early stages of one's career, holds significant importance as it helps young scientists enhance their skills and shape their research trajectory (Bozeman et al., 2001; Gaughan &

Robin, 2004). This enables them to work more efficiently, increasing their scientific productivity and influence (Cruz-Castro & Sanz-Menéndez, 2010; Geuna, 2015). In this paper we focus only on international PD mobility (excluding thus international PhD mobility, short visits, sabbatical of academics with at least an Assistant Professor position and long-term migration) as we are interested in understanding the impact of international mobility of early career scientists returning to their home country. We differentiate between short postdoc, less than 18 months, and long postdoc that have a duration of 18 months or more. We assume that only a contract relationship of a certain length such as a postdoc appointment of 18 or more months might enable young scientists to accumulate the human and social capital that can impact their future career.

The returns to PD mobility are usually associated to accessing resources, ideas (often tacit in the early phase of a science) and reputation of top research institutions (Fernández-Zubieta et al., 2015, 2016). Time and type of position are also relevant in the process of development of the human and social capital of the scientist. Short stays may be useful to "get in touch" with new ideas and approaches but only longer stays are associated to effective jobs that enable the acceptance by the host community. Longer postdoc periods allow young scientists to be trusted by senior staff via routine lab working on specific projects, resulting in the transfer of knowledge and reputation and the creation of lasting ties. In this way knowledge and reputation transfer, access to international networks and future recommendations become the outcomes of the PD stay abroad that could impact future career progression.

Especially for more closed academic systems such as in the case of various European countries including Italy, mobility abroad can be associated with the weakening of ties in the home country social network (Heining et al., 2007; Perotti, 2009) thus delaying re-entry in the national system for the returnees (Bauder, 2020). On the other hand, the human and social capital accumulated during the stay in the host country could give a reputation extra premium to the mobile postdocs on top of the increased productivity. The premium might not counterbalance the disadvantage of weaker ties for mobile postdoc at entry, but once entered in the system might increase the probability of a faster promotion to Associate Professor as those scientists can have a higher future productivity potential and could bring valuable connections to the department.[2]

This is especially true in the case of international PD stays in high prestige institutions (Holding et al., 2024). The traditional sociology of science literature has long explored the

[2] Though foreign social capital might depreciate over time (Wang et al., 2019).

relationship between institutional prestige, individual performance, and career outcomes, often interpreting this link as evidence that top universities are especially effective at attracting the most talented and productive scientists (Long, 1978). However, prestigious institutions do more than simply select top performers — they actively shape and amplify researchers' careers by providing superior resources, infrastructure, and environments. These advantages include better research facilities (such as dedicated funding, laboratory space, advanced equipment, library access, and administrative support), reduced teaching loads, stronger incentives (both monetary and promotion-related) to publish, and exposure to ambitious, high-performing colleagues. Together, these factors enhance both the productivity and the visibility of scientists working in elite institutions (Allison & Long, 1990; Long, 1978). In her foundational work on scientific elites, Zuckerman (1977) emphasized that elite research departments play a critical role as "evocative environments," serving as key transition points in scientific careers by offering outstanding instruction, resources, and opportunities that nurture and propel exceptional research talent.

From this discussion, we expect that the relative importance of such a premium is associated with the length of staying[3] and the quality of the hosting institutions.

H1a: Returnees that did a PD stay abroad enter later as Assistant Professor in their home country compared to home country stayers, while they are promoted sooner to Associate Professor.

H1b: The quality of the hosting institution and length of the stay are correlated to faster promotion to Associate Professor.

2.1 Social capital moderating effect: Inbreeding

Traditional sociological literature examining academic labor market has highlighted the role of inbreeding and silver-cording (Hargens & Farr, 1973). Changes in the academic labor market have made PD appointments much more common, in most recent years getting an Assistant Professor position directly after the PhD has become almost an exception especially in STEMM fields (with some difference across fields and countries, for example in economics in the US is still somehow common; NSF, 2024). In this paper we analyze PD mobility thus we modify Horta (2013) classification and define *postdoc mobile inbreds* as those academics

[3] However too long postdoc periods can be associated to multiple postdocs in tight labour markets and as such an indication of cheap labour exploitation rather that capital augmenting (Stephan, 2013).

that after a PD mobility spell are hired as Assistant Professor by the institution where they did their PhD. While *pure inbreds* refers to scientists that did their postdoc and got their first Assistant Professor position in the same university of their PhD. We define *silver-cording* as the case in which an academic is hired as Associate/Full Professor from the university where she did her PhD after having held a position of Assistant Professor in another university.[4] In this paper we focus mainly on inbreeding.

There is a large body of literature on inbreeding in various countries, scientific fields and in different periods of time (Horta, 2013; Horta et al., 2022; Mazzoleni et al., 2021; Shibayama, 2022), and its impact on productivity (Borenstein et al., 2022; Slepykh, 2025; Tavares et al., 2019), however less is known about the interaction between PD mobility, inbreeding and the career path of academics. In this paper we examine the role of inbreeding in influencing the time it takes for international postdocs to re-enter the home country system.

Institutional inbreeding often stems from the strong connections developed within the scientific network during the PhD, particularly the ties with supervisors and senior colleagues at the alma mater. Such relationships can facilitate the return of international postdocs to their home country by providing easier access to Assistant Professor positions at their PhD-granting university. Sometimes, supervisors even encourage or support their PhD graduates to gain international experience with the intention of rehiring them upon their return (Jonkers & Cruz-Castro, 2013). Consequently, internationally mobile scientists who secure their first Assistant Professor position at their alma mater might experience a shorter time-to-entry compared to their nonmobile colleagues.

However, the literature suggests that inbred scientists may exhibit lower productivity (Horta et al., 2010), possess smaller international networks (Scellato et al., 2015), and experience slower career progression (Inanc & Tuncer, 2011). Therefore, we expect that the positive association between foreign PD stays and career advancement may be moderated for inbred scientists, who could face longer time-to-promotion despite benefiting from faster re-entry.

H2: Institutional inbreeding is associated with faster re-entry but longer time to promotion for returnees who completed a postdoctoral stay abroad.

[4] A different definition of silver-cording would consider only those academics that after having got an Associate Professor position (a tenured position in the US market) move to their alma mater as Full Professor.

2.2 Social capital moderating effect: Home-country linkages

A different social capital effect that may moderate the time to re-entry into the home academic system concerns the researcher's national scientific network. Unlike institutional inbreeding, re-entry into the home country (in any university) can be linked to preserving interactions with home-country scientists more broadly. Research has shown that international mobility positively contributes to research productivity when mobile scientists maintain strong linkages to their home country (Baruffaldi & Landoni, 2012). The detachment from the domestic scientific network can expose internationally mobile postdocs to career risks, as it may become more difficult for them to reintegrate into the home system (Bauder, 2020; Gill, 2005; Sanz-Menéndez et al., 2013). Maintaining active linkages with various institutions in the home country, not only with the alma mater, helps postdocs remain connected to the national academic network, keeping them informed about new opportunities and increasing their access to Assistant Professor positions. Furthermore, continuing to collaborate with home-country scientists reduces the risk of being perceived as detached or disconnected from the national context (Gibson & McKenzie, 2014; F. Li et al., 2015; Murakami, 2014; Trippl, 2013), thus lowering the barriers to re-entry. Therefore, we expect that maintaining connections to the home-country scientific network while abroad can assist internationally mobile postdocs in returning more quickly, reducing their time-to-entry compared to other non-internationally mobile peers.

H3: A high level of embeddedness in the home-country scientific network is associated with faster re-entry.

2.3 Social capital moderating effect: Persistence in collaboration

Finally, we consider the persistence of collaboration networks established during the postdoc abroad. The literature indicates that international mobility enables early-career researchers to connect with potentially more prolific and reputed scientists, thereby expanding their scientific network and providing access to international peers who would otherwise be out of reach without mobility (Baruffaldi et al., 2020; Jonkers & Cruz-Castro, 2013; Netz et al., 2020). These new "weak ties," as Granovetter (1973) defines them, are particularly advantageous for scientists because they offer access to non-redundant information, enhancing creativity and productivity. Additionally, studies show that while scientists often maintain ties with former co-authors and collaborators abroad (Kato & Ando, 2017), sustaining these collaborations becomes increasingly difficult over time, and the positive effects on productivity tend to

diminish unless researchers continue engaging in international activities (Wang et al., 2019). Therefore, we expect that internationally mobile postdocs who can successfully maintain collaboration ties with co-authors they worked with during their time abroad will experience a positive association with their time-to-promotion, progressing more quickly through academic ranks.

H4: A high level of persistence in collaboration is associated with faster promotion.

3. Institutional context: The Italian academic system

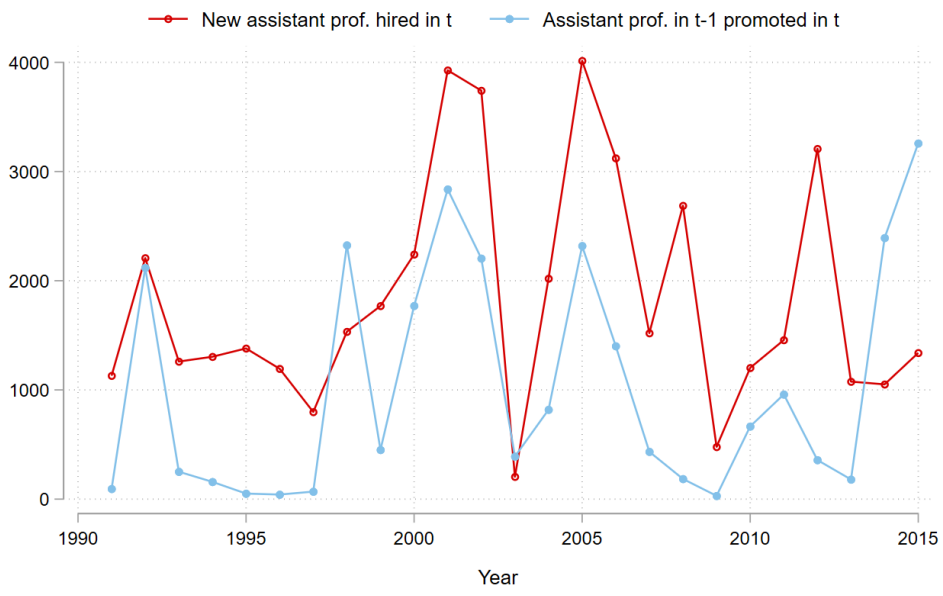
The academic labor market in Italy is similar to that of other continental European countries such as France, Germany, and Spain, featuring highly structured and hierarchical systems, strong national regulation of recruitment and promotion, limited openness to external candidates, and relatively low levels of internationalization and cross-border mobility compared to Anglo-Saxon systems (Afonso, 2016; Musselin, 2005; Seeber & Mampaey, 2022). Moreover, excellence programs have been developed in Italy and, around the same time, in several similar European countries (including Denmark, Germany, Spain, and France) as targeted efforts to address these structural limitations (Carayol & Maublanc, 2025).

The Italian academic system comprises 92 universities, 31 private and 61 public institutions, and seven specialized higher education institutions. These specialized institutions primarily offer master's and PhD programs and are more research-focused than most other universities. Employees at Italian universities are civil servants, which means that the key aspects of employment (wages, contract terms, and responsibilities such as teaching loads) are governed by national laws rather than local agreements or negotiations. Every professor at Italian universities is associated with a single scientific field, and recruitment commissions within each of these fields manage the selection of candidates at national and local levels.

The Italian academic system has three main positions: Assistant Professor, Associate Professor and Full Professor. Since 2012 the Assistant Professor position has been transformed with a mix of temporary 5 years entry contract and tenure track contract with a starting 5-years temporary position. Salaries in public universities vary only by type of position and seniority. Hence, Universities cannot link wages to research productivity or other performance indicators, though professors can be paid for teaching more than the hours of frontal teaching required by their contract. Therefore, the primary motivation for academic researchers to produce scientific work is the prospect of career advancement.

In 1990, 42,209 professors were active in Italian universities. In the period we consider in this paper, 45,795 academics entered in the Italian system and 33,219 exited, reaching the maximum in 2008 to then decrease to 54,785 in 2015. From the early 1980s until the late 1990s, the hiring of all professors was managed through standardized national competitions, with recruitment centralized by national committees. These competitions were held every 3 to 4 years. Beginning in 1999, the recruitment process shifted to a local level, allowing individual universities to conduct their own selection procedures. The 2010 reform established a two-tier process involving a national habilitation followed by local competitions for professor positions. (see Appendix A for further details about the characteristics and transformation of the Italian university system). Figure 1 shows the number of new Assistant Professors and newly promoted Associate and Full Professors in Italian academia. As in other national university systems, entry and promotions are quite cyclical.

Figure 1: Yearly entrances and promotions in Italian academia, 1991-2015



Concerning research performance (as proxied by bibliometric indicators with their intrinsic limitations) Italy has undergone an important transformation during the period considered. Both in term of quantity and "quality" Italy has shown a substantial increase being second only to Germany among the EU countries in term of output and overtaking Germany and France in the rankings based on share of top 10% most cited and share of 1% most cited by the end of the period (BEIS, 2016; European Commission, 2024).

Comparative data from Scopus, available online, on the research performance of G7 countries for the period 1996-2020 (that overlaps with our period of observation), highlights a continuous growth path.[5] Italy produced about 3.4% to 4.0% of world publications in the twenty-five years considered, overtaking France in more recent years. It had a better and growing performance in terms of citations, moving from a fork of 3.5-4.5 in the first ten years to 4.5-5.6 in the 2006-2015 period to arrive at 6.7% of world citations in 2020, again overtaking France. When the Field Weighted Citation Impact is considered, the performance is even better; by 2010, Italy had similar values to France and Germany, and by 2015, it had overtaken both countries, having similar values to the UK; in 2020, Italy was second only to the US. Finally, a similar growth pattern is shown when we look at highly cited papers (top 1%). By 2015, Italy had values like those of France, and by the end of the period, it was above both France and Germany. Productivity data is also interesting, though it should be taken with some caution, for the period 2006-2014 Italy is either the country with the highest productivity or very near to the UK and Canada level, well above France, Germany and the US.[6]

4. Data

We collected information from three primary sources: the National Library of Florence (BNCF), the Italian Ministry of University and Research (MUR), and Elsevier's Scopus database.

From BNCF, we retrieved all doctoral dissertations defended at Italian universities from the I cycle (1986) up to 2006, totaling approximately 76,000 doctoral theses. The BNCF's online public access catalog provided details including the thesis author, title, supervisor, granting institution, scientific field, and year.

From MUR, we obtained administrative records of all academics employed at Italian universities between 1990 and 2015. These records include information on academic position, scientific field, university affiliation, and personal details such as birth year and gender.

By combining these two datasets, we identified PhD holders from Italian universities who pursued an academic career in Italy. Specifically, we linked academics listed in the MUR

[5] See the 2022 report "International comparison of the UK research base" by the UK's Department for Business, Energy & Industrial Strategy (https://www.gov.uk/government/publications/international-comparison-of-the-uk-research-base-2022, last visit: May 2025).

[6] See the 2016 report "International comparison of the UK research base" by UK's Department for Business, Energy & Industrial Strategy (https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2016, last visit: May 2025).

dataset with individuals holding Italian doctoral degrees from the BNCF dataset using a record linkage procedure based on four key variables: name, gender, scientific field, and year of PhD completion. This process allowed us to identify the population of researchers who earned a PhD in Italy and worked in Italian academia for at least one year. Additional details on the retrieval process from BNCF, the record linkage methodology, data cleaning, and results can be found in Coda Zabetta & Geuna (2020).

For our analysis, we focus on a subset of these researchers: the 18,039 individuals who completed their doctorate and entered Italian academia as Assistant Professors between 1991[7] and ten years after their PhD, and who were still part of the academic workforce in 2015 (i.e., they had not migrated or retired before the end of our observation window). Around half of them (52%) were inbred, as they got their Assistant Professor position in the university that granted their PhD.

For these researchers, we used Scopus to retrieve all their scientific articles published in international journals from their first publication up to 2015. Appendix B provides further details on the publication retrieval procedure and a discussion of Scopus's coverage.

We find that 15,385 researchers (about 85% of the sample) published at least one article in Scopus-indexed journals over their career up to 2015. In total, we collected 285,000 scientific articles. Of these researchers, 9,912 published at least one paper in the period between earning their PhD and their first appointment as Assistant Professor (61% of them were inbred); this group constitutes the empirical sample used in the regression analysis presented in this paper.[8]

4.1 Identification of international PD stays

We proxy early career mobility using the affiliations reported in scientific publications indexed in Scopus. This approach allows us to identify researchers who, after completing their PhD and before their first academic appointment in Italy, spent a research period abroad – typically

[7] Our employment data from MUR begin in 1990, which means we can only reliably identify new entries as Assistant Professors starting from 1991. As a result, academics who earned their PhD between 1986 and 1990 and who already appear in the MUR data in 1990 are excluded from the analysis, since we cannot assign them a clear year of entry into the academic system. Additionally, rerunning our analysis while restricting the sample to PhDs awarded from 1990 onward yields similar results, which are available from the corresponding author upon request.

[8] Given the data collection strategy based on Scopus publications, 87% of our final sample is in the STEMM fields (see discussion below) compared to 48% in the full sample. Inbreeding at entry is more common in the STEMM fields compared to SSH.

in a PD position. This method captures mobility if the researcher produced at least one publication in the PD period and reported their institutional affiliation, ensuring traceability.

Several studies have employed Scopus data to investigate scholars' international mobility (Conchi & Michels, 2014; Subbotin & Aref, 2021; Zhao et al., 2022). Research has validated this approach: Laudel (2003) and Aman (2018) compared bibliometric mobility measures to CVs and surveys, while Moed & Halevi (2014) assessed the precision of bibliometric methods against official statistics across 17 countries. Collectively, these studies estimate that bibliometric error rates are below 10%.

Using affiliation data from Scopus, we selected each author's primary institutional affiliation as reported in their publications. In cases where multiple affiliations were listed,[9] we followed the OECD (2017) guideline and used the first listed affiliation as the primary one, thereby excluding short research visits that typically do not involve a formal change of the primary institutional affiliation.

For the empirical analysis, we compare internationally mobile postdocs with those who remained in Italy, either doing a postdoc at their alma mater or moving to another university in Italy. Because our method relies on publication records, it may miss international stays that did not result in publications. To address this, we perform a robustness check in Section 7.1 using CV data to directly identify international PD stays, finding results consistent with the bibliometric-based analysis reported in Section 6.

Our empirical sample consists of 9,912 scientists, representing 55% of the total pool of 18,039 researchers. Table 1 shows the composition by gender, cohort, and scientific field. Notably, 87% of the empirical samples belong to STEMM fields (Science, Technology, Engineering, Mathematics, and Medicine), while only 13% comes from the Social Sciences and Humanities (SSH). This reflects the lower coverage of SSH publications in Scopus and the fact that SSH scholars might prioritize other forms of scientific products, such as monographs or book chapters. We conduct a robustness analysis on the STEMM subsample, for which our bibliometric proxy is more reliable, and find consistent results (see Appendix F).

Table 1 and Figure 2 provide preliminary insights into the characteristics of internationally mobile postdocs. Women show lower mobility rates than men (16.6% vs. 21.7%). The proportion of internationally mobile postdocs is higher in the earlier cohort (1986–1996) at 24%, compared to 18% in the later cohort (1997–2006). By field, the Natural Sciences and Architecture &

[9] Approximately 8% of the publications produced during the PD period reported multiple affiliations. Excluding these publications from the analysis does not alter the results.

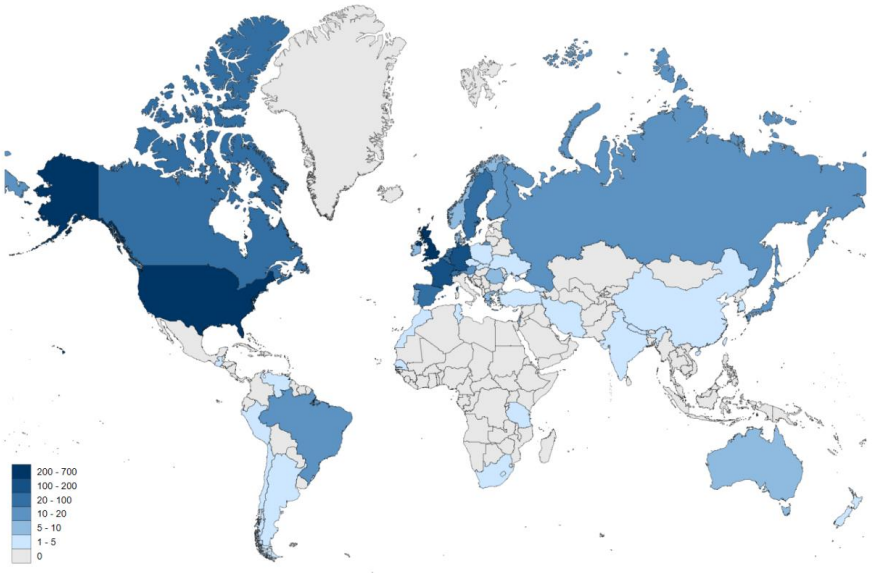
Engineering have the highest shares of internationally mobile postdocs, while Humanities, Law, and Social Sciences show the lowest. Table G.3 in Appendix G presents the same statistics for the subsample of researchers with available CV information, showing comparable results.

Table 1: Sample composition and share of researchers with international PD stays

	Nb	Share over total	Share PD_Abroad=1
All	9912	-	19.6
Men	5852	0,59	21.7
Women	4060	0,41	16.6
Cohort 1986-1997	2578	0,26	23.9
Cohort 1997-2006	7334	0,74	18.1
Field: Natural Sciences	4530	0,46	24.3
Field: Medicine & Veterinary	1728	0,17	21.7
Field: Architecture & Engineering	2343	0,24	14.7
Field: Humanities & Law	636	0,06	7.4
Field: Social Sciences	675	0,07	11.2

Form a geographical point of view, PD mobility spans about 50 countries. The United States is the top destination, attracting 45% of internationally mobile postdocs, followed by EU countries, notably the United Kingdom, France, and Germany. Together, EU countries account for 46% of mobility, with the remaining 9% spread across other destinations. Similar patterns emerge when we use CV information.

Figure 2: Destination countries for Italian International Postdocs



Notes: The map shows the number of international PD stays per destination country, based on our sample. Please note that one researcher may have undertaken multiple international PD stays.

5. Methodology

5.1 Empirical strategy

We estimate a duration model to analyze the effect of international PD stays on two key career transitions in academia: (i) the period from PhD completion to entry into the Italian academic system as an Assistant Professor, and (ii) the period from entry to promotion to Associate Professor. In this framework, each researcher is considered to be at risk of entering academia starting from the year of their PhD, and at risk of promotion beginning from their first academic appointment. To model these transitions, we employ a Cox proportional hazards model, where the dependent variable is the number of years from PhD to entry (for the time-to-entry analysis), and from first appointment to promotion to Associate or Full Professor[10] (for the time-to-promotion analysis).

It is important to stress that in the time-to-promotion analysis, our observations are right-censored, that is, our sample includes individuals who have not yet experienced the event by the end of the observation period. This is not a problem in our setting for two main reasons. First, our sample includes only researchers who remain employed in Italian academia until the end of the observation period; we explicitly exclude those who entered Italian academia and subsequently exited (for example, by leaving the country or the academic system). This means we focus only on individuals who are at risk of promotion throughout the entire observation window. In practice, this assumes that censored individuals have the same hazard (risk) of promotion as others at the point when the observation window ends. Second, the Cox proportional hazards model is specifically designed to handle right-censored data, because it uses semiparametric estimation and thus does not require any parametric assumptions about the baseline hazard function (Cox, 1972; Klein & Moeschberger, 2003).

The baseline model is specified as follows:

$$h_i(t) = h_0(t) \times exp\left(\beta_0 \cdot PD\_Abroad_i + \beta_1 \cdot PD\_Ita\_Mob_i + X_i'\gamma + \delta_{y,a,u}\right) \quad (1)$$

where $h_0(t)$ is the baseline hazard, PD_Abroad_i is a dummy variable equal to 1 if the researcher spent a PD period abroad, and $PD\_Ita\_Mob_i$ is a dummy variable indicating national (Italian) PD mobility. X_i is a vector of individual-level control variables and $\delta_{y,a,u}$ denotes fixed effects for PhD year (y), age at PhD (a), and PhD-granting university (u). In the time-to-promotion

[10] Our dataset includes researchers who were promoted directly from Assistant to Full professor. There are 67 such cases. Excluding these from the analysis yields consistent results, which are available upon request.

analysis, we additionally include fixed effects for the year of entry into the academic system and the age at entry.

To mitigate endogeneity concerns, we balance the samples of internationally mobile and non-internationally mobile postdocs based on their observable characteristics. To achieve this, we rely on Entropy Balancing (EB), introduced by Hainmueller (2012). EB is a reweighting method based on a variant of maximum entropy estimation. It identifies a set of weights for one group such that the distributions of selected covariates are aligned across groups by matching their statistical moments (typically means). Crucially, EB ensures that these weights deviate as little as possible from uniform weights, thereby minimizing distortion. As such, EB serves as an effective alternative to Propensity Score Matching (PSM) and Coarsened Exact Matching (CEM). Unlike PSM, which often requires a large donor pool of untreated individuals and can result in discarded observations, or CEM, which applies stricter matching criteria and may exclude unmatched observations due to its coarsening approach, EB retains the entire control sample and simply adjusts the weights applied to each individual to achieve balance on covariates. This allows EB to achieve covariate balance even with relatively small control groups. As a result, it is increasingly used in empirical research in the economics of innovation (see, for example: Cao et al., 2025; Murmann et al., 2023; Neffke et al., 2024).

In our analysis, we use EB to balance the sample of non-internationally mobile postdocs. Specifically, we estimate weights such that the reweighted control group mirrors the distribution of observable characteristics of the internationally mobile postdoc group. We then apply these weights in estimating a weighted version of the Cox model described in Equation (1). Further details on the implementation of EB are provided in Appendix C.

5.2 Main independent variables

The baseline model in Equation (1) aims to test hypothesis *H1a* on the impact of *PD_Abroad* on time-to-entry and time-to-promotion. In particular, the inclusion of *PD_Ita_Mob* – a dummy variable indicating whether the researcher completed a PD period in a different Italian university from their PhD institution – allows us to disentangle the effect of international mobility from that of national mobility. This comparison helps determine whether the observed correlation with career progression is specifically tied to international experience or simply to mobility *per se*, regardless of geographic scope. By including both variables in the model, we are thus able to assess the distinctive contribution of international PD training to academic career advancement.

To test hypothesis *H1b*, we split the *PD_Abroad* variable into two pairs of complementary dummy variables based on (i) the length of the PD stay and (ii) the quality of the international institution where the stay took place, as detailed hereafter.

First, we distinguish between short and long international PD experiences. The variable *PD_Abroad_Long* takes the value 1 if the postdoc abroad spans at least two years. To identify such cases, we assign a value of 1 to the dummy if the focal researcher has published at least two articles in two different years during the PD period, while consistently listing the foreign PD institution as their first affiliation. This publication pattern is interpreted as evidence that the international PD stays extended over multiple years. The complementary variable, *PD_Abroad_Short*, captures international PD stays for which the researcher either published only one paper, or multiple papers within the same calendar year, again with a foreign PD affiliation. In such cases, we assume the international mobility period was of shorter duration. This operationalization allows us to distinguish between shorter and longer international postdoc stays, and to assess whether the length of stay has a differential association with academic career progression. Table 2 summarizes the distribution of the number of years spent abroad per international PD stay among the 1,944 internationally mobile postdocs in our sample, according to the identification strategy described. The majority (52.6%) spent only one year abroad; these cases are classified as *PD_Abroad_Short*. The remaining 47.4% of researchers, who spent two or more years abroad, are classified as *PD_Abroad_Long*.

Table 2: Number of years abroad for international mobile researchers

Yr_Abroad	Freq.	Percent	Cum.
1	1,023	52.62	52.62
2	276	14.20	66.82
3	216	11.11	77.93
4	166	8.54	86.47
5	108	5.56	92.03
6	56	2.88	94.91
7	38	1.95	96.86
8	28	1.44	98.30
9	23	1.18	99.49
10	10	0.51	100.00
Total	1,944	100.00	

Second, we account for the quality of the international PD host institution using the Academic Ranking of World Universities (ARWU). The variable *PD_Abroad_Rank-High* takes the value 1 if the postdoc hosting institution is listed among the top 100 institutions in the ARWU ranking in the period between 2003 (first year of the ARWU ranking) and the last year of our analysis (2015). This reflects affiliation with a globally recognized, high-prestige research institution. The complementary variable, *PD_Abroad_Rank-Low*, takes the value 1 if the international host institution is not ranked among the top 100 in the ARWU. This captures experiences in institutions with lower international visibility or prestige. This distinction allows us to assess whether the institutional quality of the hosting institution is correlated with academic career trajectories upon return.

5.3 Moderating variables

Following the discussion in Section 2, we also examine whether time-to-entry and time-to-promotion are associated with by a researcher's social capital – specifically, the connections developed with her alma mater, home country academic community, and with international peers. We test this through three proxies of researchers' social capital and scientific networks.

First, we include variables indicating whether the focal researcher obtained her first academic position at her PhD-granting institution (*Inbred_Entry*) or was promoted within that same institution (*Inbred_Prom*), for the time-to-entry and time-to-promotion analyses, respectively. We interact these variables with international postdoc experience to assess whether tight institutional ties at the alma mater facilitate faster entry or promotion in academia.

To test hypothesis H3, we measure the strength of the researcher's ties to her home country during the postdoc period. We construct two dummy variables: *PD_Abroad (Home Linkages > TH)* and *PD_Abroad (Home Linkages ≤ TH)*. These are based on researchers' co-authors' affiliation data retrieved from Scopus. For each internationally mobile postdoc, we collect all publications during the PD period, identify the affiliations of all unique co-authors, and compute the share of Italian versus foreign affiliations. The two dummy variables are then defined based on whether the share of Italian co-authors exceeds or falls below a given threshold (TH). In the empirical analysis, we explore how the results vary when setting the threshold at the first, second, and third quartiles of the distribution.

Finally, to test hypothesis H4, we examine whether maintaining scientific collaborations with PD-period co-authors is correlated with promotion. We distinguish between two types of co-authors: those from the PD period ("PD co-authors") and those with whom the researcher

collaborates after entry but before promotion (or the end of the observation period, for censored observations), referred to as "post-entry co-authors." We then construct two dummy variables: *PD_Abroad (Netw. Persistence > TH)* is set to 1 if the proportion of PD co-authors among post-entry co-authors exceeds a certain threshold, and *PD_Abroad (Netw. Persistence ≤ TH)* otherwise. As with hypothesis H3, we explore how results change across different thresholds, specifically using the first, second, and third quartiles of the distribution.

5.4 Control variables

Since scientific performance plays a critical role in academic career advancement, our analysis includes measures that account for both scientific productivity and research "quality". To quantify performance, we calculate the annual number of publications and the average number of citations per year, both adjusted for the number of co-authors on each article. These data are retrieved from Scopus, where we extract all scientific articles authored by individuals in our sample along with the total number of citations each article has received.

We compute these performance measures for two distinct periods: (i) from the year of PhD completion to the year of first academic appointment, and (ii) from the year of entry into academia to the year of promotion (or the final year of observation for individuals not promoted within the observational period). For these two periods, we compute the average number of publications and citations per year, weighted by the number of authors, measured up until the point of entry or promotion (or exit, in the case of censored observations)[11]. In the regression models, we use the natural logarithms of these indicators (+1). Specifically, we use *Log_Pubs_Entry* and *Log_Cits_Entry* in the time-to-entry analysis, and *Log_Pubs_Prom* and *Log_Cits_Prom* in the time-to-promotion analysis.

Additionally, we include the variable *Early_Pub*, a binary indicator equal to 1 if the researcher published at least one scientific article during their PhD. This serves as an early-career performance signal, as prior research has shown that publishing during the PhD is associated with higher productivity and faster career progression (Clemente, 1973; Horta & Santos, 2016). We also control for gender (using the dummy variable *Female*) and age at PhD, as these are variables known to be associated with both international mobility (Zhao et al., 2023) and academic career progression (Pezzoni et al., 2012). Much of the literature especially in the sociology of science has documented significant disadvantages faced by women in terms of

[11] Scopus provides the cumulative number of citations as of the data download date, meaning that older articles will generally have higher total citation counts.

academic career outcomes (Cole, 1979; Long et al., 1993), though some studies, find no significant effect of gender on career advancement (Kaminski & Geisler, 2012). Age at PhD, that we use as a proxy for the starting point of an academic career, has also been highlighted in the literature as a key factor influencing both research productivity (Levin & Stephan, 1989) and has been described more as a process shaped by seniority (Cole, 1992; Nakhaie, 2007). We also include the squared term of age at PhD to account for potential non-linear effects.

To account for unobserved heterogeneity and structural differences across academic contexts, we include a set of indicator variables as fixed effects in all regression models. These include dummies for scientific field, PhD university, and PhD year in the time-to-entry models, and additionally, university of first appointment and year of entry into academia in the time-to-promotion models. These fixed effects help control for variation in job availability and promotion norms across disciplines, time periods, and institutions. This ensures that our estimates more accurately capture the correlation between international mobility, social capital, and scientific performance on academic career outcomes. Table 3 reports the descriptive statistics of the variables employed in the empirical analysis, while Table 4 provides their synthetic description.

Table 3: Summary statistics of main variables

	Obs	Mean	SD	Min	Max
Time-to-Entry	9912	3.84	2.57	1.00	10.00
Promoted	9912	0.50	0.50	0.00	1.00
Time-to-Prom	9912	8.53	4.34	1.00	24.00
Inbred_Entry	9912	0.61	0.49	0.00	1.00
Inbred_Prom	9912	0.60	0.49	0.00	1.00
Early_Pub	9912	0.65	0.48	0.00	1.00
Female	9912	0.41	0.49	0.00	1.00
Age_PhD	9912	30.78	2.53	25.00	39.00
Avg_Pubs_Entry	9912	2.88	3.14	0.10	41.00
Avg_Pubs_Prom	9912	2.53	2.55	0.00	88.67
Avg_Cits_Entry	9912	1.30	2.62	0.00	98.98
Avg_Cits_Prom	9912	1.29	1.77	0.00	38.98
PD_Abroad	9912	0.20	0.40	0.00	1.00
PD_Ita_Mob	9912	0.44	0.50	0.00	1.00
PD_Abroad_Rank-High	9912	0.06	0.24	0.00	1.00
PD_Abroad_Rank-Low	9912	0.14	0.34	0.00	1.00
PD_Abroad_Long	9912	0.10	0.29	0.00	1.00
PD_Abroad_Short	9912	0.10	0.30	0.00	1.00

Table 4: Description of the main variables

Variable	Description
Main dependent variables	
PD_Abroad	Dummy = 1 if the researcher did a PD period at a foreign institution.
PD_Abroad_Long	Dummy = 1 if the international PD extended over multiple years.
PD_Abroad_Short	Dummy = 1 if the international PD did not extend over multiple years.
PD_Abroad_Rank-High	Dummy = 1 if the postdoc institution is ranked in the top 100 of the ARWU.
PD_Abroad_Rank-Low	Dummy = 1 if the postdoc institution is not ranked in the top 100 of the ARWU.
PD_Ita_Mob	Dummy = 1 if the researcher did a PD in a different Italian university from their PhD institution.
Social Capital moderators	
Inbred_Entry	Dummy = 1 if the researcher's first academic position was at the same university where they obtained their PhD.
Inbred_Prom	Dummy = 1 if the researcher was promoted at the same university where they obtained their PhD (or was still affiliated with it at the end of the observation period, if censored).
PD_Abroad (Home Linkages>TH)	Dummy = 1 if the share of co-authors with Italian affiliations during the PD is above a specified threshold (TH).
PD_Abroad (Home Linkages≤TH)	Dummy = 1 if the share of co-authors with Italian affiliations during the PD is below or equal to the threshold (TH).
PD_Abroad (Netw. Persistence>TH)	Dummy = 1 if the share of co-authors from the PD period among co-authors after academic entry exceeds a specified threshold (TH).
PD_Abroad (Netw. Persistence≤TH)	Dummy = 1 if the share of PD-period co-authors among post-entry co-authors is below or equal to the threshold (TH).
Controls	
Early_Pub	Dummy = 1 if the researcher published at least one scientific article during the PhD period.
Log_Pubs_Entry	Natural logarithm of the average annual number of publications, weighted by the number of authors, from PhD completion to first academic appointment.
Log_Pubs_Prom	Natural logarithm of the average annual number of publications, weighted by the number of authors, from first appointment to promotion (or censoring).
Log_Cits_Entry	Natural logarithm of the average annual number of citations (per publication) from PhD completion to first appointment.
Log_Cits_Prom	Natural logarithm of the average annual number of citations (per publication) from first appointment to promotion (or censoring).
Female	Dummy variable equal to 1 if the researcher is a woman.
Age_PhD	Age (in years) of the researcher at the time of PhD completion.

6. Main results and discussion

6.1 Time-to-entry

In this subsection, we present the results for the first of our outcome variable, namely the time-to-entry to an Assistant Professor position. Table 5 shows the results from the Cox model, which analyzes the time until researchers receive their first appointment as Assistant Professors.

Table 5: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1	0.621***	0.616***	
	(0.018)	(0.019)	
PD_Abroad=1 X Inbred_Entry=0			0.549***
			(0.027)
PD_Abroad=1 X Inbred_Entry=1			0.633***
			(0.021)
Inbred_Entry=1		0.975	0.897***
		(0.027)	(0.030)
PD_Ita_Mob=1	0.738***	0.730***	0.702***
	(0.021)	(0.022)	(0.022)
Log_Pubs_Entry	2.777***	2.777***	2.785***
	(0.144)	(0.144)	(0.145)
Log_Cits_Entry	0.955**	0.956**	0.956**
	(0.018)	(0.018)	(0.018)
Early_Pub=1	1.188***	1.189***	1.191***
	(0.036)	(0.036)	(0.036)
Female	0.965	0.967	0.965
	(0.024)	(0.024)	(0.024)
Age_PhD	1.263**	1.267**	1.265**
	(0.123)	(0.124)	(0.122)
Age_PhD^2	0.997**	0.997**	0.997**
	(0.002)	(0.002)	(0.002)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-28936.881	-28936.636	-28934.623
Chi-squared	11428.974	11428.294	11428.206

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

In column 1, the hazard ratio for *PD_Abroad* is 0.621. This means that postdocs who went abroad have a 38% lower chance of getting a first academic position at any given time compared to those who did not move during the same period. In the model we also look at

postdocs who stayed in Italy but moved to a different university than where they earned their PhD (*PD_Ita_Mob*). The hazard ratio for this group is 0.738, indicating they enter the system faster than those who went abroad, but slower than those who remained at their alma mater for their PD. We thus find confirmation for our hypothesis *H1a*.

In column 2 and 3, we test hypothesis *H2* by examining the interaction between *PD_Abroad* and our first moderator related to social capital: inbreeding. Specifically, in column 2 we include the variable *Inbred_Entry*, which equals 1 if the researcher obtained their first Assistant Professor position at the same university where they earned their PhD. With this variable included the reference group for all coefficients now consists of researchers who did their PD at their alma mater but obtained their first academic position at a different university. The coefficient for *Inbred_Entry*, which is below 1 and significant only in column 3, indicates that postdocs who are not internationally mobile nor mobile within Italy at the PD stage, and who return to their alma mater for their first position, experience a slightly longer time to entry compared to similar researchers who moved to a different university for the first appointment.[12]

In column 3, we then interact this variable with *PD_Abroad*. When looking at the interaction between *PD_Abroad* and *Inbred_Entry*, we find that the coefficient is higher when the first appointment is at the alma mater (i.e., when *Inbred_Entry* = 1). The difference between these two coefficients is statistically significant according to the Wald test ($W=7.93$, $p<0.001$). This suggests that inbreeding reduces the waiting time for internationally mobile postdocs to secure their first academic position, supporting hypothesis *H2*.

Looking at the control variables included in our model, we find that scientific productivity, measured by the number of publications, is positively associated with the time to first academic appointment. In contrast, the number of citations has a slightly negative coefficient. This suggests that, at this early career stage, what matters most is the ability to publish, rather than the quality or impact of the publications. In other words, showing a consistent publishing record is more advantageous than focusing on fewer, high-impact articles, which may take longer to complete and could reduce overall productivity.

Similarly, the variable *Early_Pub*, which indicates whether a researcher published during their PhD, is positively associated with faster entry into the academic system. This early publication activity acts as a signal of research capability from the very beginning of a

[12] Removing *PD_Ita_Mob* from the model yields a positive and marginally significant ($p < 0.10$) coefficient for *Inbred_Entry*, indicating a weak positive association between inbred, non-internationally PD mobile researchers and shorter time-to-entry. Results are available upon request.

researcher's career. This is consistent with the literature showing that publishing during the PhD has positive effects on future career outcomes (Horta & Santos, 2016).

Finally, regarding individual characteristics, the variable *Female* shows a slightly negative coefficient, but it is not statistically significant in all the models. This indicates that, at this stage of the academic career, there is no observable gender difference in the time to first appointment. This is in line with previous empirical evidence from both Italy and other European countries, such as France and Spain, which similarly do not find a significant effect of gender on career outcomes in the early stages of academic careers (Cruz-Castro & Sanz-Menéndez, 2010; Gaughan & Robin, 2004; Pezzoni et al., 2012).

In contrast, age at PhD shows an inverted U-shaped relationship with time to entry. This means that older researchers may initially benefit from having more experience and time to develop their skills, but only up to a certain point. Beyond that threshold, each additional year of age is associated with a slower entry into the academic system.

In Appendix F we present the results of the analysis that includes only STEMM fields in which Scopus publications are a better proxy for research activity. The result of the STEMM estimates confirms the main findings of this paper. It is worth noting two differences. First, precocity in STEMM fields is more important compared to the full sample. Second, citations have a positive but not significant correlation with entry.

Table 6: Risk of entry in t, Social Capital moderating effect: Home-country linkages

	(1)	(2)	(3)
	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Home Linkages>TH)	0.564***	0.633***	1.122*
	(0.017)	(0.026)	(0.073)
PD_Abroad (Home Linkages<TH)	0.915	0.617***	0.595***
	(0.049)	(0.020)	(0.018)
PD_Ita_Mob	0.735***	0.738***	0.733***
	(0.021)	(0.021)	(0.021)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-28902.085	-28936.761	-28917.246
Chi-squared	11612.963	11429.449	11476.062
Wald	81.708	0.371	93.726
Prob.	0.000	0.543	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

In Table 6, we examine the moderating effect of our second social capital variable: home-country linkages, that is, maintaining co-authorship ties with Italy-based researchers during the PD period. In this table, we split the *PD_Abroad* variable into two complementary components based on the researcher's co-authorship network during their time abroad. Specifically, we focus on the share of co-authors with Italian affiliations.

Each of the three columns in Table 6 uses a different threshold (TH) for this share to assess how *PD_Abroad* behaves under varying levels of home-country linkage. In column 1, we set the threshold at the first quartile (Q1). The variable *PD_Abroad (Home Linkages > TH)* equals 1 if the share of co-authors with Italian affiliations during the PD is above Q1, while the complementary variable *PD_Abroad (Home Linkages ≤ TH)* captures cases below or equal to Q1. In columns 2 and 3, we raise the threshold to the second and third quartiles (Q2 and Q3), respectively.

We also report the results of Wald tests in each column to assess whether the difference between the two coefficients (above vs. below the threshold) is statistically significant. While the table only shows the coefficients for these two variables, all models include the same control variables used in the main analysis (Table 5).

The results show that when the share of Italian-affiliated co-authors exceeds the third quartile (column 3), internationally mobile postdocs enter the academic system faster. In this case, the hazard ratio is 1.12 and significantly higher than the complementary hazard ratio of 0.59. This supports our hypothesis *H3*: strong home-country linkages during international postdoc experiences is associated to faster time to first academic appointment.

6.2 Time-to-promotion

In this subsection, we present the results of the Cox model for the time-to-promotion analysis. To provide an initial overview of the promotion process, Figure 3 shows the Kaplan-Meier survival estimate (left panel) and the corresponding hazard curve (right panel), based on our main variable of interest: *PD_Abroad*, the dummy variable equal to 1 for researchers who spent their postdoc period abroad.

From the left panel, we observe that internationally mobile postdocs have a steeper survival curve, meaning their probability of not being promoted declines more quickly compared to those without international experience. In other words, they tend to get promoted sooner. The right panel confirms this pattern, showing that researchers with an international PD stay

consistently face a higher hazard of promotion, with the peak occurring approximately 13 years after their first academic appointment.

Figure 3: Kaplan-Meier survival estimate (left) and hazard curve (right)

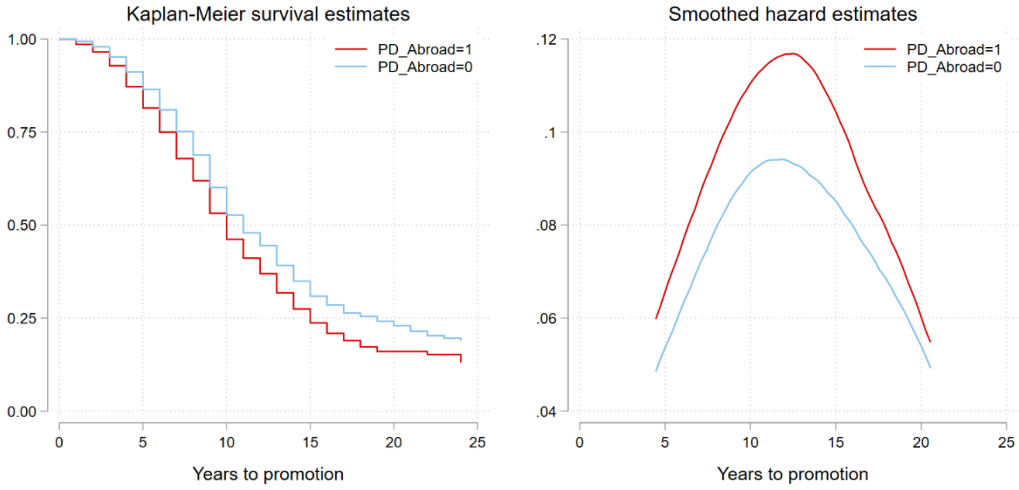


Table 7 presents the results of the Cox model estimating the time to promotion from Assistant to Associate Professor, focusing on the effect of having completed an international PD stay at a foreign institution.

At this stage of the academic career, mobility within Italian academia (captured by the variable *Ita_PD_Mob*) is not significant in any of the model specifications. This indicates that national-level PD mobility does not correlate with the likelihood of promotion.

By contrast, the baseline Cox results in column 1 show that international PD stays have a significant and positive effect. This suggests that researchers with postdoc experience abroad tend to advance more quickly in their careers than those without such experience. Specifically, internationally PD mobile postdocs have a 27% higher rate of achieving the promotion at any given time compared to their non-internationally mobile peers. These findings provide support, also at this career stage, for hypothesis *H1a*.

Table 7: Risk of promotion in t, baseline results

	(1)	(2)	(3)
PD_Abroad=1	1.269***		
	(0.058)		
PD_Abroad_Long=1		1.278***	
		(0.075)	
PD_Abroad_Short=1		1.264***	
		(0.066)	
PD_Abroad_Rank-High=1			1.341***
			(0.081)
PD_Abroad_Rank-Low=1			1.233***
			(0.063)
PD_Ita_Mob=1	1.071	1.072	1.072
	(0.047)	(0.047)	(0.047)
Log_Pubs_Prom	3.509***	3.509***	3.511***
	(0.395)	(0.395)	(0.396)
Log_Cits_Prom	1.341***	1.340***	1.335***
	(0.077)	(0.077)	(0.076)
Early_Pub=1	1.086*	1.086*	1.085*
	(0.054)	(0.054)	(0.054)
Female	0.831***	0.832***	0.834***
	(0.035)	(0.035)	(0.035)
Age_PhD	0.927	0.927	0.924
	(0.148)	(0.148)	(0.147)
Age_PhD^2	1.001	1.001	1.001
	(0.003)	(0.003)	(0.003)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-15453.8	-15453.8	-15453.0
Chi-squared	67928.8	6041.6	88962.5

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

In column 2, we distinguish between short and long international PD stays. The coefficient for longer stays (*PD_Abroad_Long*) is slightly higher than for shorter stays, as expected. However, the difference between the two is small and not statistically significant. Column 3 explores the effect of the quality of the international PD institution, using the ARWU ranking. The coefficient for researchers affiliated with higher-ranked institutions is higher than that for lower-ranked ones, which aligns with hypothesis *H1b*. However, the difference is again not statistically significant, offering only partial support for *H1b*.

Looking at the control variables, we find that both the quantity of scientific output (measured by the number of publications) and the "quality" (measured by citation impact) have a

significant and positive correlation with the time to promotion. This highlights that, at this career stage, researchers are rewarded not only for being productive, as for the time-to-entry, but also for producing higher-quality or higher-impact work. In contrast, the coefficient for the *Early_Pub* variable, which indicates whether the researcher published during their PhD, is only statistically significant at 10% level in any specification. This suggests that while early publication is an important signal for entering academia, it plays a less relevant role in determining promotion to Associate Professor (slightly more important in the STEMM estimations in Appendix F).

Regarding personal characteristics, the variable *Female* is negative and statistically significant across all model specifications. This indicates that, although we did not observe gender disparities at the entry level, female researchers take significantly longer to be promoted compared to their male colleagues, even after controlling for productivity, publication impact, and PD experience. This is consistent with previous research highlighting the persistent gender gap in academic promotion in Italy (Filandri & Pasqua, 2021; Marini & Meschitti, 2018).[13] Finally, age at PhD is not significantly associated with time to promotion, suggesting it does not play a role at this stage of academic advancement.

In Table 8, we interact our *PD_Abroad* variable, and its qualifications in terms of length of stay and quality of the PD institution, with our first moderator for social capital: inbreeding. The *Inbred_Prom* variable captures institutional inbreeding at the promotion stage and takes value 1 if the researcher was promoted to Associate Professor at their alma mater, or, for censored observations, is affiliated with their alma mater at the end of the observation period.

The results show that, across all specifications, the positive relationship of international PD mobility is stronger for non-inbred researchers. In columns 2 and 3, this association is more pronounced for researchers who spent longer periods abroad or were affiliated with higher-ranked international institutions. In both cases, the highest hazard ratios are found among non-inbred researchers, suggesting that the benefits of international experience are especially relevant when promotion occurs outside the researcher's alma mater. In our sample, 56% of

[13] A note of caution is needed. Our data cannot distinguish whether a scientist fails to get promoted because she unsuccessfully competes in a promotion concourse or because she does not apply at all. Thus, the observed patterns may reflect either discrimination by examination committees against female scientists or self-selection, where female scientists opt out of the competition for promotion. Recent research on France has shown that much of the gender gap in promotion may be explained by this second mechanism (Bosquet et al., 2019). In an unreported result, we ran the time-to-promotion model including the interaction between *PD_Abroad* and the *Female* dummy, finding no evidence of a significant differential association of international PD stays by gender, while the general negative association between being female and promotion persists. Results are available upon request.

the promotions are non-inbred that confirms the importance of this result, although these differences are not statistically significant.

Table 8: Risk of promotion in t, Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1 X Inbred_Prom=0	1.283***		
	(0.092)		
PD_Abroad=1 X Inbred_Prom=1	1.212***		
	(0.064)		
PD_Abroad_Long=1 X Inbred_Prom=0		1.372***	
		(0.121)	
PD_Abroad_Long=1 X Inbred_Prom=1		1.178**	
		(0.082)	
PD_Abroad_Short=1 X Inbred_Prom=0		1.214**	
		(0.099)	
PD_Abroad_Short=1 X Inbred_Prom=1		1.249***	
		(0.079)	
PD_Abroad_Rank-High=1 X Inbred_Prom=0			1.374***
			(0.128)
PD_Abroad_Rank-High=1 X Inbred_Prom=1			1.272***
			(0.092)
PD_Abroad_Rank-Low=1 X Inbred_Prom=0			1.239***
			(0.098)
PD_Abroad_Rank-Low=1 X Inbred_Prom=1			1.181***
			(0.072)
PD_Ita_Mob=1	1.038	1.039	1.040
	(0.050)	(0.050)	(0.050)
Inbred_Prom=1	0.893**	0.894**	0.893**
	(0.048)	(0.048)	(0.048)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-15450.1	-15449.1	-15449.2
Chi-squared	74885.6	6074.7	6045.3

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

These findings provide partial support hypothesis *H2* and indicate that, for promotion, what matters most is not institutional ties but clearly the research experience gained during the PD period. Specifically, longer stays and time spent in higher-quality institutions abroad are associated with faster promotions once researchers return to their home country. This

supports the idea that valuable international PD stays can pay off in terms of career advancement, particularly outside the context of institutional inbreeding.

Table 9: Risk of promotion in t, Social Capital moderating effect: Persistence in collaboration

	(1) TH: Q1	(2) TH: Q2	(3) TH: Q3
PD_Abroad (Netw. Persistence>TH)	1.315***	1.538***	2.302***
	(0.068)	(0.086)	(0.166)
PD_Abroad (Netw. Persistence<TH)	1.190***	1.081	1.110**
	(0.079)	(0.061)	(0.055)
PD_Ita_Mob	1.076*	1.074	1.080*
	(0.047)	(0.048)	(0.048)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-15452.914	-15439.808	-15410.960
Chi-squared	6036.535	10799.133	6178.451
Wald	1.942	31.277	102.345
Prob.	0.163	0.000	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Finally, in Table 9, we explore the moderating influence of another dimension of social capital: the persistence of collaboration with co-authors from the PD period. We divide the *PD_Abroad* variable into two groups based on the share of co-authors (between entry and promotion) who had already collaborated with the researcher during the postoc. This allows us to test the hypothesis that continued collaboration with PD co-authors is correlated with career advancement.

As in Table 6, we use the first, second, and third quartiles of this share as thresholds (TH), reported in columns 1 to 3, respectively. For each threshold, we compare researchers with a share above the threshold to those at or below it. We also report Wald tests to assess whether the difference between these two groups is statistically significant.

The results indicate that maintaining active collaboration with former PD co-authors is associated to faster promotion for internationally mobile postdocs. The coefficient for those above the threshold becomes larger as the threshold increases from the first to the third quartile, suggesting that greater persistence in collaboration is associated with faster

promotion. Moreover, the Wald tests in columns 2 and 3 show that the difference between the two groups is statistically significant when the threshold is set at the median and the third quartile.

These findings support hypothesis *H3* and reinforce the idea that building and maintaining long-term scientific relationships during the PD period is valuable. For researchers returning to their home country, these ongoing collaborations, particularly with international networks, can accelerate promotion. This is especially important in academic systems, such the Italian one, with low levels of internationalization in the recruitment, where international linkages are highly valued and may be seen as a signal of research excellence and visibility.

7. Additional results and robustness checks

In this section, we present a set of additional results and robustness checks to support our main findings.

7.1 CV data

As mentioned in Section 3, the 2010 reform of the Italian scientific system introduced the National Scientific Habilitation (*Abilitazione Scientifica Nazionale*, ASN), a requirement to apply for Associate and Full Professor positions at Italian universities (see Appendix A for additional details). The first round of the ASN was held in 2012, 72,009 CVs were put online for a short period of time, one of the authors of this paper had archived them back then.

These CVs followed a semi-standardized format, divided into sections. One of these sections was dedicated to the national and international experience of the applicant, where candidates listed their international research stays (postdocs, research fellowships, and other types of contracts, grants and experiences), including the host institution and the start and end dates of each experience.

We matched the researchers in our sample with the CVs using name, surname, and scientific field. From the matched CVs, we extracted detailed information on mobility experiences, identifying the country, host institution, and duration of each stay. This allowed us to construct mobility indicators based on CV data to validate our proxies derived from publication affiliations (additional details are provided in Appendix G).

From this information, we constructed two new variables: *PD_Abroad_CV* (for international PD stays) and *PD_Ita_Mob_CV* (for national postdoc mobility). Additionally, we further split *PD_Abroad_CV* into two complementary dummy variables based on (i) the length of the international stay (above or below 18 months, which corresponds to the typical duration of a postdoc across most disciplines), and (ii) the prestige of the host institution, using the ARWU ranking. In total, we retrieved CV data for 5,695 researchers in our research-active subsample. We present the results of our empirical analysis based on this subsample for both entry into and promotion within the academic system. We rely on EB using *PD_Abroad_CV* as the treatment variable.

The results reported in Table 10 show that the time-to-entry analysis based on CV information is consistent with the findings from our baseline analysis reported in Section 6.1.

Table 10: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding (CV sample)

	(1)	(2)	(3)
PD_Abroad_CV=1	0.736***	0.737***	
	(0.020)	(0.020)	
PD_Abroad_CV=1 X Inbred_Entry=0			0.723***
			(0.031)
PD_Abroad_CV=1 X Inbred_Entry=1			0.747***
			(0.027)
CV_Ita_Mob=1	0.812***	0.811***	0.811***
	(0.064)	(0.064)	(0.064)
Inbred_Entry=1		1.067**	1.050
		(0.032)	(0.038)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	5695	5695	5695
Log likelihood	-20638.9	-20637.6	-20637.5
Chi-squared	7421.0	7431.3	7437.9

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Looking at Table 11, which presents the results of the time-to-promotion analysis using CV-based information, we observe in column 1 that the coefficient for *PD_Abroad_CV* is positive but not statistically significant (p-value = 0.11). However, in column 2, the coefficient for longer international PD experience is positive and statistically significant, while the complementary variable capturing shorter PD experiences is not significant at the 10% level. A similar result is obtained in column 3 for international PD stays at higher-ranked institutions. These

findings are consistent with the results presented in Section 6.2 and confirm that longer postdoc stays abroad and stays at higher-quality institutions are correlated to faster for promotion.

Table 11: Risk of promotion in t, baseline results (CV sample)

	(1)	(2)	(3)
PD_Abroad_CV=1	1.068		
	(0.045)		
PD_Abroad_CV_Long=1		1.153**	
		(0.080)	
PD_Abroad_CV_Short=1		1.036	
		(0.050)	
PD_Abroad_CV_Rank-High=1			1.181***
			(0.065)
PD_Abroad_CV_Rank-Low=1			0.971
			(0.054)
CV_Ita_Mob=1	1.101	1.102	1.102
	(0.161)	(0.162)	(0.161)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	5695	5695	5695
Log likelihood	-25234.2	-25233.2	-25230.4
Chi-squared	1523.0	1524.8	1530.5

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Similarly, in Table 12 column 2 and 3, we see that the positive coefficient for international postdoc experience is especially relevant for researchers who are not inbred – that is, those who are promoted at an institution different from their alma mater. This further supports the importance of substantial international research experience, particularly for researchers who advance their careers outside their initial institutional context.

7.2 Cohort analysis

Given the regulatory changes that occurred in Italy during our period of analysis (see Section 3 and Appendix A for details), we perform a split-sample analysis by PhD cohorts to examine the heterogeneity of our results and highlight whether there are significant differences

between the earlier and later periods. We divide researchers into two cohorts based on the year of their PhD: the first cohort includes those who obtained their PhD between 1986 and 1996, and the second cohort includes those from 1997 to 2006. This allows us to compare individuals who entered the academic system under the pre-reform framework with those who were exposed to the post-reform hiring and promotion system.

Table 12: Risk of promotion in t, Social Capital moderating effect: Inbreeding (CV sample)

	(1)	(2)	(3)
PD_Abroad_CV=1 X Inbred_Prom=0	1.063		
	(0.070)		
PD_Abroad_CV=1 X Inbred_Prom=1	1.069		
	(0.058)		
PD_Abroad_CV_Long=1 X Inbred_Prom=0		1.228**	
		(0.127)	
PD_Abroad_CV_Long=1 X Inbred_Prom=1		1.096	
		(0.099)	
PD_Abroad_CV_Short=1 X Inbred_Prom=0		0.999	
		(0.076)	
PD_Abroad_CV_Short=1 X Inbred_Prom=1		1.061	
		(0.065)	
PD_Abroad_CV_Rank-High=1 X Inbred_Prom=0			1.202**
			(0.102)
PD_Abroad_CV_Rank-High=1 X Inbred_Prom=1			1.161**
			(0.083)
PD_Abroad_CV_Rank-Low=1 X Inbred_Prom=0			0.944
			(0.083)
PD_Abroad_CV_Rank-Low=1 X Inbred_Prom=1			0.989
			(0.071)
CV_Ita_Mob=1	1.096	1.097	1.097
	(0.161)	(0.161)	(0.161)
Inbred_Prom=1	0.881***	0.882***	0.882***
	(0.042)	(0.042)	(0.042)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	5695	5695	5695
Log likelihood	-25230.0	-25228.4	-25226.1
Chi-squared	1531.4	1534.4	1539.1

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

In Table 13, we compare the time-to-entry analysis for the two cohorts, shown in columns 1–2 and 3–4, respectively. Comparing column 1 (first cohort) and column 3 (second cohort), we

observe that international experience appears to be more relevant for the more recent cohort. The coefficient for *PD_Abroad*, while still negative in both cases, is larger (in absolute value) for the second cohort, indicating a stronger association with faster entry.

Another notable difference concerns the role of inbreeding. In the first cohort, the coefficient for *Inbred_Entry* is close to 1 and not significant, and there is no significant difference in the effect of *PD_Abroad* between inbred and non-inbred researchers. However, for the second cohort, *Inbred_Entry* is statistically significant, and the interaction with *PD_Abroad* shows a higher coefficient with respect to non-inbred researchers with international experience. This suggests that for the newer generation of researchers, international experience interacts more with institutional inbreeding, potentially enhancing the chances of faster re-entry when combined.

Table 13: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding (Cohort analysis)

	Cohort 1986-1997		Cohort 1997-2006	
	(1)	(2)	(3)	(4)
PD_Abroad=1	0.587***		0.639***	
	(0.033)		(0.022)	
PD_Abroad=1 X Inbred_Entry=0		0.595***		0.535***
		(0.052)		(0.031)
PD_Abroad=1 X Inbred_Entry=1		0.577***		0.663***
		(0.036)		(0.026)
PD_Ita_Mob=1	0.690***	0.686***	0.750***	0.703***
	(0.037)	(0.040)	(0.024)	(0.026)
Inbred_Entry=1		0.985		0.874***
		(0.058)		(0.035)
Controls	Yes	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes	Yes
Observations	2578	2578	7334	7334
Log likelihood	-7610.9	-7610.7	-18511.8	-18508.8
Chi-squared	1518.3	1492.8	8158.4	8199.5

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Looking at Table 14, where we replicate the results for the moderating effect of the social capital variable *Home Linkages* across the two cohorts, we again find that the results are consistent with the main analysis only for the most recent cohort. Specifically, in this group, the coefficient of *PD_Abroad (Home Linkages>TH)* with strong home country linkages (above

Q3, reported in column 6) is greater than 1, statistically significant, and significantly different from its complementary coefficient (for weaker linkages). In contrast, for the first cohort, this coefficient (column 3) is not significant, suggesting that the moderating effect of home country linkages on the benefits of international PD stays has become more relevant in the more recent academic generation.

Table 14: Risk of entry in t, Social Capital moderating effect: Home-country linkages (Cohort analysis)

	Cohort 1986-1996			Cohort 1997-2006		
	(1)	(2)	(3)	(4)	(5)	(6)
	TH: Q1	TH: Q2	TH: Q3	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Home Linkages>TH)	0.528***	0.593***	0.965	0.582***	0.657***	1.207**
	(0.030)	(0.044)	(0.104)	(0.021)	(0.033)	(0.098)
PD_Abroad (Home Linkages<TH)	0.855*	0.582***	0.558***	0.940	0.633***	0.614***
	(0.080)	(0.035)	(0.032)	(0.060)	(0.024)	(0.022)
PD_Ita_Mob	0.685***	0.691***	0.685***	0.749***	0.752***	0.747***
	(0.037)	(0.037)	(0.037)	(0.024)	(0.024)	(0.024)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2578	2578	2578	7334	7334	7334
Log likelihood	-7699.776	-7710.404	-7704.870	-18714.133	-18736.866	-18723.471
Chi-squared	1149.003	1218.399	1274.009	8532.730	8264.621	8321.639
Wald	28.574	0.081	27.790	56.381	0.514	67.764
Prob.	0.000	0.776	0.000	0.000	0.474	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Moving to the analysis of time-to-promotion by cohort, in Table 15 we do not find significant differences in the coefficient for *PD_Abroad* between the two cohorts (columns 1 and 4). This suggests that the overall effect of international PD stays on promotion remains relatively stable across different academic generations.

However, we observe a key difference when examining the split of *PD_Abroad* into long vs. short stays (columns 2 and 5) and high- vs. low-ranked institutions (columns 3 and 6) across cohorts. Specifically, we find that the effects identified in the main analysis are driven by the second (more recent) cohort. In the first cohort, in fact, the larger coefficients are associated with shorter international PD stays and stays at lower-ranked institutions. By contrast, in the more recent cohort, the pattern is the opposite and aligns with our baseline results presented in Section 6.2: here, longer stays and stays at higher-ranked international institutions are the experiences that are strongly correlated with promotion.

In Table 16, we examine the interaction between international experience and inbreeding across the two cohorts. In our baseline analysis, we found that international PD stays is

generally more beneficial for non-inbred researchers. This effect is evident only in the more recent cohort (column 4), where the interaction between *PD_Abroad* and *Inbred_Prom* yields a smaller coefficient compared to the non-interacted *PD_Abroad* term, and the difference between the two is statistically significant.

Table 15: Risk of promotion in t, baseline results (Cohort analysis)

	Cohort 1986-1996			Cohort 1997-2006		
	(1)	(2)	(3)	(4)	(5)	(6)
PD_Abroad=1	1.298***			1.302***		
	(0.099)			(0.078)		
PD_Abroad_Long=1		1.256**			1.337***	
		(0.118)			(0.103)	
PD_Abroad_Short=1		1.334***			1.279***	
		(0.116)			(0.087)	
PD_Abroad_Rank-High=1			1.239**			1.348***
			(0.126)			(0.113)
PD_Abroad_Rank-Low=1			1.329***			1.283***
			(0.112)			(0.083)
PD_Ita_Mob=1	0.989	0.987	0.989	1.122*	1.124**	1.123**
	(0.069)	(0.069)	(0.069)	(0.066)	(0.066)	(0.066)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2578	2578	2578	7334	7334	7334
Log likelihood	-5717.1	-5716.9	-5716.9	-8030.5	-8030.4	-8030.3
Chi-squared	8794.0	7768.6	5526.1	529603.6	471757.0	471103.2

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Similarly, we find that the differences in coefficients between non-inbred and inbred researchers with long international stays (columns 1 and 5) and between those with stays at high-ranked institutions (columns 3 and 6) align with our main results only for the most recent cohort, furthermore the differences between these pairs of coefficients are statistically significant. We have repeated the same analysis using CV information obtaining a consistent result for the most recent cohort[14]

[14] Results available from the corresponding author upon request.

Table 16: Risk of promotion in t, Social Capital moderating effect: Inbreeding (Cohort analysis)

	Cohort 1986-1997			Cohort 1997-2006		
	(1)	(2)	(3)	(4)	(5)	(6)
PD_Abroad=1 X Inbred_Prom=0	1.250**			1.446***		
	(0.133)			(0.145)		
PD_Abroad=1 X Inbred_Prom=1	1.266***			1.235***		
	(0.114)			(0.082)		
PD_Abroad_Long=1 X Inbred_Prom=0		1.268*			1.640***	
		(0.165)			(0.203)	
PD_Abroad_Long=1 X Inbred_Prom=1		1.184			1.218**	
		(0.134)			(0.107)	
PD_Abroad_Short=1 X Inbred_Prom=0		1.220			1.329**	
		(0.152)			(0.154)	
PD_Abroad_Short=1 X Inbred_Prom=1		1.351***			1.261***	
		(0.147)			(0.101)	
PD_Abroad_Rank-High=1 X Inbred_Prom=0			1.057			1.639***
			(0.161)			(0.214)
PD_Abroad_Rank-High=1 X Inbred_Prom=1			1.311**			1.226**
			(0.161)			(0.124)
PD_Abroad_Rank-Low=1 X Inbred_Prom=0			1.366***			1.370***
			(0.157)			(0.149)
PD_Abroad_Rank-Low=1 X Inbred_Prom=1			1.244**			1.241***
			(0.127)			(0.092)
PD_Ita_Mob=1	0.951	0.946	0.953	1.133*	1.139*	1.134*
	(0.070)	(0.069)	(0.070)	(0.075)	(0.076)	(0.075)
Inbred_Prom=1	0.847**	0.845**	0.844**	0.996	0.999	0.994
	(0.068)	(0.068)	(0.067)	(0.074)	(0.075)	(0.074)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2578	2578	2578	7334	7334	7334
Log likelihood	-5715.3	-5714.8	-5714.1	-8029.0	-8027.8	-8028.3
Chi-squared	7262.6	5472.5	5515.1	469836.1	469981.6	470686.0

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Table 17: Risk of promotion in t, Social Capital moderating effect: Persistence in collaboration (Cohort analysis)

	Cohort 1986-1996			Cohort 1997-2006		
	(1)	(2)	(3)	(4)	(5)	(6)
	TH: Q1	TH: Q2	TH: Q3	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Netw. Persistence>TH)	1.396***	1.824***	2.750***	1.309***	1.430***	2.137***
	(0.123)	(0.166)	(0.321)	(0.086)	(0.104)	(0.195)
PD_Abroad (Netw. Persistence<TH)	1.149	1.033	1.117	1.285***	1.189**	1.154**
	(0.119)	(0.091)	(0.090)	(0.113)	(0.088)	(0.073)
PD_Ita_Mob	1.003	1.007	1.002	1.122**	1.123**	1.138**
	(0.070)	(0.071)	(0.071)	(0.065)	(0.066)	(0.067)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2578	2578	2578	7334	7334	7334
Log likelihood	-5791.053	-5777.621	-5767.488	-8129.240	-8127.201	-8111.980
Chi-squared	8184.683	8276.201	7420.416	483781.082	526303.819	472169.938
Wald	3.016	36.470	62.290	0.040	4.677	44.529
Prob.	0.082	0.000	0.000	0.842	0.031	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Finally, the results reported in Table 17 on the moderating effect of the persistence of the collaboration network developed during the PD period do not show significant differences between the two cohorts. For both cohorts, the strongest coefficient is consistently associated with high levels of network persistence (above the third quartile, columns 3 and 6), highlighting the persistent value of long-term scientific collaborations.[15]

Overall, these findings from the cohort analysis suggest that the value of having an international PD stay has evolved over time. In the more recent period, promotion has become more tightly linked to the length of the stay and quality of the host institution for non-inbred promotions.

7.3 Alternative matching methods, functional form and STEMM sample

In addition to the models based on the EB matching strategy described in Section 5.1, we conduct robustness checks using alternative matching methods. Specifically, we apply PSM and CEM. PSM retains a larger portion of the original dataset, which helps preserve statistical power and precision in the estimation of effects. In contrast, CEM applies stricter matching criteria and may exclude unmatched observations due to its coarsening approach, resulting in a smaller matched sample (King & Nielsen, 2019). The results of the time-to-entry and time-to-promotion analyses using PSM and CEM are reported in Appendix D.1 and Appendix D.2, respectively. These results are consistent with those presented in Section 6, thus reinforcing the robustness of our findings.

In addition to this, we also performed a robustness analysis using as an alternative estimation approach a parametric survival model with a Weibull distribution. The results, available in Appendix E, are consistent with our main findings. Beyond providing further confidence in the robustness of our results, this alternative method offers an additional advantage: it allows us to estimate potential outcome means for both treated and untreated groups and to calculate the average treatment effect (ATE), i.e., the average difference in survival time (such as time to entry or time to promotion) attributable to international PD stays.

This is something we cannot obtain from the Cox model, whose key advantage is that it is semi-parametric, hence it does not require specifying the underlying baseline hazard function, thereby allowing the estimation of hazard ratios without imposing distributional assumptions on the timing of events. For this reason, the Cox model estimates hazard ratios, and it does

[15] We also ran the analysis using PSM as an alternative matching method and obtained similar results. These are available upon request.

not provide direct estimates of mean survival times. Using the parametric Weibull model, we can now provide an estimate of the average time differences attributable to international PD stays.

Specifically, for time to entry, we estimate the ATE as the difference in time to appointment if everyone had gone abroad versus if no one had. On average, non-mobile postdocs enter the system in 3.8 years, whereas those with international PD experience take on average 0.57 years longer, corresponding to about a 15% increase in time to entry. For time to promotion, the estimated average time for non-internationally mobile postdocs is 12.6 years. For those with international PD experience, the average time is 1.6 years shorter, representing a significant 12% reduction in the waiting time for promotion.

Finally, in Appendix F, we repeat our analysis for the subsample of researchers in STEMM (Science, Technology, Engineering, Mathematics and Medicine) fields. As discussed in more detail in Appendix B, Scopus is known to underrepresent journals in the Social Sciences and Humanities (SSH). Moreover, SSH fields often follow different publishing practices, where journal articles may carry less weight compared to other formats like monographs or book chapters. For these reasons, we rerun our main analysis focusing only on the STEMM subsample, where the bibliometric proxy for international PD stays is most reliable. The results of this exercise are consistent with our main findings. In particular, they confirm a significant difference in the promotion time for mobile PD in non-inbred universities driven by the results of the most recent cohort.[16]

8. Conclusions

In this paper, we have explored the correlation between international PD stays and career outcomes of returnees to the Italy academic system. We studied the duration until re-entry as Assistant Professor and the subsequent promotion to Associate Professor. We have assembled data on affiliations, productivity and careers of researchers active in Italian academia between 1986 and 2015. To trace international PD stays, we used both bibliometric and CV based approaches and classified them in short and long stays, where especially the latter capture formal contractual appointments. We applied a Cox proportional hazards model combined with entropy balancing to construct a matched sample that controls for pre-mobility characteristics. In the robustness checks we used both PSM and CEM matching strategies

[16] Results available from the corresponding author upon request.

obtaining consistent results. Our baseline results show that international mobile postdocs experience a longer time to re-entry in Italian academia and a lower time to promotion with respect to their peers that have done a PD period in Italy (we also compare with PD mobility within Italy). These results are confirmed when we estimate the models with the smaller sample for which we got CV information. Longer term, quality adjusted PD stays are correlated to a quicker promotion in universities different from the one that granted the PhD to the researcher. This correlation is particularly significant and important for the most recent cohorts of PhD graduates.

Postdoctoral researchers' social capital can also be an important factor in shaping their career. In this paper we have identified three distinct aspects of social capital (inbreeding, home-country linkages and persistence in the collaboration network) and developed individual and bibliometric indicators to capture the unique nuances of each.

We find a moderating effect of inbreeding associated with PD international mobility. Specifically, postdocs who are internationally mobile and secure their initial academic position at their PhD-granting institution tend to experience a slightly shorter time-to-entry. Conversely, at the promotion stage, non-inbred researchers generally achieve faster time-to-promotion, particularly those who completed longer stays at prestigious host institutions abroad. This pattern is statistically significant and especially strong among the most recent cohorts. This latter result is in contrast with some classical literature on silver-corded academics, who display a pattern of institutional mobility after their PhD but eventually return to their alma mater, and are often seen as more competitive, independent, and better connected externally compared to purely home-grown academics (Caplow & McGee, 1958). However, more recent empirical analyses have not consistently supported this assumption (Horta, 2013; Horta et al., 2022).

We found evidence of a negative correlation between having held a PD position abroad and time to re-entry in the Italian academic system. In this career phase, however, maintaining strong scientific collaboration with the home country makes the entry quicker than peers working primarily with foreign authors during their international PD stays. Also, we found that nurturing the collaboration ties created during the PD period abroad is correlated with quicker academic promotion. In particular, the ability of maintaining the scientific networks obtained by moving across different universities or laboratories, is a relevant form of social capital and valuable in the long term.

Table 18 summarizes the main findings of the paper concerning three dimensions of social capital: inbreeding, home-country linkages, and persistence in the collaboration network.

Table 18: Summary table of main findings

		Career stage	
		Entry	Promotion
Main effect	PD stay abroad	(–)	(+) Especially for high ranked host universities and longer stays
Social Capital moderating effect	Inbreeding	(weakly +)	(+ for non-inbred) Especially for high ranked host universities and longer stays
	Home-country linkages	(+) For high levels of home-country linkages	/
	Persistence in the composition of the co-authors network	/	(+) For high levels of persistence in collaboration

While previous literature (Baruffaldi & Landoni, 2012) has already noted the importance of home-country linkages for return mobility, our study highlights the significance of maintaining persistent collaborations with acquaintances established during the PD period. The analysis reveals that a PD stay abroad is associated with a delayed re-entry into the academic system. However, mainly when undertaken at a prestigious institution, not only does it enrich the researcher's human capital but also helps to develop social capital that, if nurtured throughout one's career, proves valuable during promotion stages.

The paper adopts a fixed effects approach (including university, scientific field, PhD year, university of entry, and year of entry) to control as much as possible for institutional, disciplinary, and temporal heterogeneity. We investigated the four most important personal characteristics that could be correlated to entry and promotion to professorial roles: early career achievements, productivity, gender and age. Our findings align with the existing literature. Consistent with the results focusing on productivity (Horta & Santos, 2016), we observe that early publication output during PhD years is positively correlated to time-to-entry; we also find a weaker positive correlation with time-to-promotion. Like previous literature (Pezzoni et al., 2012), scientific productivity proxied by publication output is positively correlated to both entry and promotion, instead, citations are only positively associated with time-to-promotion. These results indicate that entry in the Italian academic system is more correlated to quantity rather than quality of scientific output. In line with well-

known results in the literature (Filandri & Pasqua, 2021; Marini & Meschitti, 2018), we find that women researchers tend to experience longer durations for promotion with respect to their male counterparts, while we find a weakly negative but not significant effect on time-to-entry. We do not uncover specific age-related effects.

We have included in our analysis all scientific fields, to our knowledge this is the only paper that uses all fields with longitudinal data of the population of postdoctoral researchers. In Appendix F we run the analysis only for STEMM fields in which Scopus publications are a better proxy for research activity. The result of the STEMM estimates confirms the main findings of this paper. For what it concerns control variables it is worth noting two differences. First, precocity in STEMM fields is more important for both entry and promotion compared to the full sample. Second, citations have a positive but not significant correlation with entry.

This paper has focused on a very specific unit of analysis, returnees to the Italian academic system after a PD stay abroad. We have decided to take this narrow approach to be more precise in our assessment of this specific type of mobility as we wanted to shed a better light on the benefits and costs of PD stays abroad for returnees to the home country. This specific early career mobility and return to home country is common across countries and has become much more frequent in recent years. We decided to take this narrower approach as in the literature there is quite some heterogeneity and lack of precision on early career mobility that made comparability and replicability of the results very difficult.

The analysis of this paper is limited by the fact that we exclusively focus on Italian postdocs returning to the Italian academic system, we were not able to consider Italian PhDs that decided to stay abroad. Previous literature (Carriero et al., 2024; Dorn & Zweimüller, 2021) clearly indicate that brain-drain has become a major concern for Italy. That said, we think that our results are however of policy interest. The fact that returnees take longer to get to the Assistant Professor position in Italy point to a relative closure to the Italian system, only those PhD that keep on publishing heavily with their Italian colleagues were able to re-enter quite quickly. Italy has tried to implement various policies to attract back PhDs working abroad with mixed success. The most recent changes of tax regulation (associated also to the Brexit phenomenon that created incentives for Italians working in the UK to return home) seems to have had some more success (Bassetto & Ippedico, 2023; Prato, 2025). Still, much more can be done to attract back talent, and several policy initiatives aiming at bringing back researchers based abroad exist at the European and global levels, which are are particularly relevant for countries' scientific diasporas (Coda Zabetta et al., 2024; Marini & Yang, 2021; Matthews, 2025).

The results also point to a general mobility cost, also mobility within Italy is associated with delayed entry. In general, the Italian system seems not to provide the right incentives for mobility when we consider the entry as Assistant Professor. Given the variety of "postdoctoral positions" available in the Italian system it is very difficult to think in term of regulation to try to create the right incentives. A series of policy attempts were made from early 2000s culminated with the 2005 law on "*chiamate dirette*" to increase the ease of access to the Italian academic system for scientists from abroad. While a systematic quantitative assessment has not been yet carried out, case-based evidence and the increase of the share (though very small) of foreign professors in the years 2020 seems to indicate an increase ease of entry.

The result using the most recent PhD cohorts that, especially long-term PD stays in top universities abroad are associated with a faster promotion in a university different from the PhD graduation (after controlling for productivity) provides some indication that the institutional transformations started in the mid-2000s have supported a more competitive and mobile academic labor market. The recent transformation of the labor contracts that have introduced a propre tenure-track path (the RTT position) can be only successful if further incentives to mobility are introduced. A tenure-track system that copies the US model can only work in a market in which you have the possibility of not getting tenure in a university but getting an Associate Professor position in a less prestigious university. Mobility is fundamental to the success of the tenure-track system. In a system like the Italian in which inbreeding is still relevant new regulation that limit hiring in the university of PhD granting (Italian RTT are nationally regulated) would help to increase mobility and competition on the Italian labor market.

Our study does not come without limitations, which also offer avenues for further research. First, our analyses focus exclusively on researchers who returned to the Italian academic system, as our dataset does not capture Italian PhD graduates who pursued academic careers abroad without returning. It is possible that academics who remain abroad differ systematically in terms of research performance, career aspirations, or access to international opportunities, meaning that our findings cannot be generalized to the entire population of internationally mobile Italian postdocs. Rather, they should be interpreted as applying specifically to the population of returnees active in Italian academia during the observation period. Further research on the dynamics and motivations behind non-return decisions would provide valuable complementary insights into the broader patterns of international academic mobility.

Second, as pointed out in Appendix B, the use of bibliometric Scopus data to trace international mobility has some limitations when compared to using CV information. In particular, it is difficult to define exactly the length of the stay, there are errors in the address assignment and there are still name match issues. We were able to gather about 5,700 CVs out of the 9,900 of our sample. CVs have more precise information, but only fully standardized CVs are easily codifiable without errors (to our knowledge still today there are very few countries that have such form of CV repository publicly available, this repository does not exist for Italy). The CVs we were able to find (see Appendix G for details) and use (we also experimented with web scraping with mix success, but due to time limitations we only implemented it for a small sample) were only partially standardize, still it was quite complex to achieve a good level of codification, and we think that the process is not error free. To be able to carry out robust cross country longitudinal analysis of scientific career there is need for public investment in a standardized CV repository at the EU level.

Third, in this paper we try to handle heterogeneity and selection using fixed effects and implementing three matching strategies with pre-mobility characteristics, nonetheless, similar to other studies of this type (Cruz-Castro & Sanz-Menéndez, 2010; Lawson & Shibayama, 2015; Lutter & Schröder, 2016; Sanz-Menéndez et al., 2013, 2013), our empirical strategy cannot completely rule out the endogeneity of international PD mobility. We were not able to identify a clear external shock in the period considered that would allow us to implement a different identification strategy (see for example the use by Bassetto & Ippedico; 2023 of the 2010 change in tax regulation in Italy for young high-skills returnees). In future years, with an updated database, the 2010 change in Italian tax regulation could be used also to assess the career impact.

Fourth, to deal, at least partially, with endogeneity of international PD mobility an IV approach could be considered. Personal reasons for mobility not connected to future career could be used as an instrument. The typical family related reasons (mobility of partner, mobility of parents, death of relatives, etc ….) are less relevant for our unit of analysis, the postdoc, as they are too young to be affected by old age-related issues and they are too old to have to follow the mobility of the family members. Still, a survey to collect family-related information could be of use. Another possible instrument that could be considered is the one based on the idea that mobility costs are higher for the first mobility then subsequent mobilities become less costly. In a possible future survey, birthplace and nationality of the scientist should be included.

Finally, in this study we focus specifically on one key stage of the academic career, namely the postdoctoral period. We do so because this phase is crucial in the academic career ladder, playing a pivotal role in shaping future opportunities and trajectories for scientists. However, future research could build on our work by adopting a broader perspective on academic careers – for example, by examining international mobility at other stages, such as during the PhD (through visiting positions abroad, sabbatical leave, etc.), through permanent positions abroad, or by studying returnees who completed both their PhD and postdoc abroad. Such extensions would help develop a more comprehensive understanding of academic incentives and the dynamics of scientific careers.

References

Ackers, L. (2005). Moving People and Knowledge: Scientific Mobility in the European Union1. *International Migration*, *43*(5), 99–131. https://doi.org/10.1111/j.1468-2435.2005.00343.x

Afonso, A. (2016). Varieties of Academic Labor Markets in Europe. *Political Science and Politics*, *49*(4), 816–821. https://doi.org/10.1017/S1049096516001505

Allison, P. D., & Long, J. S. (1990). Departmental Effects on Scientific Productivity. *American Sociological Review*, *55*(4), 469. https://doi.org/10.2307/2095801

Aman, V. (2018). Does the Scopus author ID suffice to track scientific international mobility? A case study based on Leibniz laureates. *Scientometrics*, *117*(2), 705–720. https://doi.org/10.1007/s11192-018-2895-3

Baruffaldi, S. H., & Landoni, P. (2012). Return mobility and scientific productivity of researchers working abroad: The role of home country linkages. *Research Policy*, *41*(9), 1655–1665. https://doi.org/10.1016/j.respol.2012.04.005

Baruffaldi, S. H., Marino, M., & Visentin, F. (2020). Money to move: The effect on researchers of an international mobility grant. *Research Policy*, *49*(8), 104077. https://doi.org/10.1016/j.respol.2020.104077

Bassetto, J., & Ippedico, G. (2023). Can Tax Incentives Bring Brains Back? Returnees Tax Schemes and High-Skilled Migration in Italy. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4359376

Bauder, H. (2020). International Mobility and Social Capital in the Academic Field. *Minerva*, *58*(3), 367–387. https://doi.org/10.1007/s11024-020-09401-w

BEIS. (2016). *International comparison of the UK research base, 2016*. Department for Business, Energy & Industrial Strategy. https://www.gov.uk/government/publications/performance-of-the-uk-research-base-international-comparison-2016

Borenstein, D., Perlin, M. S., & Imasato, T. (2022). The Academic Inbreeding Controversy: Analysis and Evidence from Brazil. *Journal of Informetrics*, *16*(2), 101287. https://doi.org/10.1016/j.joi.2022.101287

Bosquet, C., Combes, P., & García-Peñalosa, C. (2019). Gender and Promotions: Evidence from Academic Economists in France*. *The Scandinavian Journal of Economics*, *121*(3), 1020–1053. https://doi.org/10.1111/sjoe.12300

Bozeman, B., Dietz, J. S., & Gaughan, M. (2001). Scientific and technical human capital: An alternative model for research evaluation. *International Journal of Technology Management*, *22*(7/8), 716. https://doi.org/10.1504/IJTM.2001.002988

Budimir, G., Rahimeh, S., Tamimi, S., & Južnič, P. (2021). Comparison of self-citation patterns in WoS and Scopus databases based on national scientific production in Slovenia (1996–2020). *Scientometrics*, *126*(3), 2249–2267. https://doi.org/10.1007/s11192-021-03862-w

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

Cao, J., Chen, F., Li, M., & Luo, X. (2025). Accounting backgrounds and technological innovation: Are accountant CEOs inferior innovators? *Research Policy*, *54*(3), 105175. https://doi.org/10.1016/j.respol.2025.105175

Caplow, T., & McGee, R. J. (1958). *The Academic Marketplace* (1st ed.). Routledge. https://doi.org/10.4324/9781351305969

Carayol, N., & Maublanc, F. (2025). Can money buy scientific leadership? The impact of excellence programs on German and French universities. *Research Policy*, *54*(2), 105155. https://doi.org/10.1016/j.respol.2024.105155

Carriero, R., Coda Zabetta, M., Geuna, A., & Tomatis, F. (2024). Investigating PhDs' early career occupational outcomes in Italy: Individual motivations, role of supervisor and gender differences. *Higher Education*, *87*(5), 1375–1392. https://doi.org/10.1007/s10734-023-01068-y

Carriero, R., & Naldini, M. (2022). Gender Disparity in Access to Academia in Italy. Are there barriers to women's early career stages? *Polis*, *1*, 5–32. https://doi.org/10.1424/103557

Clauset, A., Arbesman, S., & Larremore, D. B. (2015). Systematic inequality and hierarchy in faculty hiring networks. *Science Advances*, *1*(1), e1400005. https://doi.org/10.1126/sciadv.1400005

Clemente, F. (1973). Early Career Determinants of Research Productivity. *American Journal of Sociology*, *79*(2), 409–419. https://doi.org/10.1086/225553

Coda Zabetta, M., & Geuna, A. (2020). *Italian Doctorate Holders and Academic Career Progression in the Period 1986-2015* (No. 629; Carlo Alberto Notebooks). Collegio Carlo Alberto.

Coda Zabetta, M., Lissoni, F., & Miguelez, E. (2024). Star recruitment and internationalization effects: An analysis of the Alexander von Humboldt professorship programme. *Journal of Industrial and Business Economics*, *51*(3), 667–690. https://doi.org/10.1007/s40812-024-00321-4

Cole, J. R. (1979). *Fair science: Women in the scientific community*. New York: The Free Press.

Cole, S. (1992). *Making science: Between nature and society*. Harvard Univ. Press.

Colombo, M., & Salmieri, L. (2022). Higher Education in Italy: Between New Public Management and Autonomy. *Revue d'histoire Des Sciences Humaines*, *41*, 285–306. https://doi.org/10.4000/rhsh.7764

Conchi, S., & Michels, C. (2014). *Scientific mobility: An analysis of Germany, Austria, France and Great Britain* (Discussion Papers "Innovation Systems and Policy Analysis No. 41; Discussion Papers "Innovation Systems and Policy Analysis). Fraunhofer Institute for Systems and Innovation Research (ISI).

Cox, D. R. (1972). Regression Models and Life-Tables. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, *34*(2), 187–202. https://doi.org/10.1111/j.2517-6161.1972.tb00899.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

De Paola, M., Ponzo, M., & Scoppa, V. (2017). Gender differences in the propensity to apply for promotion: Evidence from the Italian Scientific Qualification. *Oxford Economic Papers*. https://doi.org/10.1093/oep/gpx023

Dias Lopes, A., & Hancock, S. (2024). International mobility after the PhD: Exploring the characteristics and early labour market outcomes of UK doctoral graduates. *Higher Education*. https://doi.org/10.1007/s10734-024-01357-0

Donina, D., Meoli, M., & Paleari, S. (2015). Higher Education Reform in Italy: Tightening Regulation Instead of Steering at a Distance. *Higher Education Policy*, *28*(2), 215–234. https://doi.org/10.1057/hep.2014.6

Dorn, D., & Zweimüller, J. (2021). Migration and Labor Market Integration in Europe. *Journal of Economic Perspectives*, *35*(2), 49–76. https://doi.org/10.1257/jep.35.2.49

Duan, Y., Memon, S. A., AlShebli, B., Guan, Q., Holme, P., & Rahwan, T. (2025). Postdoc publications and citations link to academic retention and faculty success. *Proceedings of the National Academy of Sciences*, *122*(4), e2402053122. https://doi.org/10.1073/pnas.2402053122

European Commission. (2024). *Science, Research and Innovation Performance of the EU (SRIP) report*. Directorate-General for Research and Innovation.

Fernández-Zubieta, A., Geuna, A., & Lawson, C. (2015). What Do We Know of the Mobility of Research Scientists and Impact on Scientific Production. In *Global Mobility of Research Scientists* (pp. 1–33). Elsevier. https://doi.org/10.1016/B978-0-12-801396-0.00001-6

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

Filandri, M., & Pasqua, S. (2021). 'Being good isn't good enough': Gender discrimination in Italian academia. *Studies in Higher Education*, *46*(8), 1533–1551. https://doi.org/10.1080/03075079.2019.1693990

Finocchi, I., Ribichini, A., & Schaerf, M. (2023). An analysis of international mobility and research productivity in computer science. *Scientometrics*, *128*(11), 6147–6175. https://doi.org/10.1007/s11192-023-04837-9

Franzoni, C., Scellato, G., & Stephan, P. (2012). Foreign-born scientists: Mobility patterns for 16 countries. *Nature Biotechnology*, *30*(12), 1250–1253. https://doi.org/10.1038/nbt.2449

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

Gaughan, M., & Robin, S. (2004). National science training policy and early scientific careers in France and the United States. *Research Policy*, *33*(4), 569–581. https://doi.org/10.1016/j.respol.2004.01.005

Geuna, A. (Ed.). (2015). *Global mobility of research scientists: The economics of who goes where and why*. Elsevier/AP, Academic Press is an imprint of Elsevier.

Gibson, J., & McKenzie, D. (2014). Scientific mobility and knowledge networks in high emigration countries: Evidence from the Pacific. *Research Policy*, *43*(9), 1486–1495. https://doi.org/10.1016/j.respol.2014.04.005

Gill, B. (2005). Homeward bound?: The experience of return mobility for Italian scientists. *Innovation: The European Journal of Social Science Research*, *18*(3), 319–341. https://doi.org/10.1080/13511610500186698

Granovetter, M. S. (1973). The Strength of Weak Ties. *American Journal of Sociology*, *78*(6), 1360–1380. https://doi.org/10.1086/225469

Hainmueller, J. (2012). Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies. *Political Analysis*, *20*(1), 25–46. https://doi.org/10.1093/pan/mpr025

Hainmueller, J., & Xu, Y. (2013). **ebalance**: A *Stata* Package for Entropy Balancing. *Journal of Statistical Software*, *54*(7). https://doi.org/10.18637/jss.v054.i07

Hargens, L. L., & Farr, G. M. (1973). An Examination of Recent Hypotheses About Institutional Inbreeding. *American Journal of Sociology*, *78*(6), 1381–1402. https://doi.org/10.1086/225470

Heggeness, M., Ginther, D., Larenas, M., & Carter-Johnson, F. (2018). *The Impact of Postdoctoral Fellowships on a Future Independent Career in Federally Funded Biomedical Research* (No. w24508; p. w24508). National Bureau of Economic Research. https://doi.org/10.3386/w24508

Heining, J., Jerger, J., & Lingens, J. (2007). *Success in the Academic Labour Market for Economics—The German Experience*. https://api.semanticscholar.org/CorpusID:27381094

Holding, B. C., Acciai, C., Schneider, J. W., & Nielsen, M. W. (2024). Quantifying the mover's advantage: Transatlantic migration, employment prestige, and scientific performance. *Higher Education*, *87*(6), 1749–1767. https://doi.org/10.1007/s10734-023-01089-7

Horta, H. (2009). Holding a post-doctoral position before becoming a faculty member: Does it bring benefits for the scholarly enterprise? *Higher Education*, *58*(5), 689–721. https://doi.org/10.1007/s10734-009-9221-1

Horta, H. (2013). Deepening our understanding of academic inbreeding effects on research information exchange and scientific output: New insights for academic based research. *Higher Education*, *65*(4), 487–510. https://doi.org/10.1007/s10734-012-9559-7

Horta, H., Meoli, M., & Santos, J. M. (2022). Academic inbreeding and choice of strategic research approaches. *Higher Education Quarterly*, *76*(1), 76–101. https://doi.org/10.1111/hequ.12328

Horta, H., & Santos, J. M. (2016). The Impact of Publishing During PhD Studies on Career Research Publication, Visibility, and Collaborations. *Research in Higher Education*, *57*(1), 28–50. https://doi.org/10.1007/s11162-015-9380-0

Horta, H., Veloso, F. M., & Grediaga, R. (2010). Navel Gazing: Academic Inbreeding and Scientific Productivity. *Management Science*, *56*(3), 414–429. https://doi.org/10.1287/mnsc.1090.1109

Hottenrott, H., & Lawson, C. (2017). Flying the nest: How the home department shapes researchers' career paths. *Studies in Higher Education*, *42*(6), 1091–1109. https://doi.org/10.1080/03075079.2015.1076782

Hunter, R. S., Oswald, A. J., & Charlton, B. G. (2009). The Elite Brain Drain. *The Economic Journal*, *119*(538), F231–F251. https://doi.org/10.1111/j.1468-0297.2009.02274.x

Iacus, S. M., King, G., & Porro, G. (2012). Causal Inference without Balance Checking: Coarsened Exact Matching. *Political Analysis*, *20*(1), 1–24. https://doi.org/10.1093/pan/mpr013

Inanc, O., & Tuncer, O. (2011). The effect of academic inbreeding on scientific effectiveness. *Scientometrics*, *88*(3), 885–898. https://doi.org/10.1007/s11192-011-0415-9

Jonkers, K. (2011). Mobility, productivity, gender and career development of Argentinean life scientists. *Research Evaluation*, *20*(5), 411–421. https://doi.org/10.3152/095820211X13176484436177

Jonkers, K., & Cruz-Castro, L. (2013). Research upon return: The effect of international mobility on scientific ties, production and impact. *Research Policy*, *42*(8), 1366–1377. https://doi.org/10.1016/j.respol.2013.05.005

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

Kahn, S., & Ginther, D. K. (2017). The impact of postdoctoral training on early careers in biomedicine. *Nature Biotechnology*, *35*(1), 90–94. https://doi.org/10.1038/nbt.3766

Kaminski, D., & Geisler, C. (2012). Survival Analysis of Faculty Retention in Science and Engineering by Gender. *Science*, *335*(6070), 864–866. https://doi.org/10.1126/science.1214844

Kato, M., & Ando, A. (2017). National ties of international scientific collaboration and researcher mobility found in Nature and Science. *Scientometrics*, *110*(2), 673–694. https://doi.org/10.1007/s11192-016-2183-z

Kawashima, H., & Tomizawa, H. (2015). Accuracy evaluation of Scopus Author ID based on the largest funding database in Japan. *Scientometrics*, *103*(3), 1061–1071. https://doi.org/10.1007/s11192-015-1580-z

Kim, H. (2025). Global mobility of the recent STEM postdoctoral workforce registered in ORCID. *Quantitative Science Studies*, *6*, 119–130. https://doi.org/10.1162/qss_a_00341

Kim, J., Ott, M., & Dippold, L. (2020). University and Department Influences on Scientists' Occupational Outcomes. *Research in Higher Education*, *61*(2), 197–228. https://doi.org/10.1007/s11162-019-09584-6

King, G., & Nielsen, R. (2019). Why Propensity Scores Should Not Be Used for Matching. *Political Analysis*, *27*(4), 435–454. https://doi.org/10.1017/pan.2019.11

Klein, J. P., & Moeschberger, M. L. (2003). *Survival Analysis: Techniques for Censored and Truncated Data*. Springer New York. https://doi.org/10.1007/b97377

Kotsemir, M., Dyachenko, E., & Nefedova, A. (2022). Mobile young researchers and their non-mobile 'twins': Who is winning the academic race? *Scientometrics*, *127*(12), 7307–7332. https://doi.org/10.1007/s11192-022-04488-2

Laudel, G. (2003). Studying the brain drain: Can bibliometric methods help? *Scientometrics*, *57*(2), 215–237. https://doi.org/10.1023/A:1024137718393

Lawson, C., & Shibayama, S. (2015). International research visits and careers: An analysis of bioscience academics in Japan. *Science and Public Policy*, *42*(5), 690–710. https://doi.org/10.1093/scipol/scu084

Levin, S. G., & Stephan, P. E. (1989). Age and research productivity of academic scientists. *Research in Higher Education*, *30*(5), 531–549. https://doi.org/10.1007/BF00992202

Li, F., Miao, Y., & Yang, C. (2015). How do alumni faculty behave in research collaboration? An analysis of Chang Jiang Scholars in China. *Research Policy*, *44*(2), 438–450. https://doi.org/10.1016/j.respol.2014.09.002

Li, J., Burnham, J. F., Lemley, T., & Britton, R. M. (2010). Citation Analysis: Comparison of Web of Science®, Scopus™, SciFinder®, and Google Scholar. *Journal of Electronic Resources in Medical Libraries*, *7*(3), 196–217. https://doi.org/10.1080/15424065.2010.505518

Lissoni, F., & Miguelez, E. (2024). Migration and Innovation: Learning from Patent and Inventor Data. *Journal of Economic Perspectives*, *38*(1), 27–54. https://doi.org/10.1257/jep.38.1.27

Liu, M., & Hu, X. (2022). Movers' advantages: The effect of mobility on scientists' productivity and collaboration. *Journal of Informetrics*, *16*(3), 101311. https://doi.org/10.1016/j.joi.2022.101311

Long, J. S. (1978). Productivity and Academic Position in the Scientific Career. *American Sociological Review*, *43*(6), 889. https://doi.org/10.2307/2094628

Long, J. S., Allison, P. D., & McGinnis, R. (1993). Rank Advancement in Academic Careers: Sex Differences and the Effects of Productivity. *American Sociological Review*, *58*(5), 703. https://doi.org/10.2307/2096282

Lutter, M., & Schröder, M. (2016). Who becomes a tenured professor, and why? Panel data evidence from German sociology, 1980–2013. *Research Policy*, *45*(5), 999–1013. https://doi.org/10.1016/j.respol.2016.01.019

Marini, G., & Meschitti, V. (2018). The trench warfare of gender discrimination: Evidence from academic promotions to full professor in Italy. *Scientometrics*, *115*(2), 989–1006. https://doi.org/10.1007/s11192-018-2696-8

Marini, G., & Yang, L. (2021). Globally Bred Chinese Talents Returning Home: An Analysis of a Reverse Brain-Drain Flagship Policy. *Science and Public Policy*, *48*(4), 541–552. https://doi.org/10.1093/scipol/scab021

Matthews, D. (2025). How Europe aims to woo US scientists and protect academic freedom. *Nature*, *640*(8058), 300–300. https://doi.org/10.1038/d41586-025-01002-5

Mazzoleni, S., Russo, L., Giannino, F., Toraldo, G., & Siettos, C. (2021). Mathematical modelling and numerical bifurcation analysis of inbreeding and interdisciplinarity dynamics in academia. *Journal of Computational and Applied Mathematics*, *385*, 113194. https://doi.org/10.1016/j.cam.2020.113194

Moed, H. F., & Halevi, G. (2014). A bibliometric approach to tracking international scientific migration. *Scientometrics*, *101*(3), 1987–2001. https://doi.org/10.1007/s11192-014-1307-6

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, *106*(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

Moss, D. (2012). When Patronage Meets Meritocracy: Or, The Italian Academic *Concorso* As Cockfight. *European Journal of Sociology*, *53*(2), 205–231. https://doi.org/10.1017/S0003975612000100

Murakami, Y. (2014). Influences of return migration on international collaborative research networks: Cases of Japanese scientists returning from the US. *The Journal of Technology Transfer*, *39*(4), 616–634. https://doi.org/10.1007/s10961-013-9316-9

Murmann, M., Salmivaara, V., & Kibler, E. (2023). How does late-career entrepreneurship relate to innovation? *Research Policy*, *52*(6), 104763. https://doi.org/10.1016/j.respol.2023.104763

Musselin, C. (2005). European academic labor markets in transition. *Higher Education*, *49*(1–2), 135–154. https://doi.org/10.1007/s10734-004-2918-2

Nakhaie, M. R. (2007). Universalism, Ascription and Academic Rank: Canadian Professors, 1987–2000*. *Canadian Review of Sociology/Revue Canadienne de Sociologie*, *44*(3), 361–386. https://doi.org/10.1111/j.1755-618X.2007.tb01190.x

Neffke, F., Nedelkoska, L., & Wiederhold, S. (2024). Skill mismatch and the costs of job displacement. *Research Policy*, *53*(2), 104933. https://doi.org/10.1016/j.respol.2023.104933

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

Niederle, M., & Vesterlund, L. (2007). Do Women Shy Away From Competition? Do Men Compete Too Much? *The Quarterly Journal of Economics*, *122*(3), 1067–1101. https://doi.org/10.1162/qjec.122.3.1067

NSF. (2024). *Doctorate Recipients from U.S. Universities: 2023*. National Center for Science and Engineering Statistics. https://ncses.nsf.gov/doctorate-recipients-from-u-s-universities-2023

OECD. (2017). *OECD Science, Technology and Industry Scoreboard 2017: The digital transformation*. OECD. https://doi.org/10.1787/9789264268821-en

OECD. (2019). *Education at a Glance 2019: OECD Indicators*. OECD. https://doi.org/10.1787/f8d7880d-en

OECD. (2021). *Reducing the precarity of academic research careers* (OECD Science, Technology and Industry Policy Papers No. 113; OECD Science, Technology and Industry Policy Papers, Vol. 113). https://doi.org/10.1787/0f8bd468-en

Paraskevopoulos, P., Boldrini, C., Passarella, A., & Conti, M. (2021). The academic wanderer: Structure of collaboration network and relation with research performance. *Applied Network Science*, *6*(1), 31. https://doi.org/10.1007/s41109-021-00369-4

Perotti, L. (2009). R. Perotti, L'università truccata. Gli scandali del malcostume accademico. Le ricette per rilanciare l'università. *Polis*, *1*, 171–172. https://doi.org/10.1424/29397

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

Prato, M. (2025). The Global Race for Talent: Brain Drain, Knowledge Transfer, and Growth. *The Quarterly Journal of Economics*, *140*(1), 165–238. https://doi.org/10.1093/qje/qjae040

Robinson-Garcia, N., Sugimoto, C. R., Murray, D., Yegros-Yegros, A., Larivière, V., & Costas, R. (2019). The many faces of mobility: Using bibliometric data to measure the movement of scientists. *Journal of Informetrics*, *13*(1), 50–63. https://doi.org/10.1016/j.joi.2018.11.002

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

Sarrico, C. S. (2022). The expansion of doctoral education and the changing nature and purpose of the doctorate. *Higher Education*, *84*(6), 1299–1315. https://doi.org/10.1007/s10734-022-00946-1

Saxenian, A. (2005). From Brain Drain to Brain Circulation: Transnational Communities and Regional Upgrading in India and China. *Studies in Comparative International Development*, *40*(2), 35–61. https://doi.org/10.1007/BF02686293

Scellato, G., Franzoni, C., & Stephan, P. (2015). Migrant scientists and international networks. *Research Policy*, *44*(1), 108–120. https://doi.org/10.1016/j.respol.2014.07.014

Schotten, M., El Aisati, M., Meester, W. J. N., Steiginga, S., & Ross, C. A. (2017). A Brief History of Scopus: The World's Largest Abstract and Citation Database of Scientific Literature. In F. J. Cantú-Ortiz (Ed.), *Research Analytics* (1st ed., pp. 31–58). Auerbach Publications. https://doi.org/10.1201/9781315155890-3

Schulze, G. G., Wiermann, C., & Warning, S. (2008). What and How Long Does It Take to Get Tenure? The Case of Economics and Business Administration in Austria, Germany and Switzerland. *German Economic Review*, *9*(4), 473–505. https://doi.org/10.1111/j.1468-0475.2008.00449.x

Seeber, M., & Mampaey, J. (2022). How do university systems' features affect academic inbreeding? Career rules and language requirements in France, Germany, Italy and Spain. *Higher Education Quarterly*, *76*(1), 20–35. https://doi.org/10.1111/hequ.12302

Shaaban, C. E., Dennis, T. L., Gabrielson, S., Miller, L. J., Zellers, D. F., Levine, A. S., & Rosano, C. (2022). Retention, mobility, and successful transition to independence of health sciences postdocs. *PLOS ONE*, *17*(11), e0276389. https://doi.org/10.1371/journal.pone.0276389

Shibayama, S. (2022). Development of originality under inbreeding: A case of life science labs in Japan. *Higher Education Quarterly*, *76*(1), 63–75. https://doi.org/10.1111/hequ.12315

Slepykh, V. (2025). Academic inbreeding and productivity of STEM early career researchers in different environments. *Research Policy*, *54*(6), 105240. https://doi.org/10.1016/j.respol.2025.105240

Smith, H. L. (1997). Matching with Multiple Controls to Estimate Treatment Effects in Observational Studies. *Sociological Methodology*, *27*(1), 325–353. https://doi.org/10.1111/1467-9531.271030

Stephan, P. (2013). How to Exploit Postdocs. *BioScience*, *63*(4), 245–246. https://doi.org/10.1525/bio.2013.63.4.2

Stephan, P., & Ma, J. (2005). The Increased Frequency and Duration of the Postdoctorate Career Stage. *American Economic Review*, *95*(2), 71–75. https://doi.org/10.1257/000282805774669619

Subbotin, A., & Aref, S. (2021). Brain drain and brain gain in Russia: Analyzing international migration of researchers by discipline using Scopus bibliometric data 1996–2020. *Scientometrics*, *126*(9), 7875–7900. https://doi.org/10.1007/s11192-021-04091-x

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

Tavares, O., Sin, C., & Lança, V. (2019). Inbreeding and Research Productivity Among Sociology PhD Holders in Portugal. *Minerva*, *57*(3), 373–390. https://doi.org/10.1007/s11024-019-09378-1

Thelwall, M., & Sud, P. (2022). Scopus 1900–2020: Growth in articles, abstracts, countries, fields, and journals. *Quantitative Science Studies*, *3*(1), 37–50. https://doi.org/10.1162/qss_a_00177

Trippl, M. (2013). Scientific Mobility and Knowledge Transfer at the Interregional and Intraregional Level. *Regional Studies*, *47*(10), 1653–1667. https://doi.org/10.1080/00343404.2010.549119

Waltman, L. (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, *10*(2), 365–391. https://doi.org/10.1016/j.joi.2016.02.007

Wang, J., Hooi, R., Li, A. X., & Chou, M. (2019). Collaboration patterns of mobile academics: The impact of international mobility. *Science and Public Policy*, *46*(3), 450–462. https://doi.org/10.1093/scipol/scy073

Wang, Y., & Main, J. B. (2021). Postdoctoral research training and the attainment of faculty careers in social science and STEM fields in the United States. *Studies in Graduate and Postdoctoral Education*, *12*(3), 384–402. https://doi.org/10.1108/SGPE-04-2020-0025

Yu, L. (2024). *Does overseas experience matter? The academic career development of returnee faculty in Chinese research universities*. Routledge. https://doi.org/10.4324/9781003459897

Zhao, X., Aref, S., Zagheni, E., & Stecklov, G. (2022). Return migration of German-affiliated researchers: Analyzing departure and return by gender, cohort, and discipline using Scopus bibliometric data 1996–2020. *Scientometrics*, *127*(12), 7707–7729. https://doi.org/10.1007/s11192-022-04351-4

Zuckerman, H. (1977). *Scientific elite: Nobel laureates in the United States*. Transaction Publishers.

Appendices

A. Institutional context: The Italian academic system

The Italian university sector during the period covered by our analysis (1990–2015) underwent substantial reforms, transitioning from a fully centralized system under direct government control to a mix system with some central control and some university autonomy. University autonomy was linked to increasing independence in the recruitment process with a series of changes that were going toward or against more independence. Eventually, in 2010, a two-step system combining national habilitation and local recruitment processes was introduced. While a full discussion of all the reforms affecting the Italian university system is beyond the scope of this paper, we direct readers to Colombo & Salmieri (2022), Donina et al. (2015) and Moss (2012) for detailed critical analyses. Here, we briefly summarize the key reforms specifically related to hiring and promotion.

The gradual reform process began with Law No. 168/1989, which established the Ministry of University and Research and formally introduced institutional autonomy for Italian universities. Like in many other countries (such as France), Italian universities were internally structured into faculties, which in turn included institutes, laboratories, and departments. Typically, teaching activities were managed at the faculty level, while research was organized at the level of institutes, labs, and departments. Academic staff were divided into three main ranks: Assistant Professor (*ricercatore*), Associate Professor (*professore associato*), and Full Professor (*professore ordinario*). Each academic had to be registered in one of the centrally defined 371 scientific fields (*settori scientifico-disciplinari*), although faculty and departmental membership did not need to align strictly with the scientific filed, and it was common for academics to work in faculties that were only loosely related to their research field.

Throughout the 1990s, after the incorporation of universities, university professors retained the status of public employees, with nationally uniform pay scales and career progression, typically determined by seniority and age, without the possibility of merit-based pay. Academic hiring was governed by public competitions with rigid, uniform national rules. For Assistant Professor positions, hiring followed a local selection process including shortlisting and interviews, though initially candidates were screened through two written examinations. By contrast, appointments to Associate and Full Professor posts were governed by national competitions. Positions approved and funded at the national level were announced centrally across all universities and scientific sectors, with competitions typically scheduled every two to four years. Formally, any individual could apply (even without a PhD), but in practice, most

candidates were lower-ranked academics from the same or related sectors, or researchers returning from abroad.

Under this national system, universities submitted requests for new positions across the 371 fields, and the Ministry determined which were funded. National selection committees, partly elected by peers and partly appointed or drawn by lot, had wide discretion in setting evaluation criteria and making selections, reflecting the Italian tradition of a largely self-governing academic community. Once appointed, academics were assigned to the faculty that had opened the position. After a three-year probation period, tenure was awarded by a national committee.

A major shift came with Law No. 210/1998, which followed the expansion of financial autonomy for universities. Starting in 1999, recruitment responsibility shifted from the national to the local level, giving universities the authority to organize their own competitions. Departments now competed internally for funding to open positions, after which they formed selection committees. These committees continued to include external members, maintaining a degree of central oversight. A key feature was that, although only one vacancy might be available, committees could grant "eligibility" (*idoneità*) to up to three candidates (later reduced to two), among whom the department would select the preferred hire. Importantly, other eligible candidates could be hired by other universities without undergoing a new selection process. To prevent over-application, the reform imposed a cap of five applications per academic per year.

The Gelmini Reform (Law No. 240/2010) marked the most profound restructuring of the system. While further expanding university budgetary autonomy, the law introduced a two-tier system for academic promotions: (i) candidates first had to obtain the *Abilitazione Scientifica Nazionale* (ASN), a national scientific qualification awarded by discipline-specific committees based on research metrics and qualitative assessments; and (ii) they could then compete for local professorship positions through university-level competitions. Prior to this, there was no mechanism for "internal" promotion — Associate Professors, for example, could not simply be promoted by their own university but had to apply externally through national competitions. The reform also restructured Assistant Professor positions, replacing the previous tenured entry-level role with temporary contracts (Type A) and tenure-track contracts (Type B) under an "up-or-out" system.

Later reforms in the 2010s introduced institutional performance evaluations (such as the VQR, *Valutazione della Qualità della Ricerca*) to assess departmental research outputs. However, during most of the period studied in this paper, the primary incentive for research excellence

and publication visibility came not from institutional performance metrics but from individual career advancement aspirations.

B. Retrieval and coverage of publications data from Scopus

To retrieve publication information for the 18,039 researchers in our sample, we followed the procedure described below.

We used the Scopus API to query each researcher by their full name combined with their last known affiliation (as recorded in the MUR data) to retrieve the Scopus Author ID (AU-ID) – a unique identifier within Scopus that enables the identification of all publications associated with a given author. Prior research assessed the accuracy of AU-IDs by cross-matching bibliographic records between Scopus and an open database linked to a large public funding body for academic researchers (Kawashima & Tomizawa, 2015). The study then calculated the recall and precision of Scopus AU-IDs for identifying researchers. The results showed that recall was approximately 98% and precision approximately 99%, indicating a high level of accuracy in Scopus's author identification at least for more recent years.

This search returned 34,419 results, corresponding to 15,968 unique combinations of researcher names and AU-ID. Each result is linked to an AU-ID, meaning that the same researcher may appear under multiple AU-IDs. For each AU-ID, Scopus also provides a list of scientific fields (referred to as "subject areas"[1] in Scopus) and the corresponding number of articles the author has published in journals within each of them. In other words, for each AU-ID, we know both the subject areas in which the author is active and the number of articles they have published in each.

To align the disciplinary information from Scopus and MUR, we grouped both the Scopus subject areas and the MUR scientific fields into the following broad categories: Agriculture; Biology; Chemistry; Physics; Mathematics and Computer Science; Architecture and Engineering; Medicine and Veterinary; Economics and Statistics; Humanities and Law; Sociology and Political Science.

We then matched researcher–AU-ID pairs where the researcher's disciplinary category (from MUR) aligned with the AU-ID's dominant subject area, defined as the subject area with the

[1] Scopus subject areas are: Agricultural and Biological Sciences-AGRI; Arts and Humanities-ARTS; Biochemistry, Genetics and Molecular Biology-BIOC; Business, Management and Accounting-BUSI; Chemical Engineering-CENG; Chemistry-CHEM; Computer Science-COMP; Decision Sciences-DECI; Earth and Planetary Sciences-EART; Economics, Econometrics and Finance-ECON; Energy-ENER; Engineering-ENGI; Environmental Science-ENVI; Immunology and Microbiology-IMMU; Materials Science-MATE; Mathematics-MATH; Medicine-MEDI; Neuroscience-NEUR; Nursing-NURS; Pharmacology, Toxicology and Pharmaceutics-PHAR; Physics and Astronomy-PHYS; Psychology-PSYC; Social Sciences-SOCI; Veterinary-VETE; Dentistry-DENT; Health Professions-HEAL and Multidisciplinary-MULT.

largest number of publications for that AU-ID. After this filtering step, we identified 10,582 AU-IDs that were uniquely linked to a single researcher and retained these pairs.

For researchers still associated with multiple AU-IDs after this step, we selected the AU-ID with the highest total number of publications. This allowed us to finalize 15,385 unique researcher–AU-ID pairs for use in our analysis.

Coverage of the Scopus Database

Scopus was developed by Elsevier starting in 2002 and officially released in 2004 (Schotten et al., 2017). Since then, it has retroactively incorporated many articles published before its launch. Scopus-based studies requiring long time spans (e.g., Budimir et al., 2021; Subbotin & Aref, 2021) have often used 1996 as a starting point, based on the historically correct assumption that Scopus's coverage significantly improved from that year onward (J. Li et al., 2010).

In 2015, Scopus itself acknowledged 1996 as a key year and expanded its historical content by adding 4 million earlier articles and associated references to the system. As a result, Scopus now covers approximately 19 million articles published between 1970 and 1995. Recent research by Thelwall & Sud (2022) suggests that, thanks to these updates, 1996 is no longer a strict cutoff year and proposes 1946 as the earliest practical starting point for scientometric studies seeking the longest consistent coverage.

A well-documented limitation of Scopus – shared with other databases such as Web of Science – is its uneven disciplinary coverage. It provides robust coverage in the Natural Sciences, Engineering, and Biomedical Research but underrepresents publications in the Social Sciences, Arts, and Humanities (Mongeon & Paul-Hus, 2016).

This pattern is evident in Table B.1, which compares individual characteristics across three groups: the full sample, the research-active sample, and the empirical sample used in the analysis performed in this paper. The most noticeable difference across these samples is the underrepresentation of researchers in the Humanities & Law and Social Sciences fields. There are no major differences across other observable characteristics.

Table B.1: Comparison of Individual Characteristics Across Samples

	Full sample		Research active sample		Empirical sample	
	Mean	SD	Mean	SD	Mean	SD
Time-to-Entry	3.68	2.54	3.65	2.53	3.84	2.57
Promoted	0.52	0.50	0.53	0.50	0.50	0.50
Time-to-Promotion	8.49	4.26	8.53	4.27	8.53	4.34
Female	0.43	0.49	0.41	0.49	0.41	0.49
Yr_Birth	1968.46	5.62	1968.50	5.59	1968.95	5.50
Yr_PhD	1999.54	4.84	1999.47	4.85	1999.73	4.79
PhD Cohort 1997-2006	0.73	0.45	0.72	0.45	0.74	0.44
Field: Natural Sciences	0.28	0.45	0.33	0.47	0.46	0.50
Field: Medicine & Veterinary	0.12	0.33	0.14	0.35	0.17	0.38
Field: Architecture & Engineering	0.20	0.40	0.22	0.41	0.24	0.42
Field: Humanities & Law	0.26	0.44	0.17	0.38	0.06	0.25
Field: Social Sciences	0.13	0.34	0.14	0.35	0.07	0.25
Observations	18039		15384		9912	

This underrepresentation stems partly from Scopus's more limited journal coverage in these fields, but also from the fact that publishing in international journals is a less common practice in the Social Sciences and Humanities (which might favor other publication formats such as national language journals not indexed in Scopus, monographs or book chapters). To account for this, we perform a robustness check (reported in Appendix F) by repeating our empirical analysis exclusively on STEMM (Science, Technology, Engineering, Mathematics, and Medicine) fields, where Scopus coverage is known to be strongest, and we find consistent results. Additionally, we conducted a validation check (described in Section 7.1) for a subsample of researchers, where international mobility is directly derived from CV information (rather than proxied through bibliometric indicators), and we again find consistent results. Together, these checks provide reassurance that, although Scopus coverage is uneven across fields, the overall patterns identified in our main analysis are robust.

C. Entropy balancing

To ensure comparability between groups of researchers with similar pre-PD characteristics, we apply entropy balancing (EB) (Hainmueller, 2012; Hainmueller & Xu, 2013). This method re-weights the observations of non-internationally mobile postdocs to match the characteristics of the internationally mobile postdoc group.

We balance the following variables: the number of publications before PhD defense, the average number of citations of these publications, a dummy for female researchers, and dummy variables for each year of birth, each PhD defense year, each PhD-granting university, and each macro scientific field.

The balancing is conducted on the means of these variables. It is worth noting that for dummy variables – which make up the majority of the covariates used for EB – all higher-order moments are fully determined by the mean. As a result, variances are automatically balanced once the means are matched.

Using these variables, we estimate weights so that the reweighted non-mobile sample mimics the distribution of characteristics observed in the internationally mobile PD group. Table C.1 presents the results of the balancing procedure, showing that, after reweighting, the means of the covariates are virtually indistinguishable between the two groups.

Table C.1: Descriptives before and after EB

	Before EB		After EB	
Variable	PD_Abroad = 0	PD_Abroad = 1	PD_Abroad = 0	PD_Abroad = 1
Nb. Pubs during PhD	1.640	5.012	5.012	5.012
Avg Cits during PhD	2.630	9.865	9.865	9.865
Female	0.435	0.348	0.348	0.348
Year of birth	1968.459	1968.429	1968.428	1968.429
Year of PhD	1999.618	1998.915	1998.915	1998.915

Notes: For brevity, the table does not report the full set of dummy variables for scientific fields and PhD-granting institution, which are also used for entropy balancing.

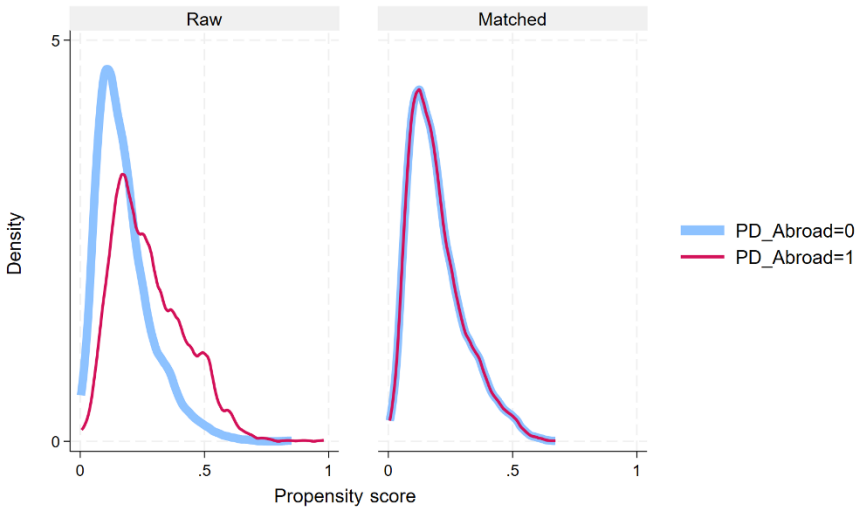
D. Alternative matching methods

D.1 Propensity Score Matching

We adopt a Propensity Score Matching (PSM) procedure, relying on the "nearest neighbor" approach, to mitigate potential selection bias. This method pairs each of the 1,944 internationally PD mobile scientists with a comparable non-internationally PD mobile scientist. Similarity is assessed using a probabilistic score based on observable researcher characteristics. Specifically, we run a logistic regression where the dependent variable is the dummy *PD_Abroad*, equal to one if the scientist undertook a PD stay abroad and zero otherwise. The explanatory variables are the same used in our entropy balancing strategy (see Appendix C): number of publications before PhD defense, average citations of these publications, a dummy for female researchers, and dummies for birth year, PhD defense year, PhD-granting university, and macro scientific field.

To construct the control sample, we apply the nearest neighbor matching without replacement. This ensures that each control (non-internationally PD mobile) unit is matched exclusively to one treated (internationally PD mobile) unit, avoiding bias from repeatedly using the same control cases (Smith, 1997). For each of the 1,944 researchers with an international PD stay, we select the closest match from the pool of 7,968 non-internationally PD mobile scientists based on the propensity score. Figure D.1.1 displays the distribution of propensity scores for treated and control groups before and after matching. After matching, the distributions align closely, ensuring the quality of the matching process.

Figure D.1.1: Propensity score distribution before and after matching



Below, we report the empirical results obtained using the PSM approach.

Table D.1.1: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1	0.567***	0.564***	
	(0.025)	(0.026)	
PD_Abroad=1 X Inbred_Entry=0			0.469***
			(0.034)
PD_Abroad=1 X Inbred_Entry=1			0.587***
			(0.028)
Inbred_Entry=1		0.986	0.865***
		(0.035)	(0.046)
PD_Ita_Mob=1	0.703***	0.699***	0.660***
	(0.034)	(0.035)	(0.034)
Log_Pubs_Entry	2.601***	2.602***	2.615***
	(0.159)	(0.159)	(0.159)
Log_Cits_Entry	1.001	1.001	1.003
	(0.023)	(0.023)	(0.023)
Early_Pub=1	1.197***	1.198***	1.200***
	(0.051)	(0.051)	(0.051)
Female	0.940*	0.940*	0.938*
	(0.032)	(0.032)	(0.032)
Age_PhD	1.393***	1.395***	1.396***
	(0.175)	(0.175)	(0.174)
Age_PhD^2	0.995**	0.995**	0.995**
	(0.002)	(0.002)	(0.002)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	3924	3924	3924
Log likelihood	-6500.991	-6500.971	-6499.640
Chi-squared	3595.337	3597.464	3621.746

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table D.1.2: Risk of entry in t, Social Capital moderating effect: Home-country linkages

	(1)	(2)	(3)
	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Home Linkages>TH)	0.535***	0.596***	1.145*
	(0.024)	(0.033)	(0.088)
PD_Abroad (Home Linkages<TH)	0.838**	0.575***	0.556***
	(0.060)	(0.027)	(0.025)
PD_Ita_Mob	0.692***	0.691***	0.684***
	(0.034)	(0.034)	(0.034)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	3882	3882	3882
Log likelihood	-6411.941	-6419.774	-6414.077
Chi-squared	2001.505	1581.373	1652.352
Wald	49.177	0.634	102.177
Prob.	0.000	0.426	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Table D.1.3: Risk of promotion in t, baseline results

	(1)	(2)	(3)
PD_Abroad=1	1.283***		
	(0.084)		
PD_Abroad_Long=1		1.272***	
		(0.101)	
PD_Abroad_Short=1		1.292***	
		(0.092)	
PD_Abroad_Rank-High=1			1.349***
			(0.107)
PD_Abroad_Rank-Low=1			1.250***
			(0.088)
PD_Ita_Mob=1	1.131*	1.130*	1.133*
	(0.082)	(0.082)	(0.082)
Log_Pubs_Prom	3.830***	3.829***	3.829***
	(0.535)	(0.535)	(0.536)
Log_Cits_Prom	1.246***	1.247***	1.241***
	(0.092)	(0.093)	(0.092)
Early_Pub=1	1.104	1.105	1.104
	(0.078)	(0.078)	(0.078)
Female	0.871**	0.870**	0.873**
	(0.048)	(0.048)	(0.049)
Age_PhD	1.010	1.010	1.002
	(0.213)	(0.214)	(0.210)
Age_PhD^2	1.000	1.000	1.000
	(0.003)	(0.003)	(0.003)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	3924	3924	3924
Log likelihood	-3558.4	-3558.4	-3558.2
Chi-squared	2838.7	2848.8	2887.0

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table D.1.4: Risk of promotion in t, Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1 X Inbred_Prom=0	1.232**		
	(0.128)		
PD_Abroad=1 X Inbred_Prom=1	1.240***		
	(0.089)		
PD_Abroad_Long=1 X Inbred_Prom=0		1.293**	
		(0.157)	
PD_Abroad_Long=1 X Inbred_Prom=1		1.193**	
		(0.106)	
PD_Abroad_Short=1 X Inbred_Prom=0		1.173	
		(0.132)	
PD_Abroad_Short=1 X Inbred_Prom=1		1.294***	
		(0.106)	
PD_Abroad_Rank-High=1 X Inbred_Prom=0			1.315**
			(0.165)
PD_Abroad_Rank-High=1 X Inbred_Prom=1			1.296***
			(0.117)
PD_Abroad_Rank-Low=1 X Inbred_Prom=0			1.197
			(0.131)
PD_Abroad_Rank-Low=1 X Inbred_Prom=1			1.210**
			(0.097)
PD_Ita_Mob=1	1.080	1.078	1.082
	(0.085)	(0.085)	(0.085)
Inbred_Prom=1	0.841**	0.841**	0.843**
	(0.070)	(0.070)	(0.070)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	3924	3924	3924
Log likelihood	-3557.1	-3556.8	-3556.9
Chi-squared	71929.7	2829.0	79699.0

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Table D.1.5: Risk of promotion in t, Social Capital moderating effect: Persistence in collaboration

	(1) TH: Q1	(2) TH: Q2	(3) TH: Q3
PD_Abroad (Netw. Persistence>TH)	1.369***	1.643***	2.313***
	(0.098)	(0.124)	(0.223)
PD_Abroad (Netw. Persistence<TH)	1.122	1.058	1.138*
	(0.100)	(0.080)	(0.078)
PD_Ita_Mob	1.142*	1.135*	1.150*
	(0.083)	(0.083)	(0.084)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	3924	3924	3924
Log likelihood	-3557.482	-3552.245	-3547.258
Chi-squared	2810.729	2800.648	65146.744
Wald	5.265	37.023	68.216
Prob.	0.022	0.000	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

D.2 Coarsened Exact Matching

We employ Coarsened Exact Matching (CEM) to identify suitable matches for each academic. Matching is based on observable characteristics assessed before the international PD mobility, ensuring: similar levels of number of publications and citations before PhD; similar birth year and PhD year distributions; same gender, university of PhD, and scientific field.

The desired outcome of this process is a balanced sample of treated and control subjects. In this instance, we identified 577 treated academics, each paired with one coarsened exact match from the pool of all possible pairs (see Table D.2.1). The matching process yielded two groups that exhibit no statistical differences across any of the matching criteria. Descriptive statistics of pre-treatment variables for academics who participated in research visits and those who did not are presented in Table D.2.2. The test of means demonstrates a significant difference in time to entry and promotion.

Iacus et al., (2012) propose a measure of imbalance (*L1*) as the semi-sum of the absolute differences between relative frequencies of treated and control groups within each identified stratum. In our case, the overall *L1* for the population is 0.98, indicating a highly unbalanced

distribution of treated and control subjects. This implies that many cells in the multidimensional matrix have either zero controls or zero treated cases. Comparing the *L1* of the matched population with the original population provides evidence of improved balance resulting from CEM. After CEM, *L1* is reduced to 0.87, indicating a higher degree of balance between treated and control groups.

Table D.2.1: Treated and control units by CEM group.

	Treated	Controls
All	1944	7968
Matched	577	577
Un-matched	1367	7391

Table D.2.2: Descriptives and t-test of matched units by treated and controls

	Controls		Treated		Diff.	
	Mean	SD	Mean	SD	b	t
Time-to-Entry	3.55	2.36	4.05	2.46	-0.51***	(-3.51)
Promoted	0.53	0.50	0.60	0.49	-0.07*	(-2.48)
Time-to-Prom	8.89	4.21	7.87	4.00	1.02***	(4.16)
Nb. Pubs during PhD	2.08	2.70	2.37	2.60	-0.29	(-1.81)
Nb. of yearly Cits during PhD	3.17	6.98	3.90	7.46	-0.72	(-1.67)
Woman	0.32	0.47	0.32	0.47	0.00	(0.00)
Year of birth	1969.69	4.84	1969.75	4.93	-0.06	(-0.20)
Year of PhD	1999.70	4.35	1999.66	4.34	0.04	(0.16)
Field: Natural Sciences	0.46	0.50	0.46	0.50	0.00	(0.00)
Field: Med. & Veterinary	0.10	0.30	0.10	0.30	0.00	(0.00)
Field: Arch. & Engineering	0.36	0.48	0.36	0.48	0.00	(0.00)
Field: Humanities & Law	0.03	0.18	0.03	0.18	0.00	(0.00)
Field: Social Sciences	0.04	0.20	0.04	0.20	0.00	(0.00)
Observations	557		557		1114	

Hereafter, we report the empirical results obtained using the CEM approach.

Table D.2.3: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1	0.589***	0.575***	
	(0.049)	(0.050)	
PD_Abroad=1 X Inbred_Entry=0			0.543***
			(0.077)
PD_Abroad=1 X Inbred_Entry=1			0.584***
			(0.053)
Inbred_Entry=1		0.910	0.873
		(0.067)	(0.096)
PD_Ita_Mob=1	0.665***	0.639***	0.626***
	(0.062)	(0.063)	(0.067)
Log_Pubs_Entry	3.367***	3.373***	3.383***
	(0.434)	(0.435)	(0.437)
Log_Cits_Entry	0.921	0.924	0.924
	(0.047)	(0.047)	(0.047)
Early_Pub=1	1.207**	1.207**	1.208**
	(0.094)	(0.093)	(0.094)
Female	0.970	0.973	0.974
	(0.080)	(0.080)	(0.080)
Age_PhD	1.527	1.548	1.571
	(0.662)	(0.669)	(0.681)
Age_PhD^2	0.993	0.993	0.993
	(0.007)	(0.007)	(0.007)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	1114	1114	1114
Log likelihood	-6762.608	-6761.801	-6761.668
Chi-squared	268.358	269.971	270.237

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table D.2.4: Risk of entry in t, Social Capital moderating effect: Home-country linkages

	(1)	(2)	(3)
	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Home Linkages>TH)	0.556***	0.616***	1.019
	(0.048)	(0.070)	(0.185)
PD_Abroad (Home Linkages<TH)	0.769**	0.580***	0.568***
	(0.094)	(0.051)	(0.048)
PD_Ita_Mob	0.667***	0.666***	0.664***
	(0.063)	(0.062)	(0.062)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	1114	1114	1114
Log likelihood	-6758.631	-6762.444	-6757.754
Chi-squared	276.310	268.686	278.064
Wald	8.360	0.330	11.107
Prob.	0.004	0.566	0.001

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Table D.2.5: Risk of promotion in t, baseline results

	(1)	(2)	(3)
PD_Abroad=1	1.232*		
	(0.141)		
PD_Abroad_Long=1		1.334**	
		(0.186)	
PD_Abroad_Short=1		1.168	
		(0.148)	
PD_Abroad_Rank-High=1			1.410**
			(0.209)
PD_Abroad_Rank-Low=1			1.170
			(0.141)
PD_Ita_Mob=1	0.920	0.921	0.928
	(0.125)	(0.126)	(0.127)
Log_Pubs_Prom	4.948***	5.063***	4.986***
	(1.295)	(1.331)	(1.299)
Log_Cits_Prom	1.106	1.079	1.089
	(0.150)	(0.149)	(0.148)
Early_Pub=1	1.016	1.014	1.013
	(0.110)	(0.110)	(0.110)
Female	0.663***	0.665***	0.667***
	(0.088)	(0.088)	(0.089)
Age_PhD	0.391	0.402	0.385
	(0.259)	(0.267)	(0.254)
Age_PhD^2	1.015	1.014	1.015
	(0.011)	(0.011)	(0.011)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	1114	1114	1114
Log likelihood	-3685.0	-3684.5	-3684.0
Chi-squared	495.8	496.8	497.8

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table D.2.6: Risk of promotion in t, Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1 X Inbred_Prom=0	1.209		
	(0.224)		
PD_Abroad=1 X Inbred_Prom=1	1.224		
	(0.153)		
PD_Abroad_Long=1 X Inbred_Prom=0		1.508*	
		(0.342)	
PD_Abroad_Long=1 X Inbred_Prom=1		1.241	
		(0.194)	
PD_Abroad_Short=1 X Inbred_Prom=0		1.042	
		(0.217)	
PD_Abroad_Short=1 X Inbred_Prom=1		1.222	
		(0.175)	
PD_Abroad_Rank-High=1 X Inbred_Prom=0			1.341
			(0.316)
PD_Abroad_Rank-High=1 X Inbred_Prom=1			1.433**
			(0.245)
PD_Abroad_Rank-Low=1 X Inbred_Prom=0			1.153
			(0.232)
PD_Abroad_Rank-Low=1 X Inbred_Prom=1			1.154
			(0.155)
PD_Ita_Mob=1	0.887	0.886	0.893
	(0.129)	(0.129)	(0.130)
Inbred_Prom=1	0.839	0.830	0.830
	(0.138)	(0.136)	(0.136)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	1114	1114	1114
Log likelihood	-3684.1	-3682.8	-3683.1
Chi-squared	497.5	500.2	499.7

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Table D.2.7: Risk of promotion in t, Social Capital moderating effect: Persistence in collaboration

	(1) TH: Q1	(2) TH: Q2	(3) TH: Q3
PD_Abroad (Netw. Persistence>TH)	1.216	1.307**	2.115***
	(0.154)	(0.170)	(0.333)
PD_Abroad (Netw. Persistence<TH)	1.262	1.151	1.054
	(0.189)	(0.157)	(0.127)
PD_Ita_Mob	0.918	0.921	0.938
	(0.125)	(0.126)	(0.128)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	1114	1114	1114
Log likelihood	-3684.959	-3684.546	-3674.093
Chi-squared	495.873	496.699	517.604
Wald	0.059	0.882	22.911
Prob.	0.808	0.348	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

E. Alternative functional form: Weibull distribution

In this appendix we perform a robustness analysis using as an alternative estimation approach a parametric survival model with a Weibull distribution.

Table E.1: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1	0.696***	0.689***	
	(0.014)	(0.015)	
PD_Abroad=1 X Inbred_Entry=0			0.633***
			(0.021)
PD_Abroad=1 X Inbred_Entry=1			0.704***
			(0.016)
Inbred_Entry=1		0.971	0.913***
		(0.018)	(0.021)
PD_Ita_Mob=1	0.798***	0.788***	0.765***
	(0.015)	(0.017)	(0.017)
Log_Pubs_Entry	2.188***	2.189***	2.193***
	(0.077)	(0.077)	(0.077)
Log_Cits_Entry	0.968**	0.969**	0.969**
	(0.013)	(0.013)	(0.013)
Early_Pub=1	1.122***	1.123***	1.124***
	(0.022)	(0.023)	(0.023)
Female	0.980	0.981	0.980
	(0.017)	(0.017)	(0.017)
Age_PhD	1.164**	1.168**	1.166**
	(0.076)	(0.077)	(0.076)
Age_PhD^2	0.998*	0.998*	0.998*
	(0.001)	(0.001)	(0.001)
Constant	0.012***	0.011***	0.012***
	(0.012)	(0.012)	(0.012)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-4681.385	-4681.063	-4679.940

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table E.2: Risk of entry in t, Social Capital moderating effect: Home-country linkages

	(1)	(2)	(3)
	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Home Linkages>TH)	0.528***	0.568***	1.059
	(0.019)	(0.028)	(0.087)
PD_Abroad (Home Linkages<TH)	0.784***	0.565***	0.538***
	(0.050)	(0.022)	(0.019)
PD_Ita_Mob	0.701***	0.695***	0.693***
	(0.024)	(0.023)	(0.023)
Controls	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-3826.038	-3848.830	-3822.064
Wald	41.763	0.014	69.663
Prob.	0.000	0.906	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Table E.3: Risk of promotion in t, baseline results

	(1)	(2)	(3)
PD_Abroad=1	1.292***		
	(0.066)		
PD_Abroad_Long=1		1.291***	
		(0.084)	
PD_Abroad_Short=1		1.294***	
		(0.074)	
PD_Abroad_Rank-High=1			1.368***
			(0.090)
PD_Abroad_Rank-Low=1			1.255***
			(0.071)
PD_Ita_Mob=1	1.072	1.072	1.073
	(0.052)	(0.053)	(0.053)
Log_Pubs_Prom	3.951***	3.951***	3.951***
	(0.486)	(0.486)	(0.487)
Log_Cits_Prom	1.344***	1.344***	1.338***
	(0.083)	(0.084)	(0.083)
Early_Pub=1	1.111*	1.111*	1.110*
	(0.060)	(0.060)	(0.060)
Female	0.825***	0.825***	0.828***
	(0.037)	(0.037)	(0.038)
Age_PhD	0.922	0.922	0.919
	(0.158)	(0.159)	(0.158)
Age_PhD^2	1.001	1.001	1.001
	(0.003)	(0.003)	(0.003)
Constant	0.002**	0.002**	0.002**
	(0.006)	(0.006)	(0.006)
Scientific field FE	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-2717.0	-2717.0	-2716.1

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table E.4: Risk of promotion in t, Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1 X Inbred_Prom=0	1.315***		
	(0.104)		
PD_Abroad=1 X Inbred_Prom=1	1.227***		
	(0.072)		
PD_Abroad_Long=1 X Inbred_Prom=0		1.396***	
		(0.137)	
PD_Abroad_Long=1 X Inbred_Prom=1		1.185**	
		(0.091)	
PD_Abroad_Short=1 X Inbred_Prom=0		1.251**	
		(0.113)	
PD_Abroad_Short=1 X Inbred_Prom=1		1.272***	
		(0.088)	
PD_Abroad_Rank-High=1 X Inbred_Prom=0			1.394***
			(0.145)
PD_Abroad_Rank-High=1 X Inbred_Prom=1			1.300***
			(0.102)
PD_Abroad_Rank-Low=1 X Inbred_Prom=0			1.278***
			(0.111)
PD_Abroad_Rank-Low=1 X Inbred_Prom=1			1.190**
			(0.081)
PD_Ita_Mob=1	1.038	1.038	1.040
	(0.056)	(0.056)	(0.056)
Inbred_Prom=1	0.888**	0.888**	0.888**
	(0.053)	(0.053)	(0.053)
Constant	0.002**	0.001**	0.002**
	(0.004)	(0.004)	(0.004)
Controls	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-2712.6	-2711.6	-2711.7

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Table E.5: Risk of promotion in t, Social Capital moderating effect: Persistence in collaboration

	(1)	(2)	(3)
	TH: Q1	TH: Q2	TH: Q3
PD_Abroad (Netw. Persistence>TH)	1.344***	1.597***	2.445***
	(0.077)	(0.097)	(0.189)
PD_Abroad (Netw. Persistence<TH)	1.203**	1.086	1.123**
	(0.089)	(0.068)	(0.061)
PD_Ita_Mob	1.077	1.076	1.082
	(0.053)	(0.053)	(0.054)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	9912	9912	9912
Log likelihood	-2715.880	-2700.395	-2669.075
Wald	1.975	31.726	103.757
Prob.	0.160	0.000	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

F. Robustness check: STEMM fields only

In the appendix we repeat our baseline analysis for the subsample of researchers in STEMM (Science, Technology, Engineering, Mathematics and Medicine) fields.

Table F.1: Risk of entry in t, baseline and Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1	0.758***	0.604***	
	(0.020)	(0.021)	
PD_Abroad=1 X Inbred_Entry=0			0.530***
			(0.030)
PD_Abroad=1 X Inbred_Entry=1			0.621***
			(0.023)
Inbred_Entry=1	1.052*	0.981	0.896***
	(0.029)	(0.029)	(0.034)
Log_Pubs_Entry	2.638***	2.673***	2.679***
	(0.140)	(0.145)	(0.146)
Log_Cits_Entry	0.957**	0.971	0.971
	(0.019)	(0.019)	(0.019)
Early_Pub=1	1.181***	1.186***	1.188***
	(0.039)	(0.039)	(0.039)
Female	0.956	0.959	0.958
	(0.026)	(0.026)	(0.026)
Age_PhD	1.284**	1.275**	1.273**
	(0.134)	(0.134)	(0.133)
Age_PhD^2	0.997**	0.997*	0.997*
	(0.002)	(0.002)	(0.002)
PD_Ita_Mob=1		0.719***	0.689***
		(0.025)	(0.024)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	7351	7351	7351
Log likelihood	-24344.496	-24326.798	-24324.756
Chi-squared	7865.876	7838.765	7841.060

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table F.2: Risk of entry in t, Social Capital moderating effect: Home-country linkages

	(1) TH: Q1	(2) TH: Q2	(3) TH: Q3
PD_Abroad (Home Linkages>TH)	0.564***	0.627***	1.107
	(0.019)	(0.028)	(0.081)
PD_Abroad (Home Linkages<TH)	0.885*	0.601***	0.582***
	(0.056)	(0.021)	(0.020)
PD_Ita_Mob	0.724***	0.724***	0.719***
	(0.023)	(0.023)	(0.023)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Observations	7351	7351	7351
Log likelihood	-24302.772	-24326.624	-24309.398
Chi-squared	8090.623	7838.128	7852.383
Wald	53.969	0.912	77.929
Prob.	0.000	0.340	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 5. * p<0.1 ** p<0.5 *** p<0.01.

Table F.3: Risk of promotion in t, baseline results

	(1)	(2)	(3)
PD_Abroad=1	1.250***		
	(0.066)		
PD_Abroad_Long=1		1.269***	
		(0.084)	
PD_Abroad_Short=1		1.236***	
		(0.073)	
PD_Abroad_Rank-High=1			1.328***
			(0.091)
PD_Abroad_Rank-Low=1			1.212***
			(0.070)
PD_Ita_Mob=1	1.069	1.070	1.071
	(0.055)	(0.055)	(0.055)
Log_Pubs_Prom	3.668***	3.669***	3.675***
	(0.443)	(0.443)	(0.445)
Log_Cits_Prom	1.365***	1.363***	1.359***
	(0.085)	(0.085)	(0.085)
Early_Pub=1	1.110*	1.109*	1.112*
	(0.064)	(0.064)	(0.064)
Female	0.870***	0.872***	0.874***
	(0.041)	(0.041)	(0.041)
Age_PhD	0.889	0.889	0.880
	(0.153)	(0.153)	(0.151)
Age_PhD^2	1.002	1.002	1.002
	(0.003)	(0.003)	(0.003)
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	7351	7351	7351
Log likelihood	-12856.2	-12856.2	-12855.4
Chi-squared	87897.7	3268.8	3266.1

Notes: The reported coefficients are hazard ratios; SE in parenthesis; * p<0.1 ** p<0.5 *** p<0.01.

Table F.4: Risk of promotion in t, Social Capital moderating effect: Inbreeding

	(1)	(2)	(3)
PD_Abroad=1 X Inbred_Prom=0	1.241***		
	(0.102)		
PD_Abroad=1 X Inbred_Prom=1	1.201***		
	(0.071)		
PD_Abroad_Long=1 X Inbred_Prom=0		1.311***	
		(0.133)	
PD_Abroad_Long=1 X Inbred_Prom=1		1.195**	
		(0.090)	
PD_Abroad_Short=1 X Inbred_Prom=0		1.186*	
		(0.111)	
PD_Abroad_Short=1 X Inbred_Prom=1		1.213***	
		(0.085)	
PD_Abroad_Rank-High=1 X Inbred_Prom=0			1.330***
			(0.145)
PD_Abroad_Rank-High=1 X Inbred_Prom=1			1.276***
			(0.102)
PD_Abroad_Rank-Low=1 X Inbred_Prom=0			1.203**
			(0.107)
PD_Abroad_Rank-Low=1 X Inbred_Prom=1			1.163**
			(0.078)
PD_Ita_Mob=1	1.030	1.031	1.032
	(0.057)	(0.057)	(0.057)
Inbred_Prom=1	0.862**	0.864**	0.864**
	(0.053)	(0.053)	(0.053)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	7351	7351	7351
Log likelihood	-12852.4	-12852.0	-12851.5
Chi-squared	3316.5	3315.0	68947.4

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

Table F.5: Risk of promotion in t, Social Capital moderating effect: Persistence in collaboration

	(1) TH: Q1	(2) TH: Q2	(3) TH: Q3
PD_Abroad (Netw. Persistence>TH)	1.336***	1.581***	2.449***
	(0.078)	(0.099)	(0.203)
PD_Abroad (Netw. Persistence<TH)	1.085	1.019	1.080
	(0.085)	(0.065)	(0.060)
PD_Ita_Mob	1.079	1.073	1.082
	(0.055)	(0.055)	(0.056)
Controls	Yes	Yes	Yes
Scientific field FE	Yes	Yes	Yes
PhD year FE	Yes	Yes	Yes
PhD university FE	Yes	Yes	Yes
Entry year FE	Yes	Yes	Yes
Entry university FE	Yes	Yes	Yes
Observations	7351	7351	7351
Log likelihood	-12853.169	-12838.104	-12811.814
Chi-squared	73108.833	3366.070	62627.334
Wald	6.475	40.059	101.991
Prob.	0.011	0.000	0.000

Notes: The reported coefficients are hazard ratios. SE in parenthesis; all models include the same set of controls as in Table 7. * p<0.1 ** p<0.5 *** p<0.01.

G. Validation of the bibliometric mobility measure using CV information

The first round of the Italian National Scientific Habilitation (ASN) took place in 2012 (see Appendix A for further details). In this process, Italian academics seeking promotion to Associate or Full Professor were required to submit a CV with specific and limited information to a national evaluation committee, which would assess their qualifications and decide on their eligibility for habilitation. Each academic could apply for habilitation in multiple scientific fields.

The 72,009 CVs of the ASN 2012 were put online for a short period of time, one of the authors of this paper had archived them back then. These were not complete CVs but had sufficient information on academic appointments to be used in this paper. We matched ASN candidates to our own dataset of 18,039 academics, using name, surname, gender, and scientific subfield. This matching process yielded 10,062 matched individuals, of whom 5,695 are included in the empirical sample used in our main analysis.

This matched subsample is used to conduct a validation exercise, in which we compare mobility indicators based on CV data with those derived from bibliometric information. Table G.1 presents summary statistics for both the full empirical sample and the subsample of researchers for whom CV information is available.

Table G.1: Summary statistics for full sample and CV subsample

	All		With CV info	
	Mean	SD	Mean	SD
Time-to-Entry	3.84	2.57	3.86	2.56
Promoted	0.50	0.50	0.58	0.49
Time-to-Promotion	8.53	4.34	8.86	4.17
N_Pub_PhD	3.52	6.07	3.97	6.72
Avg_Cit_PhD	6.06	17.07	7.54	19.62
Avg_Yr_Pub_Entry	2.88	3.14	3.33	3.54
Avg_Yr_Pub_Prom	2.53	2.55	2.90	2.84
Avg_Yr_Cit_Entry	32.04	44.04	35.03	44.42
Avg_Yr_Cit_Prom	25.61	26.12	27.51	25.96
Female	0.41	0.49	0.39	0.49
Yr_Birth	1968.95	5.50	1969.23	5.20
Yr_PhD	1999.73	4.79	1999.98	4.46
PhD Cohort 1997-2006	0.74	0.44	0.78	0.41
Field: Natural Sciences	0.46	0.50	0.43	0.49
Field: Medicine & Veterinary	0.17	0.38	0.18	0.38
Field: Architecture & Engineering	0.24	0.42	0.24	0.43
Field: Humanities & Law	0.06	0.25	0.07	0.26
Field: Social Sciences	0.07	0.25	0.08	0.27
Observations	9912		5695	

The two samples are broadly similar, but it is worth noting that the subsample with CV information appears to perform slightly better across our productivity measures and shows a higher likelihood of promotion. This pattern is expected, as – by design – these CVs were submitted by researchers applying for habilitation. Less productive academics, who anticipate not meeting the qualification thresholds, are less likely to apply, and thus are underrepresented. Additionally, the CV subsample shows a lower share of female researchers. This is consistent with existing literature, which finds that women are less likely to apply for competitions (Niederle & Vesterlund, 2007) and may face structural barriers in the promotion process (De Paola et al., 2017). Finally, the CV subsample contains a larger proportion of researchers from the more recent PhD cohort (1997–2006), reflecting generational differences in participation in the habilitation process.

The CVs followed a semi-structured format, which included a dedicated section for reporting national and international research experiences. We extracted and coded (the phyton coding is available from the authors) the information provided in this section to identify whether candidates reported an international PD stay. Based on this, we constructed the binary variable, *PD_Abroad_CV*, which takes the value 1 if the academic explicitly reported an international stay during the PD period, and 0 otherwise. We then compared this variable to our publication-based mobility measure, *PD_Abroad*. The comparison results are shown in Table G.2.

Table G.2: Comparison of bibliometric and CV measures of international PD stays

		PD_Abroad_CV		
		0	1	Total
PD_Abroad	0	3,687	753	4,440
	1	405	850	1,255
Total		4,092	1,603	5,695

Overall, our bibliometric proxy for international PD mobility correctly classifies 80% of the cases in the validation sample (3,687 true negatives, and 850 true positives). Among the misclassified cases, we observe two types of discrepancies:

- False Negatives (FN): Researchers who report an international PD experience in their CVs but do not have any publications associated with a foreign affiliation. It is worth noting that among the FN, the share of researchers from the humanities and social sciences is twice as high as their share in the overall sample (24% vs. 12%, respectively).

This is consistent with the well-documented fact that publishing during the PD period is less common in these disciplines (Waltman, 2016), and that Scopus provides more limited coverage of journals in the humanities and social sciences (Mongeon & Paul-Hus, 2016). Furthermore, among these FN, only 32% of researchers (239 cases) report international stays longer than 18 months, which is the type of PD stays we are most interested in.

- False positives (FP): Researchers for whom we detect an international affiliation in publication records, but who do not report an international PD experience in their CV. In 33% of these cases (135 individuals), the CV indicates an international stay during the PhD, meaning the publication-based indicator captured real international experience, albeit from an earlier stage of the career. The remaining 270 cases (4.7% of the total matched researchers) likely reflect missing or incomplete CV entries or data errors, such as incorrect affiliation reported in Scopus.

These results provide confidence in the overall validity of our bibliometric proxy, particularly given the study's focus on longer-term, research-active international mobility.

Table G.3 provides insights into the characteristics of internationally PD mobile scientists identified through CV data. These characteristics align with those presented for the empirical sample in Table 1 of the paper.

Table G.3: Sample composition and share of researchers with international PD stays (CV)

	Nb	Share over total	Share PD_Abroad=1
All	5695	-	0.26
Men	3488	0.61	0.28
Women	2207	0.39	0.23
Cohort 1986-1997	1245	0.22	0.25
Cohort 1997-2006	4450	0.78	0.26
Field: Natural Sciences	2426	0.43	0.28
Field: Medicine & Veterinary	1024	0.18	0.20
Field: Architecture & Engineering	1369	0.24	0.22
Field: Humanities & Law	410	0.07	0.27
Field: Social Sciences	466	0.08	0.31

The information retrieved from the CVs also includes the start and end dates of each international mobility period, allowing us to provide more precise details on the actual length

of international PD stays. On average, the mean length of stay is 1.4 years, while the median is just over one year (1.01 years). Table G.4 presents the distribution of international PD stay durations based on the CV data: nearly half of the observations (49.5%) correspond to stays of less than one year; about one-fourth (23.8%) involve stays between one and two years; around 20% fall between two and four years; and only 7% of the cases report an international PD stay longer than four years.

Table G.4: Number of years abroad for international mobile researchers (CV data)

Yr_Abroad	Freq.	Percent	Cum.
0–1	722	49.49	49.49
1–2	347	23.78	73.27
2–3	194	13.30	86.57
3–4	96	6.58	93.15
4–5	40	2.74	95.89
5–6	25	1.71	97.60
6–7	9	0.62	98.22
7–8	8	0.55	98.77
8–9	8	0.55	99.31
9–10	3	0.21	99.52
10	7	0.48	100.00
Total	1,459	100.00	

Notes: If a CV reports multiple PD stays, we selected the one with the longest duration.

References

Budimir, G., Rahimeh, S., Tamimi, S., & Južnič, P. (2021). Comparison of self-citation patterns in WoS and Scopus databases based on national scientific production in Slovenia (1996–2020). *Scientometrics*, *126*(3), 2249–2267. https://doi.org/10.1007/s11192-021-03862-w

Cantú-Ortiz, F. J. (Ed.). (2017). *Research analytics: Boosting university productivity and competitiveness through scientometrics*. Taylor & Francis. https://doi.org/10.1201/9781315155890

De Paola, M., Ponzo, M., & Scoppa, V. (2017). Gender differences in the propensity to apply for promotion: Evidence from the Italian Scientific Qualification. *Oxford Economic Papers*. https://doi.org/10.1093/oep/gpx023

Hainmueller, J. (2012). Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies. *Political Analysis*, *20*(1), 25–46. https://doi.org/10.1093/pan/mpr025

Hainmueller, J., & Xu, Y. (2013). **ebalance**: A *Stata* Package for Entropy Balancing. *Journal of Statistical Software*, *54*(7). https://doi.org/10.18637/jss.v054.i07

Iacus, S. M., King, G., & Porro, G. (2012). Causal Inference without Balance Checking: Coarsened Exact Matching. *Political Analysis*, *20*(1), 1–24. https://doi.org/10.1093/pan/mpr013

Kawashima, H., & Tomizawa, H. (2015). Accuracy evaluation of Scopus Author ID based on the largest funding database in Japan. *Scientometrics*, *103*(3), 1061–1071. https://doi.org/10.1007/s11192-015-1580-z

Li, J., Burnham, J. F., Lemley, T., & Britton, R. M. (2010). Citation Analysis: Comparison of Web of Science®, Scopus™, SciFinder®, and Google Scholar. *Journal of Electronic Resources in Medical Libraries*, *7*(3), 196–217. https://doi.org/10.1080/15424065.2010.505518

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, *106*(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

Niederle, M., & Vesterlund, L. (2007). Do Women Shy Away From Competition? Do Men Compete Too Much? *The Quarterly Journal of Economics*, *122*(3), 1067–1101. https://doi.org/10.1162/qjec.122.3.1067

Smith, H. L. (1997). 6. Matching with Multiple Controls to Estimate Treatment Effects in Observational Studies. *Sociological Methodology*, *27*(1), 325–353. https://doi.org/10.1111/1467-9531.271030

Subbotin, A., & Aref, S. (2021). Brain drain and brain gain in Russia: Analyzing international migration of researchers by discipline using Scopus bibliometric data 1996–2020. *Scientometrics*, *126*(9), 7875–7900. https://doi.org/10.1007/s11192-021-04091-x

Thelwall, M., & Sud, P. (2022). Scopus 1900–2020: Growth in articles, abstracts, countries, fields, and journals. *Quantitative Science Studies*, *3*(1), 37–50. https://doi.org/10.1162/qss_a_00177

Waltman, L. (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, *10*(2), 365–391. https://doi.org/10.1016/j.joi.2016.02.007