OXFORD

Staying or leaving? Patterns and determinants of Italian researchers' migration

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Abstract

This article aims to highlight the dynamics underlying Italian researchers' migration patterns over the last decade. Building on data gathered through an international study (MORE 3), the analysis focuses on identifying perceptions of working conditions, career prospect and confidence in the national Research and Innovation (R&I) system by Italian researchers in Italy and abroad. It provides a comparative assessment of researchers' satisfaction with regards to their R&I environment in and outside Italy, across different fields of study and career stages. Results show that Italian researchers working abroad have a faster career progression than researchers in the Italian system and provide evidence of a low confidence of Italian researchers regarding career prospect in their own country. These findings are interpreted as major determinants of the decision to emigrate and develop an academic career abroad. Implications for future science policy in Italy are discussed.

Key words: migration of researchers; research and innovation; Italian researchers' migration; mobility of researchers; international mobility

1. Introduction

Over the past decades, increased geographical mobility of researchers and use of new technologies have profoundly reshaped research and innovation activities, by allowing the development of international networks and by facilitating exchanges of information across countries (Geuna 2015). To strengthen its scientific and technological base, the European Union from 2000 onwards promoted the development of a European Research Area (ERA) in which researchers, scientific knowledge, and technology would circulate freely. While fostering a balanced mobility is at the core of EU research policy and was recently reaffirmed as a basis for a new ERA (EC 2020), highly asymmetric flows of researchers may imply large net outflows from specific countries and involve, on the long run, an increased polarisation of Research and Innovation (R&I) performance between emigration and immigration countries (Beine et al. 2001; Cañibano and Wolley 2015). In this regard, since the outbreak of the 2008 economic crisis, Italy has experienced a drastic increase of highly skilled workers leaving the country, involving a risk of structural weakening of its national R&I capacity.[1] The present article aims to identify some of the main factors underlying researchers' decision to conduct a research career in Italy or abroad. To do so, it builds on recent data provided by the MORE 3 survey funded by the European Commission to collect representative data on mobility patterns and career path of EU researchers. By

identifying factors influencing the decisions to develop a research career in Italy, go abroad, returning or not, this research aims to provide insights on key aspects to be tackled by Italian R&I policy developments in the near future.

2. Theoretical framework

With view to identify possible factors explaining the substantial outflow of researchers experienced by Italy since 2008, this section analyses the main theoretical approaches on international mobility of researchers, with a focus on balanced versus asymmetric patterns of mobility. Secondly, it builds on the existing literature to identify the main determinants of individual researchers' decisions to work in their own country or abroad.

2.1 Enhancing balanced mobility of researchers as a policy objective

With the launch of the ERA initiative in 2000, the overarching purpose of the European Commission was to achieve 'a better organization of research in Europe' (EC 2000). To do so, six priorities were identified, among which the development of an open labor market for researchers stands as one of the main purposes to be reached by 2020.[2] The importance of mobility within the ERA framework relies on its acknowledgment as a key mechanism for knowledge diffusion, as physical proximity (Collins 1974; Frenken 2010) and

access to infrastructure remains fundamental factors for knowledge and competence sharing, even in the age of new technologies (Bielick and Laudel 2016; Jöns 2007). Experiencing life and work in different institutional, cultural, and social contexts are highlighted as important features to foster open-mindeness, curiosity, and pave the way for a fruitful scientific career (Costa 2004). In addition, the link between mobility of researchers and scientific performance is of the central arguments underlying the creation of an open labour market for researchers. Analysis focused on bibliometric and patent data generally highlight a positive relationship between mobility and scientific performance (e.g. Franzoni et al. 2014; Netz et al. 2020), as well as between mobility and innovation (Breschi et al. 2014), although variations exist across fields of research (Cruz-Castro et al. 2016; Franzoni et al. 2014).

While the positive impacts of mobility are widely acknowledged, possible perverse consequences of immigration of highly skilled workers on national research systems and economies have also nurtured a long-lasting strand of analyses and argued for enhancing a balanced mobility as a policy purpose. In particular, the concept of *brain drain* was developed in the 1960s to describe long-term outflows of highly skilled workers from their country of origin towards more advanced countries (e.g. Adams 1968). This approach insisted on one side on the costs for the country of origin of educating highly skilled workers and on the loss in terms of capital accumulation, technology adoption, and overall economic development involved by their departure for more advanced economies. Conversely, host countries could benefit from the competences of highly skilled human capital without bearing the cost of their training. This involved simultaneous vicious cycles for lagging economies and virtuous cycles for more advanced ones. Debates progressively evolved towards more dynamic interpretations of migrations of researchers and moved away from the original zero-sum game, in which some countries lost and others mechanically won highly skilled human capital. Further research focused on possible positive returns from migration flows on economic growth for (developing) countries of origin (e.g. Beine et al. 2001; Bhagwati 1979; Schiff 2006). In addition, other streams of analysis specifically focused on the effect of short- and long-term migration patterns on research and innovation outputs (e.g. Ackers 2008). Evidence showed that frequent interactions between country of origin and host country often result in more intense scientific collaboration, creation of networks, bi-directional knowledge transfer, and mutual benefit for both countries (Ackers 2008; Cañibano et al. 2017; Chinchilla-Rodriguez et al. 2018; Fernández-Zubieta et al. 2015; Jonkers and Tijssen 2008; Wagner and Jonkers 2017). Independently of the nature of mobility and its effects on emitting or host countries, successive flows of researchers have favoured the expansion of scientific poles of excellence. Centres of scientific gravity would achieve a high concentration of knowledge with flows both from and towards more peripheral areas (Mahroum 2000). As original brain drain theories, this approach focuses on asymmetric flows of researchers and polarisation of scientific performance, while it also takes into account non-zero sum game argument and differential spill-over effects of knowledge creation across countries. In this regard, the complementarity or the possible mismatch between the 'supply' of researchers and the 'demand' expressed by national research systems appear as a fundamental feature characterising centres and peripheries. When one-way mobility patterns greatly exceed two-way mobility of researchers, consequences on national research and innovation sectors may involve, on the long run, loss of competences, of scientific and technological activities and an overall weakening of

national R&I ecosystems. This argues for the need to foster mobility policies allowing on one side the improvement of general scientific performance while avoiding structural imbalances across countries.

2.2 The determinants of individual mobility of researchers

In parallel to the policy implications of researchers mobility, another strand of analysis focused on the identification of factors influencing individual decisions to develop a research career in the home country or abroad (e.g. Ackers and Gills 2009; Cañibano et al. 2020; Cruz-Castro and Sanz-Menendez 2010; Geuna 2015; Mahroum 1998; Netz et al. 2020; Reale et al. 2019).

Three interlinked individual drivers are generally highlighted to motivate international mobility (Cañibano et al. 2020). The first one refers to building a professional network and accumulate significant and high-quality work experience, which may not be possible by staying in the home country (Laudel, 2005; Laudel and Bielick 2019; Melin 2004; Woolley et al. 2008). Ackers and Gills (2009) explain how mobility in science is specifically enhanced by the perception that an 'international experience' is considered by many early stage researchers as a fundamental feature for their future career. Evidence supports this perception as it highlights a strong effect of international mobility on the broadening of scientists' network (Netz et al. 2020).

Secondly, international mobility is often motivated by a will to increase research productivity and impact (Cañibano et al. 2020). Evidence generally supports a positive relationship between international mobility and scientific productivity (e.g. Cruz-Castro and Sanz-Menendez 2010; Franzoni et al. 2014; Jonkers and Tijssen 2008; Lu and Zhang 2015). However, some controversy exists (Netz et al. 2020), as some studies find no link between international mobility and publication productivity and impact (e.g. Baruffaldi et al. 2017; Conchi and Michels 2014; Cañibano et al. 2008; Jonkers and Cruz-Castro 2013; Roos et al. 2014).

Thirdly, international mobility is perceived by researchers as a mean to accelerate career advancement (e.g. Ackers and Gills 2009). Evidence in this regard is mixed (Netz et al. 2020). Specific factors linked to research field (Reale et al. 2019), career stage (Cañibano et al. 2020), national specificities, and institutional characteristics (e.g. recruitment processes) often influence this relationship (e.g. Ackers 2005; Baruffaldi and Landoni 2012; Cruz-Castro and Sanz-Menendez 2010; Cruz-Castro et al. 2016; Mahroum 1998). Contrary to common assumptions, non-mobile researchers may thus experience faster career progression than mobile ones in specific national and institutional systems promoting the development of internal academic research job markets (e.g. Lawson and Shibayama 2015; Marinelli et al. 2014).

In addition to the three main individual drivers of international mobility mentioned above, recent studies have documented the emergence of patterns of *forced mobility* for researchers (MORE 3 Final Report, IDEAconsult, 2017). This concept is defined as a subjective self-assessment of researchers declaring that their mobility arises from the need to migrate abroad, mainly because of a lack of professional opportunities in their home country. Forced mobility thus underlines the inability of a national research system to benefit from its investment in human capital due to different reasons, including the underfinancing of the system. At macro-level, it highlights asymmetric mobility patterns dominated by outflows towards countries with stronger R&I activities. At European level, this may lead to an increasing polarisation between stronger and weaker

national research systems, and to an overall reduction of the size and diversity of Europe's science and technology base.

Additional factors linked to demographic or sociological characteristics of researchers also need to be mentioned as influencing the likelihood to move abroad. The influence of gender, age, and the presence of children plays a substantial role (Reale et al. 2019; Waibel et al. 2017). In particular, international mobility becomes less likely when researchers complete their studies later in life or have children. Concerning sociological factors, social origins, or previous experiences of studies abroad increases the likelihood of further international work experiences (Reale et al. 2019).

3. Researchers' mobility in Italy

Following the information provided above, the Italian situation with regards the evolution of researchers' mobility since the outbreak of the 2008 economic crisis highlights strongly asymmetric flows mainly due to a drastic increase of migration of researchers and simultaneous decrease of R&I funding.

Concerning R&I funding, government R&D allocations (GBAORD) have systematically fallen between 2007 (€9.9 billion) and 2015 (€8.3 billion), in a context of overall reduction of public expenditure. As of 2015, total R&D expenditure (GERD) represented 1.34 per cent GDP, far from the 3 per cent GDP targeted by 2020 set up in the Lisbon strategy. While it increased up to 1.39 per cent GDP in 2018, the gap with EU average widened (2.03 per cent GDP in 2015; 2.13 per cent in 2018). The same applies to a comparison with France and Germany, with which a convergence could be observed between 1995 and 2006, followed by a strong divergence since the beginning of the crisis. The reduction of public funding particularly affected university funding, public research programmes, and public subventions to private companies. This in turn had a strong impact on human resources, especially at university level, where numbers of permanent professors and researchers decreased by 20 per cent between 2009 and 2016 (from 60,882 to 48,878 researchers) (ANVUR 2016, 2018).[3] Simultaneously, career advancement has been largely delayed, resulting in a continuing increase in the average age of university staff (52.6 years old) and of full professors (60 years old) (ANVUR, 2018: 387). The lack of turnover and the slowdown of career advancement are at the root of such fall. Over the same period, 44,345 young scholars received a post-doc contract ('assegno di ricerca'). By 2018, 61 per cent of them were out of university employment, 29 per cent remained in a post-doc position, 9 per cent became a temporary university researcher, and <1 per cent obtained associate professor contracts (ANVUR, 2018: 377).

Simultaneously, emigration out of Italy has sharply increased (Fig. 1). Migrants increased from 52,000 in 2012 to 82,000 in 2017 (ISTAT 2017). When accounting for the return of Italians from abroad, Italy's net loss of citizens above 25 reached 276,000 between 2012 and 2017, among which 77,000 were with a university degree. Annual net outflows went from 32,000 in 2012 to 54,000 in 2016 and 51,000 in 2017. Net outflows of migrants with a university degree increased from 8,800 to 13,500, one-quarter of all net migrants.[4]

Table 1 provides more precise data for 2017. It indicates that the largest flows of Italian migrants are directed towards the UK, Germany, Switzerland, and France. Regarding migrants with a university degree, Brazil, Ireland, the USA, and Belgium appear as the most prominent destinations. Return flows are documented mainly from Germany, Brazil, the UK, and Switzerland, with a share of university graduates ranging from 32 to 50 per cent. A minor positive sign is that the share of those with a university degree is higher among the Italian returning from abroad (39 per cent) than for those leaving the country (31 per cent).

As regards PhD holders, ISTAT conducted in 2018 a survey of PhD graduates of 2012 and 2014 to study their career progression (ISTAT 2018).[5] The study indicates that 11,459 students graduated in 2012 and 10,639 in 2014. The decrease by about 8 per cent in the number of PhD graduates in Italy is associated to the cuts in the number of PhD programmes and funding for universities (Nascia and Pianta 2018). Average age of graduation is high, with only 11 per cent obtaining their PhD before 30. Non-Italians are increasing among PhD graduates in the country, passing from 8 per cent in 2012 to 10 per cent in 2014. In addition, the ISTAT survey shows an increasing share of PhD graduates with international study mobility: from 27.9 per cent in 2004 to 44.6 per cent in 2014.

Table 2 presents data regarding numbers of PhD graduates of 2012 and 2014 working in Italy and abroad and compares levels of income. The share of PhD graduates working abroad increased from 16 to 18 per cent and represents a sizeable share of Italian PhDs. One-third of the PhDs who are now abroad had already moved
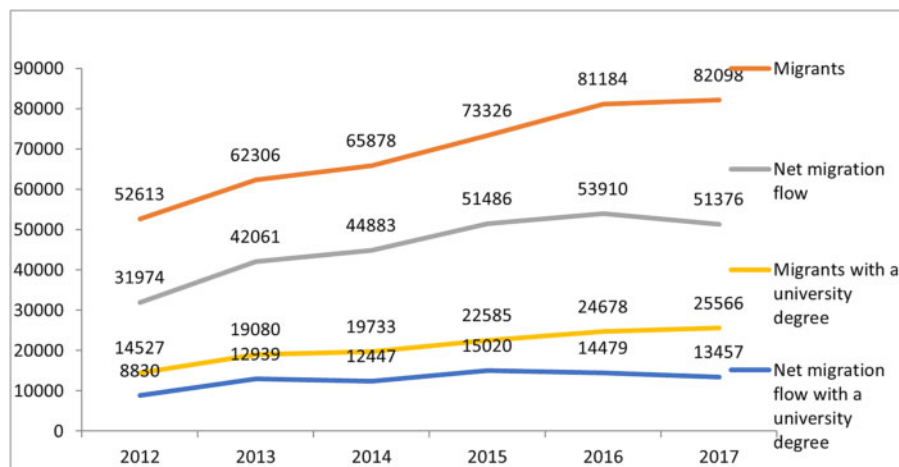

Figure 1. Italian citizens above 25 years: citizens migrating abroad, net migration flows of Italian citizens, citizens migrating with a university degree, years 2012–7.
Source: Istat surveys on migrations (2017).

Table 1. Italian citizens migrating abroad by country of destination and returning to Italy by country of origin, 2017

Country of destination	Total migrants	Migrants with a university degree	% of migrants with a university degree	Country of origin	Total migrants	Migrants with a university degree	% of migrants with a university degree
Total	82,098	25,566	31.1	Total	30,722	12,109	39.4
UK	13,794	4,283	31	Germany	3,461	1,158	33.5
Germany	12,329	3,259	26.4	Brazil	3,158	1,294	41
Switzerland	7,574	2,174	28.7	UK	3,155	1,597	50.6
France	7,437	2,193	29.5	Switzerland	3,003	972	32.4
Spain	5,848	1,668	28.5	Venezuela	1,685	615	36.5
Brazil	5,802	2,517	43.4	USA	1,581	685	43.3
USA	4,222	1,451	34.4	France	1,559	625	40.1
Australia	1,974	608	30,8	Spain	933	309	33.1
Ireland	1,942	700	36	Romania	681	240	35.2
Belgium	1699	577	34	Argentina	665	290	43.6
Other countries	19,477	6,136	31.5	Other countries	10,841	4,324	39.9

Istat survey on migrations, 2017.

Table 2. PhD graduates in 2012 and 2014 and average net monthly income by country of residence in 2018

Country	2012			2014		
	Number of PhD	Percentage of PhD graduates	Net income in EUR	Number of PhD	Percentage of PhD graduates	Net income in EUR
Italy	9,634	84	1,625	8,671	82	1,588
Abroad	1,825	16	2,600	1,968	18	2,418
Total	11,459	100	1,727 (average)	10,639	100	1,625 (average)

Source: Istat survey on doctorates, 2018.

abroad before starting the doctoral course. The most attractive countries are the UK (21.2 per cent), the USA (14 per cent), Germany (11.7 per cent), and France (11.2 per cent). In terms of income, Italian PhDs working abroad tend to earn 50 per cent more than their colleagues working in Italy.

The employment share of PhD holders in Italy is high and stable although the numbers in permanent jobs have declined from 45 to 38.6 per cent between 2012 and 2014. In parallel, holders of postdoc scholarships—a more precarious condition—have increased significantly from 14 to 21.5 per cent. Women are under-represented among those with permanent jobs.

As discussed previously, more specific data on the migration of scientific researchers have been provided by the OECD, based on the change of national affiliation of authors with at least two published articles in the Scopus scientific database (OECD 2017). These data show that net outflows of researchers leaving Italy between 2002 and 2016 reaches about 11,000 researchers. This is the highest number across all EU Member States representing around a third of net EU outflows (Fig. 2). Italian outflows accelerated after 2010, as 58 per cent of Italian researchers migrated after 2011. Figure 3 shows that Italy is a net 'exporter' of researchers to all major countries, including the USA, the UK, France, Germany, and Spain (OECD 2017: 128–129).

These patterns of mobility underline the relevance of studying the Italian case to test recent assumptions on migration of researchers. In particular, Italy shows strong emigration flows of highly skilled personnel, scientists and researchers. Bergamante and Vecchione (2017) pointed out the lack of bidirectionality of human capital flows concerning Italy as there are little inflows from abroad and in many cases outflows are not reversible. Moreover, they

reported an increasing volume of migration flows that shows no sign of scaling down. Similarly, another study on Italy argued that 'the fact that emigrating scientists maintain contacts with their country of origin does not suffice as proof that there is no brain drain occurring' (Morano-Foadi 2006: 209).

4. Research questions: Investigating the drivers of Italian researchers' mobility

On the basis of the above evidence, the present article aims to complement existing knowledge on mobility patterns of Italian researchers by identifying possible factors influencing the decision to conduct a research career in Italy or abroad and by assessing its impact on researchers' career progress. It will evaluate perceptions of working conditions, career prospects, and confidence in the Italian R&I system and compare it with other national systems. To do so, the study will build on a sample of Italian researchers in Italy and abroad and across different fields of study and career stages. By identifying factors influencing the decisions to develop a research career in Italy, go abroad, returning or not, this research aims to provide insights on key aspects to be tackled by Italian R&I policy developments in the near future.

5. Data

The data used in this study were collected through the MORE 3 study. This project was funded by the European Commission to provide empirical evidence on mobility of researchers in Europe. Data were collected through surveys distributed to academic research staff in about thirty countries and aimed to collect experiences of
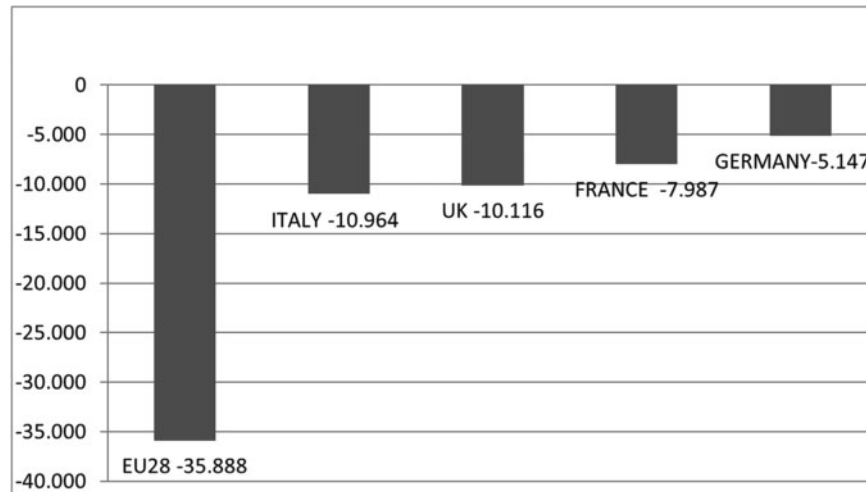
Figure 2. International net outflows of scientific authors, 2002–16. *Source*: OECD (2017: 128–129) https://doi.org/10.1787/sti_scoreboard-2017-17-en.
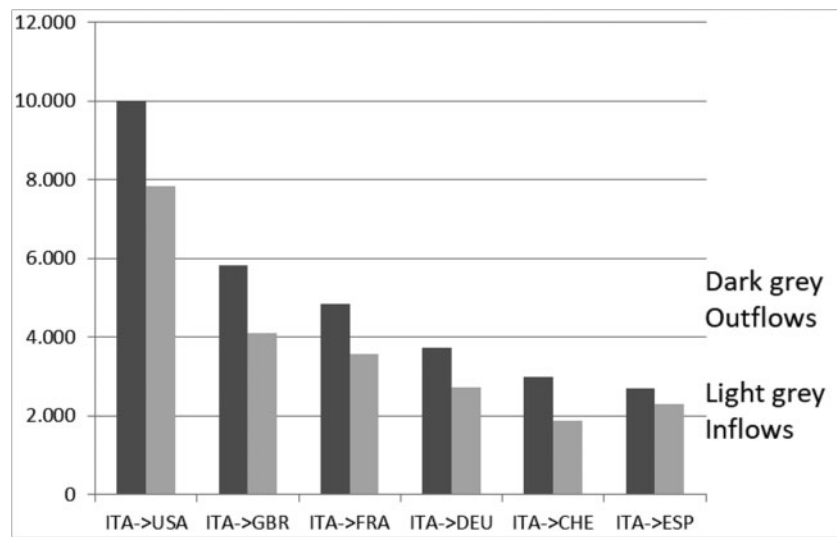

Figure 3. Flows of scientific authors between Italy and other countries, 2006–16. *Source*: OECD (2017: 128–129) https://doi.org/10.1787/sti_scoreboard-2017-17-en.

mobility and reasons for moving. The MORE 3 study surveyed thirty-one countries, collecting 10,394 answers. These were filled by researchers working in Higher Education Institutions (HEIs) and located in thirty-three countries (EU twenty-eight countries, Norway, Iceland, and Switzerland). The survey was carried out in 2016 and refers to a total population of 1,373,130 researchers in head counts.[6]

The database provides information regarding the year of birth, research career stage (R1–R4 according to European Commission classification[7]), citizenship, residence, year of each career advancement, level of education, periods of long- and short-term mobility (more or less than 3 months) between 2006 and 2016. No panel data are available. The database supplies a large number of variables relating to work activities of researchers. Of particular interest is the information on the motivation of mobility that may highlight changes in patterns of mobility and migration. To refine the information and in particular its statistical significance, partial responses were imputed by means of donor techniques to recycle information of researchers who filled in a substantial part of the survey but did not reach the end (IDEA Consult, WIFO and Technopolis 2017: 204).

6. Sample

The analysis conducted relies on two sets of comparisons. First, we compare a group of Italian researchers living in Italy and Italian researchers abroad. All Italian researchers included in the MORE 3 database are included in the analyses. The sample excludes foreign researchers working in Italy and Italians with a double citizenship working in the country of their second nationality.

Secondly, we compare Italian researchers with other foreign (non-Italian) researchers working in Austria, Switzerland, the Netherlands, and Luxembourg. These four countries are the ones hosting the largest number of Italian researchers in the MORE 3 sample.[8]

6.1 Italian researchers living in Italy

For this category, the MORE 3 database includes 374 researchers (173 women). It includes seven non-Italian researchers, who are excluded from the analysis. One hundred and fifty-four individuals are active in Natural sciences and engineering, 143 in Social sciences and humanities, and 77 in Health disciplines. The number of mobile

researchers (researchers who have spent more than 3 months abroad), is 147, of which 82 have spent >10 years abroad.

6.2 Italian researchers working abroad

The MORE 3 database identified 207 Italian researchers working in foreign HEI. Their identification was conducted on the basis of their self-informed citizenship and employer. The geographic distribution of the 207 researchers is rather concentrated, with 10 countries accounting for 165 researchers.[9] Fifteen researchers were not considered in the analysis as they declared both the citizenship of the country of their employer and the Italian citizenship. The sample of 207 Italian researchers abroad is mainly <45 years of age (152 observations) with a significant share of women (81 observations). More than the half of the sample, 102 observations, is in the first two career stages, R1 (PhD students) and R2 (post-docs and junior researchers). The most common field of activity is natural sciences and engineering, accounting for 104 observations.

6.3 Italian and other foreign (non-Italian) researchers working in Austria, Switzerland, The Netherlands, and Luxembourg

The sub-sample of Italian researchers abroad is composed of 99 Italian researchers working in Austria, Switzerland, the Netherlands, and Luxembourg. With a view to compare the previous sub-sample of Italian researchers, the present study will rely on data from 557 foreign (non-Italian) researchers also working in Austria, Switzerland, the Netherlands, and Luxembourg.

Among these sub-samples, male respondents represent 61 per cent of the population considered. Almost three-quarters of respondents are <45 years old. Total researchers are evenly distributed across career stages, with about one-quarter each for R1 and R3, 28 per cent for R2, and less than 20 per cent for R4. There are more PhD students (R1) among Italian researchers than among other foreigners (35 per cent against 25 per cent); at the other extreme, full professors (R4) account for 13 per cent of Italian and 19 per cent of other foreigners. In terms of disciplines, natural sciences account for almost half, social sciences for one-third, health sciences for 12 per cent. The distribution of career stages across fields of science is rather consistent, with about one quarter of the R1 group; full professors account for 13–14 per cent in health and natural sciences and for 24 per cent in social sciences. Regarding the sample distribution by field of science, Italians are over-represented in natural and health sciences, while other foreigners are more numerous in social sciences. The gender balance in each field highlights a prevalence of women in health and social sciences for Italians. For other foreign researchers, a prevalence of men is observed, with an even balance in social sciences.

The demographic characteristics and the distribution by career stage and fields of science show a high level of similarity across the two samples considered. This allows for comparing their career progression and confidence in future career prospect.

7. Results

The analyses conducted in this study are split in three sections. The first one presents the main descriptive statistics gathered by the MORE 3 database on Italian researchers in Italy and abroad. The second section focuses on identifying the determinants of confidence in career perspectives and of actual career progression of Italian researchers in Italy and abroad. Finally, the third section will refine the analysis by examining possible differences regarding confidence in career perspectives and actual career progression between Italian researchers and other foreign researchers working in Austria, Switzerland, the Netherlands, and Luxembourg.

7.1 Descriptive statistics on Italian researchers in Italy and abroad

An overview of the characteristics of the 374 Italian researchers in Italy and of the 207 Italian researchers working abroad included in the MORE 3 survey is provided in this section, using a set of descriptive tables included in the Supplementary Appendix. Data show a generally good gender balance (56 per cent males, 44 per cent females in Italy; 61 to 39 per cent abroad). In terms of age, Italy's young researchers are prevalent abroad, with 42 per cent of researchers <35 years of age, while senior scholars are more frequent in Italy with 68 per cent of the sample >45 years (Supplementary Appendix Table A.1).

Career levels are divided in four categories (see note 5). R1 mainly refers to PhD students; R2 includes post-docs and junior researchers; R3 refers to associate professors; R4 includes full professors (Supplementary Appendix Table A.2). Italian researchers abroad include a larger share of PhD students and junior researchers (53 per cent) and fewer professors (47 per cent), while the share of professors is higher in Italy (69 per cent). All fields of science are adequately present among researchers in all career stages (Supplementary Appendix Table A.2). Among researchers in Italy, the share of women is higher among PhDs (73 per cent) and lower than men in all other groups; among researchers abroad the gender gap is higher for professors (30 per cent of women only, Supplementary Appendix Table A.3).

A drastic divide emerges between researchers in Italy and abroad with regards to the mechanisms of hiring and in terms of remuneration and career prospects.[10] Recruitment in the home institution is considered to be transparent and merit-based by 57 per cent of researchers in Italy and 80 per cent of those abroad. PhDs and younger researchers in Italy have the most critical view of recruitment mechanisms in place. Considering the criteria for career progression, the same gap emerges. Merit is considered as the operating criteria by 54 per cent of researchers in Italy against 75 per cent of those abroad. Tenured positions are considered to be assigned on the basis of merit by 43 per cent of researchers in Italy and by 62 per cent of those abroad. Concerning the distribution by fields of science, recruitment is considered to be based on merit by 50–60 per cent of Italians in Italy as opposed to 76–85 per cent of Italian abroad; the largest gaps are in the social and health sciences (Supplementary Appendix Table A.4).

The examination of remuneration shows that the share of researchers reporting to be badly paid or paid just to make ends meet is 47 per cent in Italy and 15 per cent for Italians abroad. Close to three-quarters of PhD candidates in Italy respond that they are badly paid or paid just to make ends meet, as opposed to <10 per cent of Italian PhD candidates abroad. In Italy just a quarter says they are reasonably paid and none answers that they are well paid, as opposed to >50 and 40 per cent, respectively, among Italian PhD candidates abroad. Among post docs and junior researchers 60 per cent of those in Italy report bad pay or pay just to make ends meet, as opposed to 20 per cent among Italians abroad. In Italy those that are reasonably or well-paid reach 40 per cent only, as opposed to 80 per cent among Italians abroad. Associate professors in Italy are not satisfied by their remuneration in

42 per cent of cases; conversely only 6 per cent report they are well paid, as opposed to 12 per cent and 33 per cent, respectively, among the ones working abroad. Approximately the same results are found for Italy's full professors, while among Italian professors abroad 20 per cent report to be unsatisfied and 23 per cent have the perception of being well paid. These gaps are important and consistent across gender, countries and fields of science (Supplementary Appendix Table A.5).

Similar gaps appear when it comes to the overall confidence of researchers on the future career prospects. In Italy, 42 per cent report a lack of confidence or a strong lack of confidence, against 24 per cent among researchers abroad. Conversely, 76 per cent of the latter feel somewhat confident or very confident about their career prospects, against 58 per cent in Italy. In Italy, the gap is particularly serious among PhD students (60 per cent lacking confidence) and junior researchers (61 per cent lacking confidence), about twice the shares among researchers abroad. Even among professors expectations are significantly less optimistic in Italy than abroad: the associate professors confident in their prospects are 68 per cent in Italy and 88 per cent abroad; data for full professors are 64 per cent and 90 per cent respectively. When we consider the breakdown by fields of science, variability across disciplines is modest and the distance between confidence in Italy and abroad remains large in all areas (Supplementary Appendix Table A.6).

The speed of career is a key aspect of researchers' academic progression. Data gathered by the MORE 3 study (shown in Supplementary Appendix Table A.7) report the average number of years passed from entry in the position of R1-PhD student to R2-post-doc and junior researcher; from R2 to R3-associate professor; from R3 to R4-full professor. The gap in career speed between researchers in Italy and abroad is remarkable: 5.5 versus 4.3 years in moving from R1 to R2; 8 versus 4.1 years in moving from R2 to R3; 8.5 versus 6.1 years in moving from R3 to R4. When broken down by gender, data highlight a slower career progression for women at the start and end of the career ladder in Italy. Looking at data by field of science, social sciences appear as those with a slower career progression both in Italy and abroad, with some exceptions. The overall picture that emerges for Italian researchers is one of lower career opportunities in Italy than abroad (Supplementary Appendix Table A.7).

One-fifth of Italian researchers abroad report to have left Italy because of the lack of opportunities and 26 per cent to improve working conditions; 13 per cent point out the importance of better career chances; 30 per cent argue that moving abroad improved their networking and knowledge exchange. When considering the answers of mobile Italian researchers after their return to Italy, we find that the main motivation for mobility was networking and knowledge exchange (49 per cent of cases), increasing career changes in Italy, and improving their working conditions (13.1 per cent for both). Only 9.8 per cent felt forced to move for lack of opportunity in home country or because it was a requirement for career progression (6.6 per cent) (Supplementary Appendix Table A.8).

7.2 Confidence in career prospects and speed of career progression—a comparative analysis of Italian researchers in Italy and abroad

On the basis of the data presented above, this section aims to shed light on the factors associated with migration of Italian researchers. A major limitation of the MORE 3 data is the lack of information on actual research performance and publication records. For privacy

reasons, data of MORE 3 cannot be matched to bibliometric databases for individual scholars (e.g. Scopus). We first investigate the factors influencing researchers' levels of confidence in their career prospects. This variable combines a perception of subjective capacities and an assessment of opportunities offered by the national research system and by the institution where researchers operate. Our dependent variable is binary—high and low confidence.[11] We build a model using logit regressions considering four independent variables including the country of the university, gender, the level of satisfaction with remuneration, and the perception of a merit-based tenured career in the home institution. Covariates are binary, the pseudo-R square parameter is the Cox & Snell, based on the ratio of the likelihoods of the intercept, and the full model is assessed through goodness of fit indexes. Regressions are estimated using SAS software. Estimations are first carried out on the total sample, then separately for researchers in the R2, R3, R4 career stages and finally for the three fields of science; results are shown in Table 3.

For total researchers, the results show that all four variables have a positive and significant influence. Italians male researchers working abroad who consider that merit is the criteria for tenured careers in their institutions and who are satisfied about their remuneration show a higher probability to be confident in their career prospects than other categories.

Looking at odds ratios, Italian researchers abroad are twice more likely to be confident in career prospects than Italians in Italy; males have one and a half time more likely to be confident in career prospects than females; those satisfied with their wages have two and a half times probabilities to be confident; those in merit-based institutions three and a half times probabilities to be confident in their career prospects. The estimate is able to predict correctly 72 per cent of cases.

When the sample is split on the basis of career stages or fields of science, findings show that merit-based tenure has a highly positive and significant influence in all cases. Residency abroad loses its significance in a few subsets only—R3-Associate professors, health, and natural sciences; in terms of odds ratios, it is striking that for R4-full professors, those working abroad are four and a half time more likely to be confident in their career than those in Italy. Gender is significant in natural sciences alone. Wage satisfaction is significant for R2-postdoc researchers alone. There is some variation of the goodness of fit of the model for each breakdown. However, the LR chi-square is always significant and the share of correctly predicted cases ranges between 67 and 76 per cent (Table 3).[12]

A second analysis is carried out considering the speed of career progression of researchers as dependent variable, an indicator of individuals' academic success and of the opportunities offered by the national research system and the institution where scholars operate. This variable has already shown wide differences between the career trajectories of Italian researchers in Italy and abroad (Supplementary Appendix Table A.7). We consider the evolution between R2 and R3 and from R3 to R4. The variables are split into five categories, ranked from 1 (very slow career advancement) to 5 (very fast career advancement), with an even distribution of frequencies among them. The speed of career advancement from one career stage to the next is inversely proportional to the number of years of permanence in each career stage.[13]

We test a model using ordered logit regressions, considering the same four variables used in the previous model—country of university, gender, level of satisfaction with remuneration, and the perception of a merit-based tenured career Results are shown in Table 4.

Table 3. Determinants of Italian researchers' confidence on their career prospects in Italy and abroad

Logit estimates Variables	Total Odds ratio	R2 Odds ratio	R3 Odds ratio	R4 Odds ratio	Health Odds ratio	Natural Odds ratio	Social Odds ratio
Working abroad	2.019***	2.258**	1.943	4.580**	1.459	1.988	2.417**
Gender: male	1.648**	1.700	1.571	1.318	0.639	4.392***	1.000
Satisfaction for wage and remuneration	2.595**	3.693**	4.752	2.263	4.177	2.400	3.336
Presence of merit-based tenured career	3.533***	3160***	5.777***	2.603**	5.449***	4.390***	2.569***
No. of observations	512	158	223	131	99	227	186
LR chi-square	72.5220	24.6846	40.0334	16.4849	20.8795	49.7582	20.6617
Prob > chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Log likelihood	666.385	218.401	257.693	159.535	133.574	286.612	244.243
Pseudo-R^2	0.1321	0.1446	0.1643	0.1182	0.1901	0.1968	0.1051
Percentage of correctly predicted cases	72.1	71.6	76.7	72.5	75.6	76.0	67.3

Dependent variable: confidence of researcher (values: high or very high = 1; Low or very low = 0).

*Significant at the 90% level;

**significant at 95%;

***significant at 99%.

Table 4. Determinants of career speed of Italian researchers in Italy and abroad

Ordered logit estimates		R2 to R3		R3 to R4			
Variables	Total Odds ratio	R3 Odds ratio	R4 Odds ratio	Health Odds ratio	Natural Odds ratio	Social Odds ratio	Total Odds ratio
Working abroad	5.626***	7.326***	4.260***	6.266***	4.846***	6.810***	2.412**
Gender, male	1.043	0.705	1.949**	0.456	1.327	1.066	1.006
Satisfaction for wage and remuneration	0.429**	0.342**	0.529	1.104	0.290*	0.276**	2.375
Presence of merit-based tenured career	1.189	1.096	1.268	1.825	0.794	1.303	0.475**
No. of observations	354	223	131	60	150	144	131
LR chi-square	65.2452	51.7977	21.4629	14.8636	27.7799	29.2957	11.5511
Prob > chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Log likelihood	1,133.388	710.656	417.082	191.793	473.140	456.521	418.274
Pseudo-R^2	0.1683	0.2073	0.1511	0.2194	0.1691	0.1841	0.0844
Percentage of correctly predicted cases	63.8	67.4	65.0	69.5	66.6	64.0	64.6

Dependent variable: years in each career stage.

*Significant at the 90% level;

**significant at 95%;

***significant at 99%.

First, the speed of passage from researcher to associate professor is considered. Secondly, we investigate the move from associate professor to full professor.

Working abroad is by far the most important factor, significant in all specifications of the model, with very high odds ratios. For all researchers moving from R2 to R3 positions, working abroad is associated with a 5.6 time increase of the probability of faster career than researchers working in Italy. Among those moving from R3 to R4, Italians abroad are 2.4 times more likely to have a faster career than researchers working in Italy. Satisfaction for wages is the only other significant factor for the R2–R3 move. Presence of merit-based tenure is significant for the R3–R4 move only. This shows that subjective opinions about merit-based tenure do not affect the speed of career. In the case of full professors, career speed is slower for those who agree on the presence of a formal tenured merit based

system at their home institution. This indicates that full professors may be aware of bottlenecks preventing career progression and highlight some disillusion based on a long experience of academia. The predictive power of the model lead to 64 and 65 per cent of correctly predicted cases, the goodness of fit LR chi-square is always significant and for the R4 subsample pseudo-R^2 score indicates a small improvement from null model to fitted model. In the different subsamples, we considered for researchers moving from R2 to R3 positions, working abroad is always significant, wage satisfaction is significant in most subgroups, other variables are not relevant. Generally, career progression is very strongly affected by the location—in Italy or abroad (Table 4). The contextual factor of working in countries with larger resources and more dynamic research environments as opposed to Italy appears to discriminate among the career outcomes of researchers much more than any other available

variable. The external conditions shaping the research system emerge as a key factor influencing the speed of career progress.

The combined results of the econometric tests on the confidence on future career prospects and actual career speed provide a consistent and robust picture of the main factors affecting trajectories of Italian researchers in Italy and abroad. The influence of systemic factors associated to working in Italy or abroad emerges as a crucial determinant of career trajectories. In order to further explore the presence of systematic differences, in the next section we provide a comparison of Italian researchers abroad with other foreign researchers working in the same countries.

In order to further assess the relevance of national research systems and institutions where researchers operate, additional analysis was carried out to compare Italian researchers in the four countries where they are more present in the MORE 3 sample, and other foreign researchers in the same countries. The analysis compared a sample of 99 Italian researchers residing in Austria, Switzerland, the Netherlands, and Luxembourg with a sample of 557 other foreign researchers residing in those countries, with the following distribution: Austria (105 cases), Switzerland (214 cases), the Netherlands (110 cases), and Luxembourg (227 cases).

The analysis of researchers' confidence in future career prospect highlights that Italians are more pessimistic (27 per cent lack confidence) than other foreign researchers (20 per cent), with early stage researchers having the most negative views. The negative expectations of Italian researchers are evenly distributed across fields of science.

With regards to the career progression of Italian researchers, there is some descriptive evidence of a more rapid career advancement with respect to other foreign researchers in Austria, Switzerland, the Netherlands, and Luxembourg across the different stages (moves to R2, R3, and R4); the strength of this finding will be assessed in the econometric analysis carried out below.

As in the previous section, models for identifying the determinants of confidence in career prospects and of career speed include the four independent variables, including citizenship (Italian or other foreign origin), gender, satisfaction with wages, and presence of a merit-based tenure career. Italian and other foreign researchers share similar views regarding satisfaction with remuneration; a very large majority agrees that they are well paid or reasonably paid, with similar values for Italians and foreigners (90 and 86 per cent). However, about half—both Italian and foreigners—consider to be

paid worse than colleagues outside academia; Italian early stage researchers have more positive views of their salaries.

This descriptive overview suggests that Italian researchers and other foreign researchers in the same four countries tend to have similar characteristics with some evidence of a faster career progression for Italians. We can now test the determinants of confidence in future career prospects and of actual career speed, replicating the econometric exercise to assess differences between Italian and other foreign researchers. We adopt the same methodology as in previous models. Results are shown in Table 5.

First, we investigate the factors affecting confidence in future career prospects; we find that Italian researchers are not significantly different from other foreign researchers in the same countries, while gender and merit-based tenure emerge as significant explanatory factors of career confidence. The estimate correctly predicts 65 per cent of cases (Table 5, first column).

Secondly, we analyse the determinants of career progression focusing on the move from postdocs to associate professors (R2–R3).[14] Results for the four variables show that no significant difference exists between Italian and other foreign researchers, in spite of some descriptive evidence pointing out faster career path for Italian researchers. Satisfaction for wages is the only significant variable (Table 5, second column).

The goodness of fit and the predictive power of the two logistic regressions about the speed of career of Italian and foreign researchers working in Austria, Switzerland, the Netherlands, and Luxembourg are weaker than the sample of Italian researchers working in Italy and abroad as outlined by the lower predictive scores, LR chi-square and pseudo-R^2 scores.

These tests allow us to state that Italians abroad are similar to other foreign researchers working in the same countries, with some descriptive evidence on a more rapid career advancement. The systemic factors related to the research and university system of the country of work, therefore, emerge as crucial in shaping career trajectories, regardless of nationality. These findings further strengthen the results of the comparison of Italian researchers in Italy and abroad.

8. Discussion

The current study provides novel insights on two different aspects linked to the mobility of Italian researchers.

Table 5. The determinants of confidence in career prospects and of the speed of career of Italian and foreign researchers working in Austria, Switzerland, the Netherlands, and Luxembourg

Logit estimates	Dependent variable: confidence in career prospects (High or very high = 1; Low or very low = 0)	Dependent variable: years in each career stage
Italian citizens	0.696	1.452
Gender, male	1.628**	1.018
Satisfaction for wage and remuneration	1.064	0.519**
Presence of merit-based tenured career	2.561***	1.225
No. of observations	480	292
LR chi2	211.441	78.114
Prob > chi-square	0.00	0.10
Log likelihood	460.328	851.631
Pseudo-R^2	0.0423	0.0264
Pecentage of correctly predicted cases	64.6	55.7

*significant at the 90% level;
**significant at 95%;
***significant at 99%.

First, it builds on data collected through the MORE 3 survey to bring original descriptive statistics regarding Italian researchers' characteristics, perceptions of their working conditions, and of national research systems in Italy and abroad. Data consistently show that Italian researchers in Italy report significantly worse working conditions than Italian researchers abroad, as highlighted by lower levels of permanent contracts in most stages of career progression and across fields of study. In addition, Italian researchers located in Italy perceive their national system as fostering untransparent and non-merit-based recruitment and are generally dissatisfied by their levels of remuneration. They show low levels of confidence in future career prospect. Consequently, lack of professional opportunities and will to improve working conditions are identified as the main reasons why Italian researchers decide to move abroad. When reported by Italian researchers working abroad, transparency of recruitment, satisfaction with remuneration, confidence in future career evolution consistently show higher levels. Similarly, a major and growing gap is emerging between the favourable conditions of Italian researchers working abroad and the difficult condition of those working in Italy. This gap appears to be a major determinant of the decision to emigrate abroad. This provides some justification to the unbalanced and strongly asymmetric flows of researchers observed in Italy since the outbreak of the 2008 crisis, as perceptions of working conditions are significantly worse in Italy than abroad.

In addition, in order to explore the factors associated to confidence on future career prospects and to actual career speed, analyses based on logit and ordered logit models were conducted. Results show that residency abroad is a significant and highly relevant factor. Other relevant variables include gender, presence of merit-based tenure in the home institution and satisfaction with wages. Findings highlight that Italians abroad have a higher confidence in future career prospects and experience a faster career progression than their colleagues in Italy. This goes in line with previous evidence (e.g. Ackers and Gills 2009; Rindicate 2008) showing that mobility is often perceived as a mean to accelerate career advancement.

A second set of regressions highlights no significant difference between Italian researchers and other foreign researchers in Austria, Switzerland, the Netherlands, and Luxembourg regarding their confidence in future career development and career speed. While recent studies show that mobile researchers often outperform non-mobile ones in terms of academic productivity (Franzoni et al. 2014; Geuna 2015), the impossibility to match MORE 3 data to scientometric databases does not allow us to test this hypothesis for the sample used in this study. In this sense, we cannot discard the effect of a self-selection process indicating that mobile researchers perform better that non-mobile ones. These insights, however, are compatible with our identification of a major career bottleneck in Italy as one of the main incentive for emigration and permanence in foreign countries. First, the existence of such a bottleneck regarding career advancement is highlighted by the continuing increase in the average age of university staff (52.6 years old) and of full professors (60 years old) (ANVUR 2018: 387). Secondly, the reduction of public funding in the last decade has had a strong impact on human resources; between 2009 and 2016 in Italian universities, the number of Italian full professors, associate professors, and researchers has fallen by 12,000—a 20 per cent reduction (ANVUR 2016, 2018; Nascia and Pianta 2018). Thirdly, the numbers of highly skilled migrants and researchers moving out of Italy have substantially increased. The emigration of Italian researchers—mainly towards the USA and European countries—can be estimated at 14,000 in the 2008–19 period.

The findings of this article showing that Italian researchers abroad have a faster career progression and are more confident in their future than Italian researchers in Italy can be interpreted both as an incentive to leave Italy temporarily, and for not returning once abroad. Replicating the analysis conducted here for other countries could shed light on whether similar processes can be observed in other EU Member States.

As for Italy, the evidence provided has major implications for the definition of future research and innovation policy. The key factor associated with the large increase in the migration of Italian researchers is the weakening of the country's research and university system (Nascia and Pianta 2018). While little policy action has so far emerged in this field, the evidence emerging from the present research indicates key areas where improvements of Italy's characteristics and performances are needed. In particular, key challenges include:

- an increase in the amount of resources for the research system and for universities that may bring Italy closer to the conditions of the countries of destination of Italian researchers moving abroad;
- a significant increase in the recruitment of university researchers and professors and researchers in public research organisations, so that the reduction due to lack of turnover is reversed, bringing Italy closers to other EU countries in terms of number of researchers;
- an improvement in the remuneration and career prospects of researchers, which could be facilitated by the above actions, again bringing them closer to EU standards; and
- a move towards more merit-based recruitment and career decisions, changing distorted practices of academic power that are discouraging Italian researchers and contributing to their emigration (and lack of return).

In parallel, broader policy and institutional changes could be required to modernise and expand Italy's research and innovation system, as argued in previous work (Nascia and Pianta 2018). Finding appropriate ways to reduce the net outflow and to encourage the return of Italian researchers is a major policy challenge for the Italian government, academia, and research system.

Supplementary data

Supplementary data is available at *Science and Public Policy* online.

Funding

Notes

1. This article builds on a research project prepared for the European Commission-Joint Research Centre on the migration of Italian researchers.
2. The six ERA priorities are: (1) more effective national research systems; (2) optimal transnational cooperation and competition, including 'jointly addressing grand challenges' and 'research infrastructures'; (3) an open labor market for researchers; (4) gender equality and gender mainstreaming in

research; (5) optimal circulation, access to and transfer of scientific knowledge, including 'knowledge circulation' and 'open access'; (6) international cooperation (EC 2012).

3. ANVUR stands for the Italian State Agency for Evaluation of Universities and Research.

4. Data about migrations come from an Istat survey conducted on a yearly basis on the population register. It is a census based on administrative data coming from municipalities and it provides information about foreign and domestic mobility patterns of the resident population in Italy. See (ISTAT 2017: 18–20) for the detailed methodology.

5. The survey on university doctorate holders' vocational integration is a census conducted every four years. The survey is based on a Computer Assisted Web Interviewing method and investigates on the labour situation of PhD graduates after 4 and 6 years from the diploma. The target population are the cohorts of PhD graduates, respectively, 4 or 6 years before the survey, around 22,000 PhD holders. Data are available from 2009. See https://www.istat.it/it/archivio/234817 for methodological details.

6. See IDEA Consult, WIFO and Technopolis (2017) for complete methodological details of the survey. The target population are the researchers in HEIs, according the Frascati manual definition. The MORE 3 team set up a list of around 31,000 faculties or departments for thirty-one countries built from the official national registers and sampled researchers through a web-based search in all the selected HEI. The questionnaire sent to the sample included the definition of researchers as individuals 'carrying out research or supervising research or improving or developing new products/processes/services or supervising the improvement or development of new products/processes/services'. For most countries (including Italy), the MORE sample is representative at country level and the sampling design has an accuracy at country level of 5 per cent (confidence interval 95%) according the finite population sampling formulation. The sampling strategy relied on a proxy frame of the HE research staff in each EU country and drawn a sample at random for each country. The sampling is based on headcount totals without distinction for part time and full time contracts and fixed and permanent positions.

7. This definition of career levels is based on the model defined in the European Commission communication 'Towards a European Framework for Research Careers' (European Commission 2011: 2), and identifies the following broad profiles: R1—first stage researcher; R2—recognized researcher; R3—established researcher; R4—leading researcher. As the sample of researchers we consider here is active in HEIs only, we will refer in the text to the four groups considering the largest category in each of them: R1—PhD students; R2—Post-docs and junior researchers; R3—Associate Professors; R4—full professors.

8. The sample of Italian researchers in Italy is close to the accuracy of the original MORE 3 survey. Italian researchers abroad, as well other researchers working abroad considered in the comparison, cannot be statistically representative as no information is available on the actual population of researchers abroad.

9. Switzerland, Austria, Luxembourg, the Netherlands, UK, Sweden, Belgium, Denmark, France, and Ireland, in decreasing order according to numbers of Italian researchers.

10. The information about recruitment and career progression refers to selection processes and career advancement conditions within the work institution of each researcher.

11. The MORE 3 survey includes four categories: 'lack of confidence' and 'very much lack of confidence' are grouped here in 'low confidence'; 'somewhat confident'; or 'very confident' are grouped here in 'high confidence'.

12. The Pseudo-R^2 highlights some improvement from null model to fitted model, as does the Nagelkerke based on an adjustment of the Cox and Snell one, as its values are always above 10 per cent.

13. The five categories of career speed are defined as follows.
    For the progression from R2 to R3: 5-very fast (0–2 years); 4-fast (3–4 years); 3-average (5–7 years); 2-slow (8–10 years); 1-very slow (more than 11 years).
    For the progression from R3 to R4: 5-very fast (0–3 years); 4-fast (4–5 years); 3-average (6–7 years); 2-slow (8–11 years); 1-very slow (more than 12 years).
    We have grouped the above categories on the basis of the quintiles of the distribution of the variables. We have obtained similar results to the ones for MORE 3 data for Italy's researchers where the average period required for the passage from R2 to R3 is 7.85 years, and the one from R3 to R4 is 8.59 years (IDEA Consult, WIFO and Technopolis, 2017: 337).

14. Career moves from R3 to R4 include a smaller number of observations, results are not significant and are not reported here.

Acknowledgements

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