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MOBILITY AND MIGRATION OF RESEARCHERS –
A STUDY BASED ON THE ITALIAN PUBLIC RESEARCH SYSTEM

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Abstract

In the last decades, in some countries - such as Italy - the migration of highly skilled personnel, scientists and researchers present strong one-way flows.

Some analysts and commentators argue that this raises new challenges for the sustainability of the national research and innovation system. This scenario was broadly investigated in 2018 by (Italian National Statistics Institute) by an annual survey on migration in Italy. Unfortunately, the data collected by ISTAT does not specifically examine the migration of highly qualified researchers.

For the reasons mentioned above, in this work, we want to evaluate the impact of the migration of highly qualified personnel in the research infrastructures from a personal point of view.

To do so, we conducted a semi-structured set of interviews to highlight the key motivation that drove the Italian and foreign researchers in their mobility choices.

Then we set a protocol used to conduct the interview. We carefully designed six profiles of researchers that we considered fundamental to be interviewed, and we have identified four macro-topic that must be discussed during the interviews.

The interviews were conducted during the COVID's pandemic, but this does not affect the collected results.

To summarise, the researchers gave high relevance to personal dynamics and cultural issues unrelated to the work environment and their scientific productivity.

The result presented in this work allows us to stress that conducting an investigation in the researchers' mobility field of study, based only on quantitative analysis, is not sufficient, even if necessary, to have a complete overview of the problem.

Introduction

In some countries, such as Italy, the migration of highly skilled personnel, scientists and researchers, presented strong one-way flows in the last decades.

Some analysts and commentators argue that this raises new challenges for the sustainability of the national research and innovation system.

For example, Bergamante and Vecchione (2017) pointed out the lack of bidirectionality of human capital flows concerning Italy. There are few inflows from abroad, and outflows are not reversible in many cases.

Moreover, they reported an increasing volume of migration flows that shows no sign of scaling down. Similarly, another study 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, p.209).

The scenario mentioned above was broadly investigated for several years by ISTAT (Italian National Statistics Institute) with their annual surveys on Italian PhD mobility.

Moreover, the recent data collected on migrations shows that in 2017 the total volume of people migrating to foreign countries was 155 thousand units.

Among these, the emigration of Italian citizens is 74% of the total (114.559 units).

Let's consider the number of repatriations (registries from abroad of Italian citizens), equal to 42.369. The calculation of the migration balance with foreign countries gives us a negative value of 72,190 units.

The emigration rate of Italian citizens (number of registry cancellations of Italians on average resident population, per thousand) is equal to 1.9 per thousand.

The ranking of emigrant PhD citizens does not change concerning what was observed in the previous edition of the survey. It remains unchanged if gathered by gender or by year of doctorate. At the same time, it varies according to the disciplinary area: Belgium is the first destination for PhD in legal studies, Germany for PhD in the philological-literary and historical-artistic antiquity sciences and France for PhD in physical sciences.

The reasons that led doctors to leave Italy are mainly linked to the possibility of finding a job, be it generic (90.9%) or more qualified (88.2%) or better paid (86.2%).

Despite the higher rate of fixed-term work abroad, those employed outside the national borders express themselves more optimistically than their colleagues who work in Italy for job stability, suggesting the presence of more favourable conditions for the renewal of employment.

Unfortunately, the data collected by ISTAT does not specifically investigate the migration of highly qualified researchers.

As mentioned earlier, in this work, we want to evaluate the impact of the migration of highly qualified personnel in the research infrastructures. In particular, we like to understand which are the more relevant components perceived by the involved researchers.

To do so, we conducted a semi-structured set of interviews to highlight the key motivation that drove the Italian and foreign researchers in their mobility choices.

It was needed to set up a precise research methodology path. We first have identified an Italian research institution that can expose the characteristics required for this study.

We set a protocol used to conduct the interview. We have identified four macro-topics that must be discussed during the interviews.

By a dense emails' correspondence between the research institute's director and us, we have finally mapped the desired profiles with the real employees (the selection was made by considering all the available present and past personnel).

The interviews were conducted during the COVID's pandemic, but fortunately, this does not affect the collected results.

Analysing what has emerged from the interviews, we can say that all the subjects recognise the influence of the mobility of the researchers on scientific activities.

Mobility is credited as an internal process of a researcher's career apt to develop knowledge (Dosi et al. 2005) and scientific's competencies.

Both short-term and long-term mobility affect scientific production, and they ease the development of an active international scientific network that affects both countries involved.

Start a collaboration, a project or a discussion and meetings in person is necessary.

All the interviewee has confirmed the perception that an international experience is essential for career advancement. As Ackers and Gills (2008) described, this attitude increases the propensity for mobility in this sector.

To summarise, the researchers highly valued personal dynamics and cultural issues not strictly related to the work environment and their scientific productivity.

The result presented in this work stresses that conducting an investigation in the researchers' mobility field of study, based only on quantitative analysis, is not sufficient, even if necessary, to have a complete overview of the problem.

Chapter 1 – Overview of the phenomenon

Background knowledge

The mobility and migration of researchers in Europe raised increasing attention in recent years. They produced short and long-term consequences by reshaping the science and technology landscape, transferring human capabilities among countries, and affecting major Research and Innovation (R&I) activities.

Voluntary high mobility of researchers can improve the quality of research and promote better integration within the E.U. The ERA recommended aims to achieve an "*Optimal circulation and transfer of scientific knowledge*".

On the other hand, the movement of researchers is characterised by increasingly asymmetric patterns of mobility. Some E.U. countries suffer large outflows of highly skilled personnel, thus opening the risk of increasing polarisation of R&I systems in Europe.

Thus, several perspectives and analyses approaches can be assumed to better address, understand and evaluate the impact of the mobility and migration of researchers in the E.U.

We like to remark that the focus of our project is on Italy, and specific attention will be devoted to the Italian case. Moreover, the specificity of research disciplines is important, and a breakdown between Humanities and Social Sciences, Natural sciences and engineering, and Health Sciences is essential to understand the diversity of institutional settings, research opportunities, funding availability, career trajectories, academia-industry relationships that contribute shaping the direction of mobility and migrations of researchers.

For the reasons mentioned above, first, we will present the main approaches and perspectives present in the literature used to analyse the mobility and migration of researchers. Secondly, we will deliver the fundamental concepts and the relevant literature and studies needed to overview the Italian research and innovation infrastructure.

1.1 Approaches used to analyse the mobility and migration of researchers

The mobility and migration of researchers can be analysed from several analysis approaches and perspectives. To better understand and study the highlighted issue, we summarise existing literature by highlighting the most relevant ones.

Development of knowledge

The mobility and migration of researchers can be seen from the overall development of knowledge, learning processes and operation of the higher education system. Considering the dual nature of knowledge – tacit and codified – the mobility of researchers and highly skilled personnel is an important component of the transmission and diffusion of knowledge and capabilities across countries, research disciplines, fields of application, and academia and industry. Several case studies on the development and distribution of specific technologies have pointed out the importance of such mobility and the migration of highly skilled workers, and the benefits generally obtained by the receiving country.

In particular, a large literature in the scientific and technological field of studies in conjunction with sociology has highlighted the impact of mobility of researchers on scientific activities.

During the sixties, the human capital theory diffusion stressed the role of education and training related to economic development (Schultz 1961, 1963), underlining the importance of tacit knowledge.

Dosi et al. (2005) stressed that scientific and technological information and knowledge include specific characteristics of public goods as "*non-rival access...low marginal cost of reproduction and distribution....a fundamental uncertainty concerning the mapping between whatever one expects from search activities and their outcomes...*".

The degree of tacitness is embedded both in the pre-existing knowledge and in the knowledge used to interpret and apply any codified information. Those properties explain why the mobility of researchers and highly skilled personnel is a key variable for the dissemination of the knowledge across states, research areas, fields of application, as well as between the academia and the industry and as such stands as one of the crucial elements involved in the development of knowledge.

Mahroum (2000) addressed the physical mobility of scientists as a key element in the scientific development and the development of scientific hubs since mobility contributes to the credibility of the most attractive 'centres of scientific gravity' institutions and impacts the host countries' economic performance.

According to Mahroum, scientific knowledge is related to the geographical area where it has been developed, and its spreading abroad is linked to "*physical mobility*".

The approach of Mahroum is based on a core-periphery pattern where the centre of gravity countries reaches a high concentration of knowledge and high talents in science. Periphery countries, the source, suffer the process since they cannot provide financial incentives like bigger countries.

According to this model, science falls under a pattern far to be distributed made of concentrations in most prosperous countries at the expense of less developed countries.

This phenomenon leads to the natural establishment of Scientific poles, which are rich in resources and scholars and inevitably attract researchers from all over the world, enhancing the research and innovation system of the receiving country.

Mahroum stressed that physical mobility is essential for scientific growth because scientists need to expand their reputation and communicate their findings among peers to get closer to "mainstream" science. In this way, they tend to create closed groups or hubs of peers.

Ackers and Gill (2009) stressed the role of virtual mobility that, especially with digitalisation, could replace or augment physical mobility. They outlined that mobility based on long term living abroad is not the most common and not necessarily the most effective approach. ICT and science policies can address mobility schemes, scientists' immigration procedures, distribution of tangible assets and address issues related to the openness to the wide scientific community.

Moreover, as Zubieta et al. (2015) discussed, mobility in the current progressing research and innovation system includes both short-term and long-term exchanges in all their dimensions: internationalisation, increasing collaboration between different sectors, and diversification of work roles.

Brain drain phenomenon and the economic growth

Economic theories have long investigated the role of migration of highly qualified personnel in economic growth, with a special focus on developing countries. The concept of 'brain drain' has defined the ambivalent situation where a country educates (with substantial efforts) groups of citizens who may obtain better wages and career prospects abroad and leave the country. This perspective highlights the role of highly skilled labour and human capital in the development process its

complementarities with capital accumulation, technology adoption and use. In the context of major knowledge gaps between countries, a one-way flow may weaken the economy of the poorer nation, losing its skilled personnel after the investment made for their training; this may create serious bottlenecks in the development process. Conversely, the richer country receiving highly qualified personnel benefits from their competencies without paying for their training.

Studies in this field started long ago. The term "brain drain" was used for the first time during the early 60th for the massive migration of scientists from the U.K. to the USA to indicate a one way flow of researchers from the source to the host country. The semantic of brain drain suggests one-sided and essentially lasting flows of human capital from one country to another, which seems to affect the smaller countries and the countries that cannot implement effective policies for their R&D system. Harry Johnson proposed a first interpretation in 1968 debating on "*the economics of brain drain*", implying a substantial economic loss related to the issue for those who decided to stay in the home country. Other authors such as Boulding (1968) discussed the threat of migrations, especially in developing or economically fragile countries.

However, the scholars' debate evolved towards interpretations stressing the complexity of the migration of researchers and criticised the limitations of a mere "zero-sum game" to understand migrations. Thus, a large part of the academic literature acknowledges the benefits from brain circulation and the positive returns for source countries.

Thus, Bhagwati and Hamada (1974) pointed out that all the theoretical literature analysing the effects of the "brain drain" has been carried out within the neoclassical Hicks-Samuelson theory. However, the reality is much more complex, and they looked at the brain drain like a negative externality. In another study, Bhagwati (1979) proposed a supplementary income tax policy on the migration of a highly-skilled workforce to compensate the source country for the negative externalities. The study of Ackers (2008) introduced the concept of brain circulation. Their investigation on mobility's patterns showed an increase of short-term exchanges preceding extended mobility experiences and returns to the home country. They observed that even the scientists who seemed more established in the host country spent several short visits in their native country enhancing associated collaborations and knowledge transfer in both directions.

Beine et al. (2001, 2008) investigated in depth the link between brain drain and economic growth in developing countries. They analysed brain drain within the endogenous growth pattern, based on the case of a small open economy model. They estimated the impact on the growth in the source country, focusing on two consequences: the brain effect, potentially positive for the development, and the

drain effect, detrimental for the source country. They showed some cases where a beneficial brain drain in the source country is most likely to happen. They suggested some caution about the policy implications since the impact of migration is not always negative for growth.

Cañibano et al. (2017) left the traditional neoclassical "allocative approach" that assessed researcher mobility under the assumption that the productive system uses efficiently human capital. They explored a '*connective approach*' within the evolutionary economics framework and a "creative approach", which considers changes of contexts as inherent to creating the conditions for knowledge recombination. Their empirical work based on MORE2 data, an E.U. survey on researchers' mobility, explored how new interpretations could better understand researchers' mobility. Cañibano argued about the limitations of the mobility survey and suggested researching big data sources, like CV and bibliometric databases, to shift towards an interpretation that could catch the creativity and the connectivity notions.

However, although the literature about the migration of scientists has overcome the term of one way brain drain, in countries like Italy, the migration of highly skilled personnel, scientists and researchers is still a real challenge for the sustainability of the national research and innovation system.

Bergamante and Vecchione (2017) discussed two key issues about the migration of human capital: they pointed out the lack of bidirectionality of the human capital flows (flows seem to go only in one direction), and they demonstrated that there aren't significant inflows from abroad.

Although it is more appropriate to talk of "brain circulation" or "brain exchange" as noted by Morano-Foadi, 2006 "The fact that emigrating scientists maintain contacts with their country of origin does not suffice as proof that there is no brain drain occurring...."

Researchers' careers

Other studies are focused solely on the growth aspects of the researchers. Thus these studies analyse the education, training, professional growth, career steps (either in academia or in the industry), the wages obtained, position of responsibility and power of the considered researchers. These issues are related to the specific area of activity – university or business, research discipline, etc. – to the countries involved, with different institutional setups, varying opportunities for employment and advancement, specific with rules for recruitment and careers. This approach emphasises the subjective perspective of the researcher preferences, choices and degree of success, satisfaction and

fulfilment. The context of the country and research environment where s/he operates is investigated mainly by considering the emergent opportunities and networks.

The debate of mobility on the impact on researchers' careers is still vivid and has not reached a definitive position yet.

Geuna (2015) included detailed studies of the mobility of researchers from the viewpoint of their careers in different frameworks. Lepori et al. (2015) consider mobility as a human resources' allocation tool in international markets.

The review in Wooley et al. (2016) showed how the institutionalist school and the human capital school documented researchers' migration in a context where collaboration plays a key role in mobile researchers' careers and productivity.

Ackers and Gills (2008) explain how mobility in science careers is enhanced by perceiving that an '*international experience*' is fundamentally needed for career advancement.

In their view, mobility exposes scientists to new ideas and work styles and expedites knowledge transfer. This process is so deeply related to their profession that they are called "knowledge" migrants.

Ackers and Gills (2008) explain how mobility in science careers is enhanced by perceiving that an 'international experience' is fundamentally needed for career advancement.

In their view, mobility exposes scientists to new ideas and work styles and expedites knowledge transfer. This process is so deeply related to their profession that they are called "knowledge" migrants. However, a study by Cruz-Castro and Sanz-Menendez (2011) did not find any positive influence on careers from mobility.

Moreover, for researchers' career progression, gaining an adequate number of international experiences is mandatory, despite the dissimilarities between different disciplines (Mahroum 1998) and various national contexts (Ackers 2005). The MORE2 and MORE3 projects (IDEA Consult, 2013, 2017) explore these issues with an original survey. Other contributions include Barré et al. (2003), Stephan et al. (2016), Cañibano et al. (2017). A bibliometric approach to mapping the researcher's mobility and careers is used in Moed et al. (2013) and Moed and Halevi (2014).

Moed approached the use of bibliometric data to study international scientific migration by studying researchers' migration trends between ten scientifically developing countries and seven developed countries. The study documented how author affiliation databases are a reliable source of information in studies on international scientific migration.

Scientific output, research performance productivity, impact, quality, criteria for excellence

Studies have explored the scientific networks in particular fields identified by citation patterns, identifying the diffusion of ideas and the changing boundaries of research areas. This approach has also led to efforts to assess the impact and quality of research, considering individuals, research institutions, disciplines and countries. The attempt based on individual researchers can be extended by investigating their scientific and technological output – generally using bibliometric and patent data.

These issues, often connected with career issues, are addressed in chapters in Geuna (2015) and Breschi et al. (2014).

Breschi et al. (2014) found that in several European countries, foreign inventors rank high in terms of productivity.

Baruffaldi and Landoni (2012) investigated return mobility and the scientific productivity of researchers. They estimated a positive relationship between scientific productivity, linkages in the source country and researchers in the host country. Connections provide benefits for both countries to sum up with the indirect advantage of expanding their scientific networks.

Franzoni et al. (2014) estimated higher productivity, calculated on the impact factor of focal publications, for mobile researchers outperforming their domestic colleagues. However, they don't find any career benefits for the outperforming mobile researchers.

Canibano et al. (2008) found out that international mobility improves access to international funding and networks but does not improve the publication or patenting performance.

Researchers and industry, patenting, hiring of researchers by business

Patenting outputs are a major result of R&D activities, with major differences across disciplines, technology, and business strategies. A subset of studies on researchers' careers has focused on researchers moving into industry and working on technological developments rather than scientific research. Academia-industry interaction and how researchers operate in a business environment are important aspects relevant to this approach.

Breschi et al. (2014) have used patent data to document researchers' migration, and Breschi focused on empirical studies based on patent and inventor data. Although with some limitations due to the

reliability of the measurement, the analysis of the European patent Office database showed some evidence about the positive impact of immigrant inventors on innovation not in the U.S. and selected European countries. Moreover, the industry role is addressed by various more general studies cited above.

The OECD reports (OECD, 2013a, 2013b, 2015, 2017) focus on the effects of mobility for the industry and the academia, with special attention on the linkages and the interaction between the universities and firms.

Chapter 2 – A quantitative outline

2.1 - Migration of researchers considering the Italian research and innovation system

The core of the present research relates to the mobility and migration of researchers in the Italian Research and Innovation (R&I) system. In this perspective, the education and training of researchers are seen as a major activity of a country's university system. Two-way mobility of researchers and the connections among research institutions of different countries allowed by researchers' mobility are seen as important channels for transmitting and developing knowledge. When one-way migration becomes dominant over the two-way mobility of researchers, the consequences on the National Research and Innovation system of the country of origin may be serious. A key factor here is the complementarity or the possible mismatch between the 'supply' of researchers and the 'demand' expressed by the national system, including a country's overall R&D activities, the organisation and recruitment of research institutions and universities.

This scenario may include a loss of competencies and complementarities, scientific and technological activities, output and productivity, an overall weakening of the national system.

The OECD reports provide basic information on the migration issue (OECD, 2013a, 2013b, 2015, 2017), setting the context of the R&I system and pointing out the relevance of researchers' migration. The concentration of researchers is documented by Wende (2015).

In the case of Italy, an overview of problems can be found in Nascia et al. (2016, 2017, 2018). Evidence can be drawn from the ISTAT survey on PhD holders (Istat, 2018) and Gill (2005) focusing on reverse migration.

Morano-Foadi (2006) discussed how the migration of scientists is a challenge for the long-term sustainability of the indigenous research system. The migration of scientists is one way only since

Italy does not attract many international students either, and as underlined by Hansen (2003), it cannot attract foreign scientists.

Morano-Foadi stressed how Italy is dealing with a negative situation similar to that of some developing countries in attracting highly skilled migrants and returnees. The lack of public funding, the opaque recruitment system of the universities, nepotism and bureaucracy has turned the Italian research system unattractive. According to the discussion of Morano-Foadi, the Italian research system needs major reform and an increase of funding to prevent the increasing outflows of scientists abroad.

ON the other side Hart (2007) and Teitelbaum (2014) discussed the reverse dimension from the perspective of a receiving country.

Hurt (2007) argued on the limitations of an approach based on flows of researchers like input into the innovation process. A framework based on the system of innovation notion can shed light on the dynamics and the understanding of the mobility of researchers. Moreover, according to Hurt, it is not guaranteed that the innovation systems can capitalise on the differences between immigrants and native-born to increase the innovation output in host countries.

A major problem for Italy's high skill human resources is the growing emigration of graduates and researchers. The ISTAT survey on doctorates showed that PhD holders living abroad have doubled from 2009 to 2014, reaching 12.9% (ISTAT, 2015).

ISTAT data on migrations show that in 2016 81,184 Italian citizens above 24 years of age migrated abroad, of which 24,678 had a university degree (+9% over the previous year); the share of graduates among migrants is 30%, a value far higher than the ratio of graduates in Italy's labour force (ISTAT, 2017).

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).

According to the OECD database, from 2002 to 2016, nearly 11,000 researchers migrated from Italy, the highest number in E.U. countries (out of around 35,000 moving out of a country in the whole E.U.).

Moreover, the policies carried out by the E.U. and national governments play a major role in shaping the context, the opportunities and the incentives for the mobility and migration of researchers. Again, policies have been developed with various goals that reflect the approaches listed above. For instance, the perspectives outlined in points 1 and 3 above shape the European Research Area, ERA, that aims to build an open labour market for researchers: 'Facilitating mobility, supporting training and ensuring

attractive careers' is one of its five priorities. Conversely, national policies may favour the two-way mobility of researchers or attract the country's highly qualified scholars and scientists living abroad with attempts to reverse the 'brain drain'.

Overview of the migration of Italian PhD

We can have an idea of the trajectories and motivation of the migration of the Italian students by ISTAT (Italian Institute of Statistics) 's annual surveys on PhD holders.

Like any year, in late 2018, ISTAT (Italian National Statistics Institute) led its annual survey on migration in Italy. The analysed data are those on students who got their PhD degrees between 2012 and 2014.

From the data exposed, we can see that in 2017 the total volume of personnel migrating to foreign countries was 155 thousand units. This number is lower by 1.2% compared to 2016.

Among these, the emigration of Italian citizens is 74% of the total (114.559 units).

Let's consider the number of repatriations (registries from abroad of Italian citizens), equal to 42.369. The calculation of the migration balance with foreign countries gives us a negative value of 72,190 units.

The emigration rate of Italian citizens (number of registry cancellations of Italians on average resident population, per thousand) is equal to 1.9 per thousand.

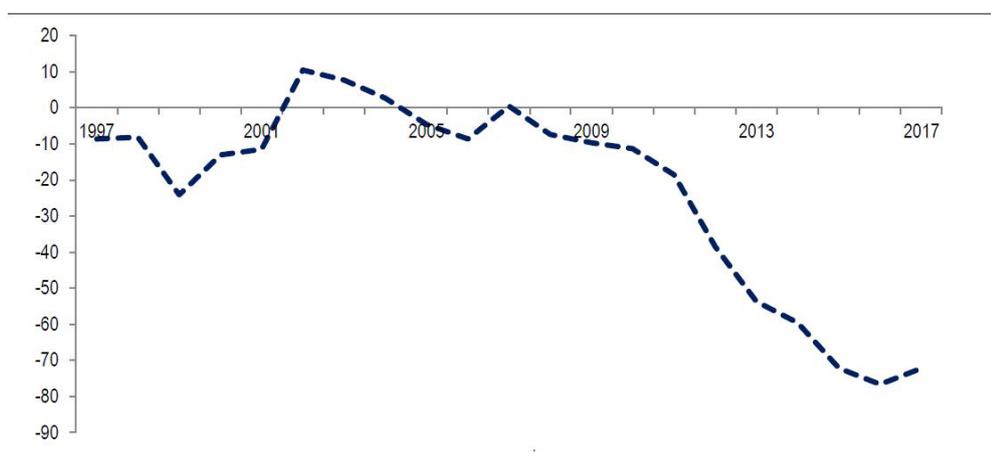
Looking at the analysis of historical data, we can see that in 1997-2010 Italians who transferred their residence abroad were 583 thousand against 497 thousand repatriations, with a negative balance of 86 thousand units.

From 2011 to 2017, there is a sharp rise in emigration, by 2015, well exceeding 100,000 units while repatriations maintain the levels of previous years, around 33,000 a year.

Consequently, the migratory balances abroad of Italian citizens register the lowest values of the last twenty years.

ITALIAN MIGRATORY BALANCE

1997-2017, values in thousands



Looking closely at the results, we can appreciate the composition of the migration abroad:

- 55,8% of the expatriates are male;
- Italian migrants' average age is 33 for men and 30 for women;
- one in five is less than 20 years old;
- two out of three are between the ages of 20 and 49.

Expatriates aged 25 and over are 82 thousand and 31 thousand repatriated in the same age group: their foreign migration balance is negative for over 51 thousand units, of which 13 thousand are universities graduates (26.2%) and 19 thousand high-school graduates (36.7%). The cumulative migratory balances from 2013 to 2017, calculated for the over 24-year-old emigrants, show a net loss of the Italian population of that age group of about 244 thousand units, of which 64% have a medium-high degree.

In 2017, more than half of Italian citizens moving abroad (52.6%) own a medium-high qualification: they are around 33 thousand high-school graduates and 28 thousand universities graduates, with an increase from 2016 of about +4%.

Compared to the previous year the number of emigrated high-school graduates is substantially stable while universities' graduates show a slight increase (+ 3.9%).

However, the increase is much more substantial if the temporal spectrum is widened: compared to 2013, graduated emigrants increase by 32.9% and graduates by 41.8%.

Motivations that push young migrants to leave Italy are attributed in part to the negative trend of the Italian labour market and, in part, to the new perspective of globalisation.

This situation leads the most qualified young people to invest their talent in foreign countries in which career and pay opportunities are greater.

Within this sample is our interest in understanding what happens to the PhD holders, as these are more likely to become researchers.

The recent survey on PhD graduates (Istat, 2018a), conducted in 2018 on the individuals that have achieved the title in the years 2012 and 2014 (11,459 and 10,639 respectively), allows shedding light on their work placement paths and the possibility offered to development and innovation in our country.

The study aims to observe their characteristics, opinions on the completed study path and the employment results at six and four years from the title.

PhD holders, in 2014, were 1.1 per thousand individuals aged 25-34.

This figure, which summarises a country's ability to provide potential future workers with the skills necessary to carry out high-level research, highlights that Italy's situation is slightly behind the E.U. average (1.3 per thousand), worse than France (1.2 per thousand), but better than Spain (1 per thousand). Denmark and Germany have the largest annual flow (2.3 per thousand).

In 2018, six years after obtaining their PhD, 93.8% of PhDs worked, 4.6% were looking for a job, while 1.6% did not work and were not looking for work. After just four years from graduation, 93.8% work, 5% are looking for work, and 1.3% are not working or searching for a job.

One out of ten works as a university professor or researcher (40% at the same university where they got their PhD); among those living abroad, the same ratio is one out of four.

During their training, the percentage of PhD holders going outside Italy for a certain study period is increasing: 44.6% for doctors 2014, 27.9% for doctors 2004. The more attractive countries are the United States (18.2%), the United Kingdom (15.5%) and Germany (11.1%).

The PhDs holders considered (years 2012 and 2014) who live abroad at the interview are 17.2%.

Those who have experienced periods abroad during their doctoral studies are more willing to stay abroad, especially men while considering the studies' areas; those with a degree in physics, mathematics, and computer sciences have greater mobility experience.

Training abroad during the PhD years is an important and recognised element to strengthen the integration of the Italian research system in the international context through international doctorates.

In 2014 44.6% of PhD holders experienced periods of study outside of Italy, a sharp increase compared to the 27.9% recorded for the previously analysed cohort (2004).

The number of doctoral dissertations written in a language other than Italian is growing steadily.

The percentage increased from 39.2% of doctors in 2012 (38.4% in English) to 48.3% in 2014, witnessing a growing internationalisation path.

The most attractive countries abroad for doctors who have taken part in doctoral studies in 2014 are the United States (18.2%), the United Kingdom (15.5%), France (13.5%) and Germany (11, 1%)

Looking at the occupational ratio, we can state that in 2018, six years after graduation, 93.8% of PhD holders of 2012 work, while 4.6% are looking for employment.

The survey also considered those who are engaged in activities supported by scholarships or research grants to investigate the employment status of PhD graduates. These activities represent the beginning of a research career for the analysed sample. They are considered a form of employment for 14% of PhD holders of 2012, a percentage downward compared to PhD holders of 2008 (17.1%).

Six years after graduation, 10.2% of 2012 PhD holders work as professors or researchers at the University (40% at the same university where they received the title). In addition to this percentage, 4% of employees are employed as researchers in public Research Performing Organisations (RPO) and 78.7% as high profile management. The residual portion (7.2%) mainly carries out office work or a technical profession.

The job opportunities in university, as researchers, are higher for men (13.4% vs 7.2%) and for those who have a doctorate in the area of Economics and Statistics (20.7%) or Mathematics and I.T. (19.7%).

For those who live abroad, the percentage of those who work as professors or researchers at the university reaches 25.9%.

Six years after the title, PhD holders who work in Italy receive a median monthly net income of 1,789 euros (1,750 euros reported by doctors in 2008).

PhD holders who live and work abroad earn almost 1,000 euros more than those living in the Centre-North of Italy, who receive salaries 200 euros higher than those who live in the South of Italy or on the islands.

Italians PhD holders employed after six years from PHD degree divided by the area of employ, median monthly net income and geographical distribution						
		<i>Professors or researchers at the University</i>	<i>Researchers in RPO</i>	<i>High profile management</i>	<i>Other</i>	<i>Median monthly net income</i>
Italy	North-west	8.9	2.1	82.2	6.8	EUR 1,798.00
	North-east	7.8	2.5	80.5	9.3	EUR 1,727.00
	Center	5.9	4.9	80.3	8.9	EUR 1,733.00
	South	6.8	3.2	82.6	7.4	EUR 1,571.00
	Islands	5.5	4.7	82.5	7.4	EUR 1,579.00
Italy average		6.98	3.48	81.62	7.96	EUR 1,681.60
Foreign countries		25.9	7	64.4	2.8	EUR 2,700.00

After graduation, an increasing number of PhDs goes abroad; 17.2% of PhD holders declare that they normally live abroad at the interview (15.9% of doctors 2012 and 18.5% of doctors 2014), 4.3 percentage points higher than the one registered in the previous survey.

However, one-third of this sample comprises individuals who lived abroad even before starting university studies: the PhD in an Italian university represented only a passage in our country.

Looking only to the 2012 and 2014 PhD holders in Italy before starting university, the share of those who consistently live abroad in 2018 stands at 12.5% (11.8% in the previous survey).

People from the north of Italy tend to move mostly to foreign countries (14.9% for PhD holders in the North-West and 16.9% for those in the North-east).

People from the South migrate mainly within national boundaries, towards the Centre (16% of doctors in the South and 8.7% of those in the Islands) and the North-west (8.6% of doctors in the South and 9.6% of those in the Islands).

The PhD holders from the Centre of Italy are equally interested in migrations abroad (11.2%) and within the country (11%), the latter almost exclusively towards the Northern areas.

PhD holders who lived in the border regions of Friuli-Venezia Giulia and Trentino-Alto Adige show the highest tendencies to travel abroad: shares exceeding 20% for PhD holders from Friuli Venezia Giulia and 18.8% for those of Trentino-Alto Adige.

Looking at the socio-demographic characteristics and the PhD holders' curriculum, it emerges that men have a greater predisposition to go abroad than women (15.1% against 10.2%).

Also, who has achieved the doctorate at a young age (under 32 years) and comes from families with a high level of education. At least one of the two parents has been awarded a university degree moves more, both abroad and among the Italian regions.

Research doctors from Physics (31.9%), Mathematics and Computer Science migrate abroad more frequently.

The countries that most attract Italian PhDs are the United Kingdom (a nation chosen by 21.2% of the sample), the United States of America (14%), Germany (11.7%) and France (11.2%).

The ranking does not change with respect to what was observed in the previous editions of the survey and remains unchanged if gathered by gender or by year of doctorate. At the same time, it varies according to the disciplinary area: Belgium is the first destination for PhD in legal studies, Germany for PhD in the philological-literary and historical-artistic antiquity sciences and France for PhD in physical sciences.

The rate of PhDs holders who have spent time in another country during the doctorate and are still living abroad at the interview is double the average (21.1% against 12.5%).

The reasons that led doctors to leave Italy are mainly linked to the possibility of finding a job, be it generic (90.9%) or more qualified (88.2%) or better paid (86.2%).

Considering what the interviewed claimed, it appears that abroad the PhD title is more considered: more than 67% of respondents believe that the PhD is a title expressly required to access work abroad. At the same time, the same percentage is halved for who is employed in Italy (34%).

Questioned about the quality of the work carried out, those employed abroad systematically expressed satisfaction levels higher about all aspects of their work.

The greater distances between the two groups (those who work abroad and those who work in Italy) concern the possibility of professional enrichment offered by their employers and economic treatment.

Levels of satisfaction for the degree of autonomy are more aligned.

Despite the higher rate of fixed-term work abroad, those employed outside the national borders express themselves more optimistically than their colleagues who work in Italy for job stability, suggesting the presence of more favourable conditions for the renewal of employment.

Chapter 3 - A qualitative approach

3.1. Research methodology

The reviewed analysis, and the data analysis that we gathered examining the MORE projects and the ISTAT's surveys, stresses that Italy seems to be a country where highly skilled personnel, scientists, and researchers' migration presents strong one-way flows.

Some analysts and commentators argue that this raises new challenges for the sustainability of the national research and innovation system.

This work aims to verify and analyse the scenario from the quantitative analysis, using a practical case study.

In particular, we like to understand the more subjective relevant components perceived by the involved researchers.

In this section, first of all, we provide an overview of the involved institutions.

Then we present the research methodology that we have chosen to follow:

We describe the specific methodology used to conduct the interviews, then explain the global strategy, provide the details that drove us the design of these particular profiles, and highlight the four identified macro-topic (from now on named just "topics") touched during the interviews.

Lastly, we present the selected participants with a detailed description, providing a mapping to the originally designed profiles.

Overview of the Involved Institutions

The chosen organisation is the Institute for photonics and nanotechnologies (IFN) of the National Research Council of Italy (CNR), the main Italian Research Performing Organisation (RPO).

The IFN institute has been chosen because "*Physics*" emerged as one of the areas more affected by researchers' mobility (ISTAT, MORE3 data).

It has also been chosen because its branches are located in different Italian territories (Milan, Lecco, Como, Bari, Rome, Trento, Padua). Its sections cover the majority of the Italian areas and represent a good sample of national researchers.

Hereafter we present an overview of the main involved organisation (CNR) and the chosen Institute (Institute for photonics and nanotechnologies IFN).

CNR – National Research Council of Italy

The National Research Council (CNR) is Italy's largest public research institution, the only one supervised by the Ministry of Research performing multidisciplinary activities.

Founded as a legal entity on 18 November 1923, CNR's mission is to perform research in its own Institutes, to promote innovation and competitiveness of the national industrial system, to promote the internationalisation of the national research system, to provide technologies and solutions to emerging public and private needs, to advise Government and other public bodies, and to contribute to the qualification of human resources.

In the CNRs research world, the main resource is the available knowledge which means people, with their skills, commitment and ideas.

This capital comprises more than 8.000 employees, of whom more than half are researchers and technologists. Some 4.000 young researchers are engaged in postgraduate studies and research training at CNR within the organisation's top-priority areas of interest.

A significant contribution also comes from research associates: researchers from Universities or private firms, who participate in CNR's research activities.

CNR-IFN - Institute for photonics and nanotechnologies

The institute for photonics and nanotechnologies (CNR-IFN) carries out innovative research in photonics and nanotechnologies, considering both the fundamental aspects and those applied involving the development of novel photonic devices and systems, optoelectronic equipment, and electronics devices. CNR-IFN belongs to the National Research Council (CNR).

It is tightly integrated with the national scientific community; it collaborates with the major international Universities and research centres through targeted projects funded by main national and international agencies and foundations.

The IFN consists of a headquarter in Milan, and four branch sections (operative units) in Bari, Padua, Rome, and Trento.

The personnel comprise 45 staff researchers, 18 administration and technical services employees, 95 associated researchers, and a variable number of undergraduate, PhD students, and post-doctoral fellows.

The IFN was established in 2002 by the merging of the Institute for Solid State Electronics (Istituto di Elettronica dello Stato Solido-IESS) - in Rome, the Center for Quantum Electronics and Electronic Instrumentation (Centro di Elettronica Quantistica e Strumentazione Elettronica - CEQSE) - in

Milan, and the Center for Aggregate State Physics (Centro di Fisica degli Stati Aggregati - CeFSA) - in Trento.

In 2010, following the merger of the National Institute of Matter Physics (Istituto Nazionale di Fisica della Materia-INFN) with CNR, one INFN centre, ULTRAS of Milan, and two regional laboratories, LUXOR of Padua and LiT3 of Bari were unified into INFN.

Interviews' Protocol - Migrants

To depict the different dynamics of mobility and migration, we have chosen to select six distinct profiles of people who decided to move abroad.

First, we want to balance the number of Incoming and Outgoing profiles.

Secondly, we chose to follow the gender **M/F** distribution of the considered field of study (around 80% Male, 20% Female).

Thirdly, we want to evaluate the impact of the differences in salaries; for this purpose, we chose to consider two-level of earnings (**Mid** and **High** respectively).

Lastly, we want to take into account the nationality of the participants by dividing it into **Italians** and **Foreigners**.

Moreover, all the chosen profiles have a mid-level of research independence. Thus, we exclude those at an early or highly consolidated level of their careers from our study.

The following list better describes the chosen profiles:

- **IIMM** profile: is an **Incoming Italian Male** with **Mid** earnings.
- **IFMM** profile: is an **Incoming Foreign Male** with **Mid** earnings.
- **IIMH** profile: is an **Incoming Italian Male** with **High** earnings.
- **OIFM** profile: is an **Outgoing Italian Female** with **Mid** earnings.
- **OFMM** profile: is an **Outgoing Foreign Male** with **Mid** earnings.
- **OIMH** profile: is an **Outgoing Italian Male** with **High** earnings.

The corresponding candidates were selected under the supervision of the Director of the involved research institute, considering all the available present and past personnel.

All the participants' demographic data have been collected through their research institute's Director and other online sources, such as institutional (CNR, Institute's website, Scopus) websites, databases, and, in some cases, non-institutional websites (personal blogs).

In particular, through their curriculum vitae, we have taken the preliminary information about their career, positions, and personal life.

Due to the study's nature, we have adopted a qualitative approach based on semi-structured interviews.

We have conducted extended conversations between the researchers and the interviewer using the video chat Zoom platform to obtain the most detailed and in-depth information possible on the addressed topic.

The Semi-structured interviews were organised by topics that must be addressed during the meeting. The topics were proposed to the researchers in a series of open questions that left the interviewee free to comment on the matter and expand their thoughts.

Although there was a fixed and standard track for all the interviews, the conduct of each one of them has varied with the answers given by the interviewee and based on their individual situation.

Different topics arose spontaneously during the interviews and were developed by the interviewer to understand the interviewee better.

In some cases, the interviewee anticipated some answers; therefore, the interviewer had to change the order of the questions.

The identified motivations related to mobility (from Italy to another state and from the native country to Italy) are described in the following list:

- **T1:** Personal motivation
- **T2:** Work-related motivations
- **T3:** Country's environment motivation
- **T4:** Impact on collaborations

Upon the interviewee's authorisation, each interview has been recorded on video, transcribed in the exact same words as were used originally and analysed.

As we are analysing researchers related to an Italian research institute, all the interviews were conducted in Italian, the mother tongue for most of the researchers interviewed.

Italian was also chosen for those conducted with non-Italian subjects to facilitate comparison between the different interviews. After years of living in the Italian territory, the interviewees could perform an extended and in-depth interview in their non-native language.

For the purpose of this work, the answers, when quoted, will be reported both in Italian and in English.

Overviews of the selected participants

This subsection presents a detailed description of the selected participants, mapping the originally designed profiles.

Note that all the below information are also publicly available through the World Wide Web.

Subject ONE IIMM - Incoming Italian Male with Mid earnings is a **Male Italian** theoretical physicist born in Rome in 1987.

He earned his Bachelor's Degree (2008) and his Master's Degree (2011) at La Sapienza University of Rome.

During his second course of studies, he spent almost a year (in 2009) abroad with the Erasmus European Lifelong Learning Programme in Spain at the University of Valencia.

After his graduation, he was a research intern for the Physics Department of La Sapienza University (2011-2012), and later he attended a PhD course as a Marie-Curie PhD fellow (2012-2015) at the University of the Basque Country UPV/EHU, Bilbao, Spain, achieving his diploma in 2015.

From 2015 to 2019, he was a Marie-Curie Postdoctoral Fellow at the University Paris Diderot, in France.

After his French experience, he won another Post-doctoral Fellow.

He went back to Spain at the Autonomous University of Madrid for a few months (April- November 2019) before moving back (**Incoming**) to Italy for a permanent position at CNR in Milan.

Due to his current position, he can be inserted in the class of the **Mid** salaries.

Subject TWO IFMM – Incoming Foreign Male with Mid earnings is an **Incoming Foreign Male** experimental physicist born in Canada in 1978.

He first attended the University of British Columbia in Vancouver, where he graduated in 2002, then attended the University of Toronto, where he earned his PhD in 2008.

He then moved to Italy, where he was first employed at CNR-IFN as a post-doctoral researcher (on different temporary positions) until 2012, then at Politecnico of Milan from 2013, on various temporary contracts, continuing his work as a postdoctorate researcher.

He was finally hired with a permanent contract in 2016 as an entry-level researcher (Ricercatore III livello) at CNR-IFN, where he still works.

Due to his current position, he can be inserted in the class of the **Mid** salaries.

*Subject **THREE IIMH** - Incoming Italian Male with High earnings* is an **Italian Male** theoretical physicist born in 1981 in the centre of Italy (Abruzzo region).

From 2000 to 2003, he attended the Electronic Engineering faculty of Politecnico di Milano (Milan, Italy), graduating in 2003 (check).

In 2003 he won a student position at the Ecole Normale Supérieure, Physics (Paris, France), graduating in 2006.

After this experience, he enrolled as a PhD student at the Université Paris Diderot-Paris 7 with a Marie-Curie scholarship, graduating in 2009. During the same period, he also worked as a teaching assistant at the same university.

He then decided to apply for a postdoc position at the University of Tokyo, where he stayed one year between 2009 and 2010.

He returned to Paris, taking another postdoc position at the Université Paris Diderot-Paris 7 (2011-2012).

In 2012 he moved to England. He has been a Marie Curie IEF Fellow at the University of Southampton between 2012 and 2013, associate professor at the University of Southampton between 2014 and 2019 and Professor Fellow from 2019 onward.

In early 2020 he won a permanent position at CNR-IFN (**Incoming**) as a **Middle-level** researcher (Primo Ricercatore), where he recently started working.

*Subject **FOUR OIFM** – Outgoing Italian Female with Mid earnings* is a **Female Italian** researcher born in Milan in 1981.

She firstly attended the Università degli Studi di Milano (University of Milan) and graduated in 2005, and secondly, also in Milan, she got her PhD degree at Politecnico di Milano in 2009.

Between 2009 and 2015, she spent several months as visiting scientist on short-middle term mobility abroad (Germany, The Netherlands).

Between 2009 and 2011, she also worked as a post-doctoral researcher at Politecnico di Milano.

In 2011 she was hired on a permanent position as an entry-level researcher (Ricercatore III livello) at CNR-IFN.

She then decided to move to Germany in 2016, with a contract as a Leading Scientist at DESY and Professor (W3) at the University of Hamburg.

Due to his current position, she can be considered **Outgoing** personnel and inserted into the **Mid** salaried class.

Subject FIVE OFMM - Outgoing Foreign Male with Mid earnings is a **Male Foreign** researcher born in London in 1978.

He graduated in two different subjects: he got his first master degree at the University of Oxford in 2001 and a second master degree at the University of London in 2004.

At the University of London, he also got his PhD in 2008.

From 2004 and 2007, he also was a Marie Curie Early-Stage Training Fellow in Greece, then a research fellow in London between 2008 and 2010.

He moved to Italy in 2010 and became a Post-Doctoral Fellow at Politecnico di Milano where he stayed one year before being hired by CNR-INF with a permanent contract as an early-stage researcher (Ricercatore III livello).

Since 2019 he moved to Sweden at the University of Göteborg (University of Gothenburg); there, he was hired as a Senior Lecturer.

Due to his current position, he can be considered **Outgoing** personnel and can be inserted in the class of the **Mid** salaries.

Subject SIX OIMH - Outgoing Italian Male with High earning is a **Male Italian** applied researcher born in the south of Italy (Bari) in 1974.

He graduated in 1997 and earned his PhD degree in 2002 at the University of Bari.

For several months, he worked for INFN – Istituto Nazionale per la Fisica della Materia (National Institute for Matter Physics) in Bari, even before his PhD graduation between 1998 and 2002.

From 2002 to 2004, he was a postdoc research fellow (with temporary positions) at the University of Bari.

From 2004 and 2009, he was Tenure Track at INFN – Istituto Nazionale per la Fisica della Materia (National Institute for Matter Physics) in Bari and in 2009, when CNR absorbed INFN, he became permanent CNR-INFN personnel with an entry-level position.

Meanwhile, between 2006 and 2007, he spent one year as a visiting scientist at Friedrich-Schiller-Universität Jena in Germany. In 2008 he continued his collaboration with this university, winning a DAAD-Deutscher Akademischer Austausch Dienst research grant (German Academic Exchange Service research grant).

In 2010, he won the permanent middle-earning position of Primo Tecnologo at CNR-INFN, and from 2015 on, he worked as a Guest Professor at the University West – Trollhättan, Sweden.

Due to his current position, he can be considered **Outgoing** personnel and inserted into the **High** salaries class.

Report of the interviews

In this section, we are going to describe the transcription of the conducted interviews.

Note that the transcriptions do not follow the original temporal flow but are reorganised to follow the topics flow presented in the previous section.

Interview of Subject **ONE IIMM - Incoming Italian Male with Mid earnings:**

Personal motivations T1

Subject one tells us that he considered his personal character while moving abroad to attend his PhD course.

After his Erasmus program abroad, he wanted to live outside of the country, having new experiences:

“Avevo voglia di andare all'estero e fare esperienza”

(I wanted to go overseas to have experience.)

Some personal preferences had also primary importance when he talked about his choice of moving from Spain to France for his first post-doctoral experience:

“Non avevo voglia di continuare il mio percorso accademico sempre nello stesso posto (a Bilbao). Finito il dottorato volevo spostarmi altrove.”

(I didn't want to continue my academic career always in the same place (in Bilbao); after finishing my doctorate, I wanted to move elsewhere).

Although, the personal drive was less relevant than the professional one for this choice.

Strong personal motivations reemerge in his choice of moving back to Italy.

While looking for a permanent position, Italy and especially Milan were his first choices as his girlfriend lives and works there:

“Il mio primo obiettivo era trovare una posizione permanente nel mondo della ricerca.”

(My first goal was to find a permanent position in research.)

and

“a quel punto, per avere una posizione permanente, l'Italia sarebbe stata, per motivi personali, la prima scelta”

(at that point, to have a permanent position, Italy would have been, for personal reasons, the first choice).

Work-related motivations T2

Subject one choosing to move abroad right after his graduation had anyway strong work-related motivations.

From his point of view, Italy offered fewer PhD positions, and he found the foreign selection process more suitable and more direct for his choices.

Economic conditions offered abroad were higher than in Italy, and he also considered that a PhD stipend is treated as a scholarship in our country.

He reported that a PhD student is not fully equal to an employee in Italy, while in Spain, he was considered a fixed-term employee with all its rights.

Moving to France after this first experience abroad was mostly an academic decision.

He perceives that research is not suitable to continue one's career path all in the same place.

Hence, he chose to move to the place that offered him the most attractive opportunities for his research, considering that Paris was a city that interested him a lot.

In this choice, economic determinants had a lighter impact.

Although he finds that postdoctorate positions in Italy are less paid, he would not have disdained to return to Italy at that point of his career.

The final choice in his own words:

“è stata una scelta fatta più seguendo le opportunità lavorative disponibili in quel momento”

(it was a choice made by following more the job opportunities available at that time)

Going back to Spain was also a choice driven by working opportunities.

He tried public contests at CNRS (The French National Centre for Scientific Research) for a permanent position several times; therefore, he continued searching for a suitable opportunity and moved to Madrid when he found one.

He stayed less than a year in Spain as in the meanwhile, he won a public selection at CNR-IFN and moved back to Italy.

The first motivation for this choice was searching for a permanent contract, but the decision taken about the country and location was strongly driven by personal impulses.

However, the city was also chosen to maintain his working collaboration with the University of Milan researchers.

Country's environment motivations T3

During the whole interview, the subject never mentioned motivation related to the country's social, environmental or welfare conditions.

Impact on collaborations T4

Although back in Italy, Subject one continues to collaborate daily with the researcher's networks created in Spain and France with whom he shares projects and publications.

Not only with the most recent ones but also, even in a less intense way, with the one built during his PhD in Spain.

He actively collaborates with groups located where he didn't have direct working experiences: for a theoretical physicist is straightforward to build collaboration with individuals because there is no need for infrastructures.

As he was hired by CNR-IFN a few months ago, his collaborations with external networks are still much more extensive than those with the CNR network as he didn't have the time to build it up.

Interview of Subject **TWO IFMM -Incoming Foreign Male with Mid earnings:**

Personal motivations T1

Subject two choices seem to be strongly influenced by personal motivations.

He chose to move from Canada to Italy due to his family's influence.

He has a relative-in-law who made him love Italy, and by that, he grew a deep passion for our country.

Work-related motivations T2

Besides his strong personal motivation, a certain amount of work-related motive still existed as a foundation for his migration choice.

He met representatives of the CNR-IFN research group at a conference while he was still working for his PhD and maintained contacts with them over the years until there was an opening at the institute.

He had a very high opinion of the Italian research group, so he was quite happy to move to Italy to work with those he considered the best scientific group on his research topics.

Once in Italy, he worked with different fixed contracts for several years. Although he describes his working situation as harsh ("*ho lottato tanto*" - I struggled a lot), the aim of being in a place he loved overcame the precariousness of his working condition.

He has no problem relating to the Italian bureaucratic system: rules for funds' employ, Public Administration rules, recruitment system etc.

He is pleased to be able to coordinate a research group in Italy even without formally being the group leader.

He showed some edginess as he might have had more money elsewhere (Canada, U.S.A., Switzerland, Germany). Still, he considers his Italian experience very valuable anyway. Infact, he had the opportunity to be selected for a big project fund (SIR), which allowed him to establish a group and build a lab from scratch.

In his personal opinion, there are no significant differences regarding funds availability when comparing the Italian situation to the one in other countries.

He feels that a lack of funds exists all over Europe.

He feels that Italian public selections were more ambiguous in the past, but things have changed, and nowadays, the hiring process is more meritocratic. Infact he became an early-stage researcher with a permanent position at CNR-IFN, winning an open competition with more than 200 candidates being a foreigner without particular connections.

Country's environment motivations T3

Between the motivation mentioned by subject two during his interview, the main reason for moving and staying in Italy appears to be his strong feeling for our country.

He is enthusiastic about Italian's country, culture, people, food, the football championship, nature's variety, etc.

When he talks about his choices, he continuously underlines these kinds of rationales.

He is aware of the differences in wages between Italy and his native country, North America or Switzerland. Still, he has consciously chosen to come and stay in our country as to him it is the best place to live in the whole world.

Bureaucratic issues don't bother him. While talking, he underlined that he had to renovate his residence permit every year, but this didn't seem to disturb him; on the contrary, he thinks these kinds of battles have prepared him to handle the administrative issues of the job better.

A few years ago, during a public selection, the examiner asked him if he'd move to another country for a better-paid position, and he clearly stated that he'd prefer to stay in Italy.

Nowadays, as a result of the current pandemic disease (COVID-19), he recognises that his prospects have changed a bit, but he still doesn't think about leaving Italy.

Impact on collaborations T4

He strongly values his research group and the people within CNR-IFN and Politecnico of Milan because he can easily collaborate with them on projects and publications. For this reason, he feels that, compared to other countries, being in Italy, and especially in Milan, is an advantage.

He has maintained, anyway, an extensive international working network over the years.

For instance, his most important research project (SIR) results from a Canadian collaboration that he maintained since his graduation and his connection to Canada is still stable.

Interview of Subject **THREE IIMH** – *Incoming Italian Male with High earnings*:

Personal motivations T1

Subject three started his mobility history quite early. He moved to France after his Bachelor at Politecnico di Milano.

His motivations were predominantly personal for this choice: he wanted to live abroad and felt that the Ecole Normale Supérieure was an excellent place for his studies.

Personal motivation occurred again when he was choosing his destination for his first post-doctoral position. He wanted to live in Tokyo, and that was the essential criterion he used.

Again personal constraints came up at the end of his staying in Japan. Over the past years, he had opened some firms in France, so he decided to go back to Paris to follow them.

Even if work-related, this wasn't a choice linked to his scientific career; during the interview, he addressed this issue as an "*interesse personale*" (personal concern).

Work-related motivations T2

The migration between France and the United Kingdom was different.

He was looking for a permanent position, and he found that this wasn't achievable in France.

He feels that France shares with Italy the same difficulties related to the labour market entry barriers.

He feels that Germany and the U.K. are the only two countries in Europe where, for a researcher, it is easier to find a permanent position.

He also felt that the French academy judged as undesirable his work with private companies.

He chose to move to England as he was hired with a very well paid, long-term fellowship that allows him to act as a "*Research Director*".

He is very keen on the English academic system, but he recognises that a long-term contract in England is not equal to an Italian long-term contract.

The English system can terminate your contract quickly if your work is not sufficient; moreover, the university can decide to close your whole department and end all the contracts if the department becomes inefficient or unnecessary.

He also appreciates what he calls "*the fellowship system*"; in his opinion, this system helps universities hire a more extensive range of candidates.

On the other hand, he doesn't appreciate that the education system has become too commercial and that the decisions taken are principally money-related.

As his work overtime shifted from researching to writing grants and searching for funds, he was no longer satisfied with his working environment. Besides his strong personal motivations, this led him to choose to go back to Italy even with a lower salary.

“Bisogna scegliere se fare ricerca o essere un grande ricercatore”

(You have to choose between research or being a recognised researchers)

Country's environment motivations T3

He decided to come back to Italy in 2016 after the Brexit vote; moreover, he feels that England has profoundly changed in the last seven/eight years.

He felt that ten years ago, the U.K. was a wealthy country with an excellent safety network and the money was used for public services but is no longer so.

Things have changed, and now England shows extreme poverty.

He feels that the past public policies and the austerity of the past ten years had a considerable impact also on the research system.

He thinks that English universities' existences are at risk as they became solely for-profit entities.

What made him choose was mainly the sense of insecurity that he feels in the U.K. and no longer feels a sense of community.

Criminality increased, and the social context profoundly changed.

He feels that a higher salary is not enough to prevail over these issues.

Impact on collaborations T4

His work is based on collaboration with groups of experimental researchers, and he maintained partnerships built in places where he worked and lived over the years.

Although these collaborations are not directly with his original working groups, his experiences allowed him to build them.

He maintains close relations with a group in Tokyo, where he still goes once a year, and with groups in Paris.

Subject **FOUR OIFM** - *Outgoing Italian Female with Mid earnings*

Personal motivations T1

For this subject (FOUR), it isn't easy to distinguish between personal and work-related motivation.

The researcher had no intention to move abroad, having already a permanent position in Italy; this was something that simply "happened".

After studying and earning her Master's degree and PhD in Milan, Subject Four was quickly hired with a permanent contract at CNR-INF.

She was not looking for a position abroad even if she had some experience in a foreign country as a visiting scientist.

Once she was already offered the position, personal motivations were considered: more of her partner than hers.

At that moment, her husband also had a permanent position in Milan. He is a software engineer and has competencies easily utilised in foreign countries, so he was keen to migrate.

The Subject stated that otherwise, she would not have disrupted the career of her partner. It was a joint decision. Personal motivations were taken into account not as a push to move abroad but as a weight to consider for deciding to stay or move.

Work-related motivations T2

Subject FOUR already had a permanent position and was quite happy with her work and career in Italy. She was not particularly looking for other opportunities, but the one presented to her had several working-related benefits that she took into account deciding.

She was offered a double position as a researcher and full-time professor, laboratories, and a fixed budget for research every year.

She is autonomous and can decide who hire and how to conduct her work. After three years, she already has a group of around fifteen people.

She stated that although she was happy in Italy with her research group, her freedom now is inconceivable at the early stage of a career in an Italian institution.

CNR tried to make a counteroffer, but the number of funds and resources offered abroad were unbeatable. Otherwise, she would have stayed in Milan.

Country's environment motivations T3

There weren't really country environments motivations involved in the decision to move abroad, but one factor that had relevance was that she already knew the city and some of the people that work there.

Although in another institution, she had spent seven months in the same city as a visiting scientist, and she had already met some of the people who worked there.

Even though she recognised an excellent welfare system in the foreign country, especially for child support (she had a baby in 2019), this was not a reason to move.

Impact on collaborations T4

Her network was already international even while working in Italy, so it really didn't change, and it continues in being international. She also brought some of her Italian students abroad to complete their curriculum and specialisation and continues her collaboration with the original research group.

Interview of Subject **FIVE OFMM - Outgoing Foreign Male with Mid earnings**

Personal motivations T1

Subject five is an English man who has a long history of work-related migration.

After his PhD in London, he moved to Italy for either personal or professional reasons.

On the other hand, while choosing to move abroad from Italy, the choice was facilitated because he had no native family in Italy.

Work-related motivations T2

During his PhD in London, subject five started to collaborate with Politecnico of Milan. Continuing these collaborations was the main reason to find a job in our country and move to Italy. At that time, he had a very well paid Marie Curie's scholarship and was working between London and Crete (Grece). Knowing that that experience was fixed term and seeking a job in the research and academic field, he got the opportunity to become a research fellow (Assegnista di Ricerca) at Politecnico of Milan. Being hired wasn't easy: he tried many different public selections before winning this position.

Although he found that the Italian selection process was very closed and often unfair at that time, he felt lucky to have a job as a lot of his colleagues didn't.

He was a foreigner and didn't study at Politecnico di Milano; therefore, he was doubtful about the result of the public selection.

He stayed in Italy, and, in 2011, he was hired by CNR-IFN with an entry-level contract (Ricercatore III livello) as a researcher, winning another public selection.

At the beginning of his career at CNR-IFN, he was very happy as he felt there were many opportunities to participate in projects and get funds.

After almost seven years of work, he started being frustrated as the funds became smaller, and there were fewer possibilities to propose projects.

He also got frustrated by the administrative and bureaucratic process: administrating his fund seemed to be more and more difficult.

He reports that a lot of administrative paperwork is required to use less and less money.

He also felt enormous difficulties in setting up a working group. CNR hadn't the possibility to directly hire PhD students, so he was usually the only researcher collaborating with students of Politecnico; this didn't allow him to build up a stable working team as the students came and went.

He was the only CNR-IFN researcher working on his research's thematic and had insufficient funds to hire other researchers with permanent positions.

He reports that he felt there were also no possibilities for career advancement.

He believes that the criteria used by CNR to select people for career improvements are too strict.

His contract at CNR-IFN kept being an entry-level researcher (Ricercatore III livello).

During the last years, he also perceived that CNR strategy, as an effect of national laws such as the "Legge Madia", was to invest money in converting fixed-term and unstable contracts into permanent positions and not focus on career developments.

He also realised that it would have been impossible to provide for his family with the Italian retirement system without career advancement in the future.

All this frustration led him to apply for positions outside Italy, and the University of Göteborg finally hired him as a Senior Lecturer.

All the mentioned above were the main motivations that convinced him to move to Sweden.

He was interested in career growth more than in a salary raise, and that, to him, was the essential aspect to consider.

Although he is pleased with his choice, he did not end the CNR contract; instead, he took a leave of absence and will decide next March if coming back to Italy or staying there.

His main fear is to move back to Italy after two years, starting all over his career from where he had left it, as he no longer has funds at CNR-IFN.

He feels that moving back wouldn't be a wise choice mainly because, after just one year, he is already sure that there are more funds and projects' opportunities in Sweden and that career advancement is more feasible.

The salary level is also a critical factor to consider for this choice, as in Sweden, he earns more than double the CNR salary.

On the other hand, he wants to maintain an open possibility to work again with CNR.

Country's environment motivations T3

Subject five is still an English citizen: he applied for Italian citizenship, but he didn't get it yet.

The Brexit process and future rules that E.U. might apply for the mobility of English people are also a component that he will consider for his next choices.

Impact on collaborations T4

Although in Sweden, he continues to collaborate continuously with the Italian research group; he reported that it wasn't possible to establish new collaborations in his new country in more than one year, so his entire scientific production is still based on his Italian network.

His scientific network is one factor that still significantly impacts the decision to stay abroad or go back to Italy.

He is also trying to establish collaborations between Sweden and Italy to impact the original scientific group positively.

He also maintained his collaborations with his previous working group in London and is still the link between the London's groups and Politecnico of Milano's groups.

*Interview of Subject **SIX OIMH** - **Outgoing Italian Male with High earning***

Personal motivations T1

Subject six was introduced as an ongoing male Italian researcher. Still, at the end of the interview, it was clear that he decided otherwise to stay in Italy even if abroad has an excellent opportunity waiting for him.

In 2014, after a long selection process, he was nominated, Full Professor at the University West – Trollhättan, Sweden.

Sweden insisted on having him full time, and he seemed to appreciate the Swedish research system, but finally, he decided to stay at CNR-INFN.

The main reasons for this choice were his family's constraints.

His wife is a business owner in their home city, and she thinks that it would be difficult to adapt to the culture and the language of Sweden.

He feels that moving abroad would open better possibilities even for their child, but he clearly stated that he could not defeat his wife's wish.

For this reason, he found a way to collaborate with Sweden, splitting his working time between CNR and the other country.

He worked 50% of his time in Italy and 50% of his time in Sweden for the first two years. Nowadays, he is working outside the country only 20% of the time as a Guest Professor.

Work-related motivations T2

His first experience abroad was several years ago, in Germany, and was strictly working related.

After his studies, all conducted in Bari, his birth-town, he was hired as a tenure track at the INFN in Bari.

During this time, the institute could develop some new research lines, and there was a need to train staff with new skills.

Under the institute wishes, he spent one year in Germany, acquiring new competencies.

The position was fixed term, and Germany had no interest in keeping him.

On the other hand, he wasn't interested in staying in Germany; getting a permanent position was quite difficult, and he already had a stable job in Italy.

After this year, he continued collaborating with the same research group as he won an ADD project with them.

This experience was also precious for the Italian research institute as he brought back all the knowledge developed there.

The German group also helped him in building new laboratories in Italy.

He cherishes this experience as one of the most valuable of his whole career.

Otherwise, the working related motivations that he considered while choosing to accept the later Swedish proposition were:

- There were few possibilities for career advancement due to the lack of public selection held by CNR;
- Even having the needed funds, he had difficulties in hiring new people for his research group due to CNR internal policies and bureaucratic rules applied to research institutes;

- Lack of collaborators with a permanent position in his institute;
- Inability to plan long-term activities due to the absence of a long term research strategy (at the Institution and governmental level).

The position in Sweden offered him to go beyond all these difficulties:

- he could lead his research group
- he can program his long-term activity (ten years plan)
- clear research strategy at the national and University's level
- coordination between different research institutes and universities on the same research topic
- companies embedded into the University's infrastructure (shared laboratories)

Nevertheless, as already mentioned, he decided not to migrate to Sweden for personal reasons but to stay in Italy, maintaining a close collaboration with the Swedish University.

Country's environment motivations T3

During the whole interview, the subject never mentioned motivation related to the country's social, environmental or welfare conditions.

Impact on collaborations T4

His work with Sweden has a huge impact also on CNR-IFN's activity.

He established collaboration for new joint projects, and this is an opportunity for other researchers.

It has become a prestige and an opportunity for them.

Discussion of the surveyed scenario

In this section, we will provide a discussion about the interviews presented in the previous segment. From the direct experience of the group of subjects, it is possible to highlight some key emerging outlines.

For the sake of readability, we will organise and group them, following the order of the original topics:

Personal motivations T1:

In the area of personal motivations, we can state that personal - especially family relationships - have a significant impact on the decision to stay or leave the country of origin.

Sometimes this even overcome a higher salary and a better position.

Other personal drivers to consider are the predisposition to travel abroad and the ease of adapting to a new situation.

Work-related motivations T2:

From the work-related motivations, the main focus has been on funds availability and career advancement.

As also emerged from the MORE3 project results:

"The quality of the working conditions influencing scientific productivity, such as, e.g. working with leading scientists, long-term career perspectives and research autonomy are the main drivers of the attractiveness of jobs in research: factors that drive the decision of researchers to become mobile."

In our sample, researchers were not focused only on their own salary, and some of them accepted even lower positions and earnings to work in environments that they valued more. The main concern seemed to be about their working group and collaborations: the difficulties in building a personal working group or a lab is perceived as crucial.

Sometimes this difficulty is due to a lack of fundings. Still, most of the time, researchers who decided to leave Italy attributed it to the strict administrative public rules applied to the researchers' institutions.

Italian public administration rules are perceived as oppressive and conflicting with the principles expressed in the European Charter for Researchers.

Career progressions are also crucial for those who decide to move abroad from their native country: these seem to be equally important for those who left their homeland to move to Italy and for those who left Italy to move abroad.

Country's environment motivations T3:

Other aspects that emerged during the interviews are elements related to the social and cultural environment of the country where the researcher decided to move from or to.

Welfare, safety, culture and even food appeared to be crucial in the choice made.

For instance, subject two decided to move to Italy mainly for its culture and food, and he stated that despite a lower salary, he doesn't want to move back to his country.

Well-being and welfare issues instead, push subject three to move back to Italy as he no longer feels safe in the country where he migrated.

In this new era and especially in the actual situation related to the spread of COVID-19, these considerations became more valuable.

Paradigms of choice are slipping; personal issues and well-being are becoming much more present in everybody's picks.

Overall, mobility is considered a fundamental step for one's career.

Impact on collaborations T4:

All the cases interviewed maintained good relationships and collaborations with research teams from the countries where they had previously stayed and worked.

Even in the case of migration, they have all maintained relations with their country of origin. This attitude has also had a positive impact on the previous working group.

The institution and consequently the country from which they have left is, infact, profiting from their decision to leave.

From what has emerged, mobility processes do not seem to be entirely linear, and the claim that the migration of researchers is an exclusively negative result for the country of origin should be further investigated.

Moreover, it would also be worthwhile to analyse the dynamics of choices related to personal and environmental issues in greater depth.

Another point of view

Seen the results of the first set of interviews, we continued interviewing IFN personnel to deepen our analysis.

We have also chosen to select another six distinct profiles of people who decided to stay in Italy for their whole career to analyse the individual components involved in the process.

Interviews' Protocol - permanent personnel

To make them comparable with the previous sample, we chose to continue to follow the gender **M/F** distribution of the considered field of study (around 80% Male, 20% Female) and to continue to evaluate the impact of the differences in salaries considering two-level of earnings (**Mid** and **High** respectively).

At the same time, all the chosen profiles have a mid-level of research independence.

They are all Italians in an Italian institution, as a difference between foreigners and Italians is not feasible.

The following list better describes the chosen profiles:

- **PIMH** profile: is a **P**ermanent **I**talian **M**ale with **H**igh earnings.
- **PIFM** profile: is a **P**ermanent **I**talian **F**emale with **M**id earnings.
- **PIMH** profile : is a **P**ermanent **I**talian **M**ale with **H**igh earnings.
- **PIMM** profile: is a **P**ermanent **I**talian **M**ale with **M**id earnings.
- **PIFH** profile: is a **P**ermanent **I**talian **F**emale with **H**igh earnings.
- **PIFH** profile: is a **P**ermanent **I**talian **F**emale with **H**igh earnings.

These candidates were also selected under the supervision of the Director of the involved research institute (CNR-IFN), considering all the available present and past personnel.

As well as we have done for the first selected group, the participants' demographic data have been collected through online sources such as institutional (CNR, Institute's website, Scopus) websites, databases, etc.

In particular, through their curriculum vitae, we have taken the preliminary information about their career, positions, and personal life.

Likewise, we have adopted a qualitative approach based on semi-structured interviews for this sample. We have conducted extended conversations between the researchers and the interviewer

using the video chat Zoom platform to obtain the most detailed and in-depth information possible on the addressed topic.

Like the previous ones, the semi-structured interviews were organised by topics that must be addressed during the meeting.

The topics were proposed to the researchers in a series of open questions that left the interviewee free to comment on the matter and expand their thoughts.

Although there was a fixed and standard track for all the interviews, the conduct of each one of them has varied with the answers given by the interviewee and based on their situation.

Different topics arose spontaneously during the interviews and were developed by the interviewer to understand the interviewee better.

In some cases, the interviewee anticipated some answers; therefore, the interviewer had to change the order of the questions.

As stated for the first group, we used the same identified motivations to describe the motives behind pursuing their whole career in Italy.

The motivations used are described in the following list:

- **T1:** Personal motivation
- **T2:** Work-related motivations
- **T3:** Country's environment motivation
- **T4:** Impact on collaborations

Upon the interviewee's authorisation, each interview has been recorded on video, transcribed in the exact same words as were used originally and analysed.

All the interviews were conducted in Italian, the mother tongue for all the researchers interviewed.

The answers will be reported both in Italian and in English when quoted for this paper.

Overviews of the selected participants

Subject ONE PIMH - Permanent Italian Male with High earnings is a Male Italian born and raised in Padova (Italy).

He earned his Master's Degree (1993) and his PhD Degree (1997) at the University of Padua, and soon after (in 1999), he was hired by the INFN – Istituto Nazionale di Fisica della Materia (National Institute for the physics of matter).

He held his whole career between the University of Padua (where he graduated), INFN and CNR as the INFN was merged with CNR in 2004.

Currently, he is a Research Director "Dirigente di ricercar" of the Institute for Photonics and Nanotechnologies of the National Research Council of Italy (CNR IFN). He has been the Head of the Division of Padua for several years.

He is also active in technology transfer, where he has been responsible for several industrial contracts. Due to his current position, which is absolutely not early stage, he can be inserted in the class of the **H**igh salaries.

*Subject **TWO PIFM** - Permanent Italian Female with Mid earnings* is a **F**emale Italian, born in Senegal as her father was a diplomat.

Since high school, she lived all over the world and grew speaking either French and Italian.

Eventually, she came back to Italy in 1992, where she studied physics in Rome at La Sapienza University, where she graduated in 1997.

From the beginning, she chose an academic career because she liked it. She wanted to stay in this area; to do so, she accepted a scholarship at the University La Sapienza.

After a while, though, she had the opportunity to move to England for her PhD, and she accepted.

Afterwards, she came back to Italy and started looking for research contracts in Milan's area.

She spent eight, nine years working either with scholarships or research grants (assegni di ricerca), but she stayed in Italy.

In the end, she was hired by IFN- CNR with a permanent position since 2012.

Due to her current position, she can be inserted in the class of the **M**id salaries.

*Subject **THREE PIMH** - Permanent Italian Male with High earnings* is a **M**ale Italian born in the Milan area in 1977.

He graduated from Politecnico di Milano in 2002, and he continued his studies at Politecnico di Milano with his PhD.

Soon after his PhD graduation, staying in Milan, he was hired with several research grants between Politecnico of Milan and INFN - Istituto Nazionale di Fisica della Materia (National Institute for the physics of matter).

In 2009, one of his contacts offered him a one-year research grant in Hamburg, working with the Max Planck Research Group for Structural Dynamics at the Deutsches Elektronen-Synchrotron.

He was not looking for an experience abroad, and he was quite uncertain about the decision, but eventually, he went.

Soon after his leave, he was hired by CNR-IFN with a permanent position. He decided to finish his one-year work in Hamburg and return to Milan, where he is still staying.

He has now reached the position of "Primo Ricercatore" so he can be inserted in the class of the **High** salaries

*Subject **FOUR PIMM** - Permanent Italian Male with Mid earnings* is a **Male Italian** born in Rome. He graduated from the University "La Sapienza" of Rome in 1992.

Later on, for four years, looking for a permanent position, he collaborated with scientific groups, started teaching at High School, and even worked for a private company.

In 1996 he started his PhD at the University "La Sapienza" of Rome. Soon after, he had a scholarship from a CNR institute followed by a research grant. Eventually, he was hired with a permanent position at CNR- IFN in 2001, where he still works.

For his research activities, he went abroad several times during these years using a CNR program called "Short Term Mobility". Moreover, all these visiting periods were no longer than one or two months, sometimes shorter. He never stayed longer abroad, and he spent the majority of his career in Rome.

Due to his current position, he can be inserted in the class of the **Mid** salaries.

*Subject **FIVE PIFH** - Permanent Italian Female with High earnings* is a **Female Italian** born in Rome.

She graduated in Physics from the University "La Sapienza" of Rome. After a couple of years of collaboration with the University's department, she won a PhD scholarship at the University of L'Aquila.

Soon after, she was hired with a fixed contract by IFN-CNR, and her contract was transformed into permanent after four years.

She never moved abroad, although she had one possibility to do so, which she refused. She never pursued a career abroad.

She is still at IFN-CNR, and due to her current position, she can be inserted in the class of the **High** salaries.

*Subject **SIX PIFH** - Permanent Italian Female with High earnings* is a **Female Italian** born in the Milano area.

She graduated in Physics from "Università Degli Studi" in Milan, and she wrote her master's thesis in collaboration with an international group of scientists at JRC-ISPRA (Italy).

After this experience, she won a PhD scholarship also at the "Università Degli Studi" in Milan. Soon after graduation, she started working at INFN – CNR with a post-doc position in conjunction with an "Adjunct Professor" of Physics position at Politecnico di Milano.

Ultimately in 2009, after her post-doc, she was hired with a permanent position by INFN- CNR, where she is still working.

The only experience she had abroad was one in Canada. It was a one-year collaboration as a visiting scientist at the Steacie Institute for Molecular Sciences of Canada's National Research Council (NRC) in Ottawa, Canada. She went there only after her full-time employment.

Due to her current position, she can be inserted in the class of the **H**igh salaries.

Report of the interviews

In this section, we are going to describe the transcription of the conducted interviews.

Note that the transcriptions do not follow the original temporal flow but are reorganised to follow the topics flow presented in the previous section.

Interview of Subject ***ONE PIMH - Permanent Italian Male with High earnings:***

Personal motivations T1

Subject ONE was about to move to a country right after his PhD. At that time, it was not mandatory but strongly suggested.

He decided not to move for personal reasons: he was newlywed, and his wife still had to finish her studies.

Moreover, she wanted to stay in Italy to pursue a teaching career, and she felt that moving abroad was not an appropriate choice.

He decided to stay with his wife and not go abroad, and he states that this was the best choice of his life as it opened many work opportunities that he otherwise would not have had.

Work-related motivations T2

The decision to stay in Italy let him start a huge collaboration with a research group in Milan.

He is still working on this collaboration after 25 years, and it is very profitable.

If he had been abroad, he would have lost it. Instead, it was a very important booster for his career.

It is a very valuable collaboration and scientifically very rewarding.

Even the person with whom he collaborates in Milan has made a splendid career by staying all the time in Milan

He stated that there are very good career opportunities even if you always stay in the same place. According to him, the best choice was to stay.

Country's environment motivations T3

During the whole interview, the subject never mentioned motivation related to the country's social, environmental or welfare conditions.

Impact on collaborations T4

He has two main collaborations, one with Canada and the other in Beijing; he also works with at least ten international partnerships in his sector. He has excellent global visibility.

He also has several applied research projects with industrial collaborations and patents with the CNR and the University of Padua.

He has an extensive and important scientific productivity, and he believes that if he had gone abroad, it would have been lower.

Interview of Subject **TWO PIFM - Permanent Italian Female with Mid earnings**

Personal motivations T1

Even though subject TWO struggled for several years (around 9) without a permanent position, she decided to wait for a better opportunity in Italy.

This choice was mainly due to personal issues related to her family.

When she had the opportunity to move abroad, she struggled with family issues. Later on, she married and had a child, so she decided she didn't want to go away.

Work-related motivations T2

Even though the choice to stay in Italy was dictated by personal issues, subject TWO values her working environment and career very highly.

She finds that she always had great independence and various opportunities to grow and develop her expertise.

She is very happy with her research activities, and she was able to manage her own team and students from the very early stage of her career.

She stated that this contributed to her staying in Italy and not looking for other opportunities abroad. She found that she had good opportunities for career advancement even without moving. She finds herself lucky.

Country's environment motivations T3

During the whole interview, the subject never mentioned motivation related to the country's social, environmental or welfare conditions.

Impact on collaborations T4

She collaborates with an international network, coordinating several projects worldwide. She finds that her choices have not harmed her activity. Her scientific production is continual and extensive.

Interview of Subject **THREE PIMH - Permanent Italian Male with High earnings**

Personal motivations T1

Subject THREE decided to return to Italy from his only experience abroad for working and personal reasons.

He stated that his character does not fit well with changes, and this is something that has been part of him since his childhood and still is.

Even now, when he has to move abroad (he still does that from time to time, for no more than a month) for his research activity, he recalcitrates until the last minute.

He likes his city and environment and highly values closeness to his family and friends. He finds it very challenging to know a new city without having any contacts and not understanding the language.

Work-related motivations T2

He was hired with a permanent position at IFN-CNR during his visiting abroad. At that point, he had to choose between remaining and staying abroad or returning to Italy.

Although he liked the foreign working environment, he felt insecure about his contract's length and stability.

On the other hand, he was offered a permanent position in Italy, and he chose to come back.

He preferred "*il posto fisso*" (the fixed-term position).

He also stated that he had (and still has) a close working group with whom he collaborates very well, and he didn't want to lose it.

He is quite happy with his work and career and never felt the urge to move abroad to be fulfilled.

He also stated that a higher salary does not interest him as with a higher wage comes more responsibility, which he doesn't want.

He prefers to keep experimenting in labs rather than having to deal with management and administration's issues.

Country's environment motivations T3

During the interview, the subject talked about his insecurity in moving to a city that he doesn't know, with no contacts, no family, and without knowing the language.

He recognises that it is more a personal issue than something really linked to the country's social or cultural environment.

Impact on collaborations T4

His network is quite international, and he often goes abroad for short-term visits (no more than one month at a time) when his expertise is required.

He maintains contacts with the German group where he visited and collaborates with a wide variety of international experts.

His scientific production is highly considered, and he is well known at the international level.

Interview of Subject **FOUR PIMM** - *Permanent Italian Male with Mid earnings*

Personal motivations T1

Subject FOUR decided to not move abroad for both working and personal reasons.

In his words, he was never interested in looking for other positions in a foreign country: "*per comodità*" (due to comfort).

He was satisfied with the situation he had, and he didn't want to move his family.

Work-related motivations T2

Subject FOUR liked his working environment and decided to pursue the work he was doing with his research group and not change his setting.

He had a strict collaboration with a research working group, and he felt that moving abroad would have troubled his network.

He feels that someone need to stick with his own position to move on in the Italian academic environment. To move abroad means to lose your advantages.

Country's environment motivations T3

During the whole interview, the subject never mentioned motivation related to the country's social, environmental or welfare conditions.

Impact on collaborations T4

He collaborates with several international scientific groups, and staying in Rome his whole career didn't affect his network. He maintains his wide international collaboration's network through participation in several EU scientific projects.

He is very active and has a vast scientific exchange.

Interview of Subject **FIVE PIFH** - *Permanent Italian Female with High earnings*

Personal motivations T1

The main reason for subject FIVE not moving from Italy and not looking for other positions in a foreign country is personal.

She was quite happy with the situation she had in her own town. She liked the proximity to her family and friends as well as the comfort of knowing the city. She also owns a house, so the expenses she faces every month are fewer.

Work-related motivations T2

She found sufficient motivation in the work she was conducting in Rome for not moving abroad.

The only occasion she had to move abroad didn't meet her expectations.

Although very well paid, the position offered was more close to technical work than to research's one, so she refused it.

She was more interested in maintaining the working group she built in Rome and pursuing the kind of activities she liked.

Over the years, she became a "First researcher", which is quite satisfying for her.

Country's environment motivations T3

During the whole interview, the subject never mentioned motivation related to the country's social, environmental or welfare conditions.

Impact on collaborations T4

She collaborates with several international scientific groups, and staying in Rome her whole career didn't affect her network. Her lack of migration does not affect her project's collaborations, and her publications are mostly international.

Interview of Subject **SIX PIFH - Permanent Italian Female with High earnings**

Personal motivations T1

The main reason for subject SIX to return to Italy after her only experience abroad and not looking for other positions in a foreign country was personal.

She was married at the time, and her partner worked as well in the Milano area. She was determined not to disrupt the life that she liked as it was.

Over the years, other personal reasons emerged, such as proximity to her family and friends, comfort in knowing the city, homeownership and so on.

Work-related motivations T2

Even though she spent her whole career in Milan at IFN-CNR Institute, she quickly advanced.

After only one year, she became "First Researcher", and recently (in 2019) she became "Director of Research".

She was quite happy with her salary and advancement. She was also quite independent regarding her research activity, so she never really felt the need to look abroad.

Country's environment motivations T3

She reported the feeling of being treated as an "immigrant" in a foreign country. That is how she felt during her visiting abroad in Canada, and this was a feeling that she didn't want to feel again.

Impact on collaborations T4

She collaborates with several international scientific groups, and staying in Italy didn't affect her network. She also won an ERC starting grant in 2012 and an ERC- Proof of concept in 2018.

Her project's collaborations are not affected by her working steadiness, and her publications are mostly international.

Discussion of the surveyed scenario

As we did with the previous interviewee group, in this section, we will provide a discussion about the interviews presented in the last segment.

From the direct experience of the group of subjects, it is possible to highlight some key emerging outlines.

For the sake of readability, we will organise and group them, following the order of the original topics:

Personal motivations T1:

Also, for this second group, we can state that personal - especially family relationships - significantly impact the decision to stay or leave the country of origin.

Sometimes this even overcome a higher salary and a better position.

Other personal drivers to consider are the predisposition to travel abroad and the ease of adapting to a new situation, which in some cases were determinant.

Work-related motivations T2:

All the researchers interviewed are happy with their career and autonomy, and none of them regrets the decision not to emigrate.

From the conversations, it emerged that, despite some initial difficulties that occurred in some cases, the career path is satisfactory for all interviewees.

The salary is considered satisfactory by all the interviewees, and, in some cases, it is not an aspect that is critical for job choices. Other elements such as autonomy and personal satisfaction are preferred.

Country's environment motivations T3:

For this second group, this appears to be a variable with little impact. In some cases, the feeling of being treated as an immigrant and not welcomed was reported, but it was not considered crucial for any of the subjects.

Impact on collaborations T4:

All interviewees stated that not having been abroad for long periods did not prevent them from developing an international network and important collaborations.

They all have international contacts, coordinate several European projects, and have relevant scientific production.

They think that the decision to stay in Italy has not compromised their career, contacts, and scientific production. Indeed, in some cases, they are convinced that having remained in their country of origin has allowed them to develop their business further and take advantage of opportunities they would otherwise haven't had.

Chapter 4 – Policy’s implications

After exploring the phenomenon of the researcher’s mobility and migration from a quantitative and a qualitative point of view and addressing the different motivations involved, we would like to investigate what kind of policies could help the retention and development of the Italian researchers.

Usually, governments use a mix of fiscal policies to retain and attract back their researchers.

Some governments use a nationalistic approach to incentivise researchers to return to their countries or discourage those who choose to move abroad.

Others facilitate researchers' mobility and try to benefit from the uprising networks.

To explain the various kind of utilised politics, we can reference the classification used by L. Beltrame in 2007.

Return policies

This family of policies favours the return of the researchers with taxes reductions and facilities and funds for the researchers and the researcher’s family once relocated.

A few European countries have used these kinds of policies over the years: for example, England from 2000 to 2005 increased the post-doc salaries by 25% to those who decided to come back to the U.K, in 2007 Poland utilised a mix of taxes reductions and services offered to convince polish people to return in their country and Portugal, from 2019, promised full-time positions, money and a 50% tax reduction for five years, to researchers who decided to come back.

Italy used a similar approach for the first time in 2001, launching the “*Rientro dei Cervelli*” program. This program encouraged contracts with Italian and foreign scientists developing their research programs abroad, asking them to move to Italy for a variable time between six months and three years.

Universities and EPR had to cover 10% of the program's costs, and the Ministry of University and Research covered the difference. The main goal was to offer a salary in line with the European's earnings.

Unfortunately, the program wasn’t successful, and only 1% of the researchers used it (*Aspen Institute data*). This result is not unexpected and corroborates what emerged from our interviews: the salary alone is not the main variable determining the researcher's choice.

Over the years, different Italian regions offered similar solutions, and two main laws (Berlusconi’s govern “*Legge controesodo*”, 2010 and Renzi’s govern “*Impatriati*” since 2015) tried to promote huge tax reductions (between 30% and 50%) for those who decide to come back.

But none of these has been effective; although tax reduction is a good incentive for those who decide to move back, this is never the main reason the choice is made.

Restriction policies

These policies are those that set up barriers to migration. Those can be explicit laws or other forms of restrictions such as a lower number of PhD positions abroad offered by Universities.

Similar restrictions have been used in Italy since medieval times. Moreover, the first anti-migration law was enacted in 1868 during the Italian Reign trying to stop those migrating to Algeria or the United States. Only in 1901 migration has been recognised as a human right. Nowadays, in Italy, we don't have restriction policies like those used in the past, even though bureaucracy and the costs of documents' official translation often can discourage the process.

Recruitment policies

These are the policies apt to attract researchers from abroad to fill the workforce gap where is needed. They can be of an economic or legislative nature: tax reductions, direct funding, specific migration policies.

Several European countries use this kind of politics; Germany is the main promoter of these policies for researchers and highly qualified workers in any field.

One of the measures that Germany uses is the creation of "*assessors*": people dedicated to assessing the competencies of those who intend to move to their country to facilitate the match between the workers and the specific requests.

Another example is what the Czech Republic has implemented to retain international students: they favoured courses in the Czech language, increasing the cost of classes held in English. As a result, knowing the language, international students were more prepared for entering the Czech labour system after their degree and were more prone to stay in the country.

In Italy, the Ministry Gelmini tried a similar approach in 2008. The Ministry launched the program "*Montalcini*" to attract young scientists who lived and worked abroad for at least three years. The program offered each year fixed-term position contracts in Italy at the level of "*professore associato*"(Universities) or "*primo ricercatore*" (EPR) without a public competition (*chiamata diretta*).

While this program seemed to be successful initially, nowadays, only a few use it due to reduced funds over the years, which made hiring young researchers very difficult.

During our interviews, the importance of personal reasons linked to researchers' choice to stay or move emerged as a crucial variable.

One of the essential aspects was related to the family or spouse of the scientist's life and work situation and confronting that, a good example of migration policy that could help is the so-called "spousal hiring". This policy, unfortunately scarcely used, require the administration, university or company of destination to make every effort to help the researcher's partner find a suitable job.

In some cases (for example, german Universities), they even undertake to hire the person directly if finding a job elsewhere is not possible.

Compensation policies

These policies want to compensate the country of origin of the researchers with the idea to pay back for the education they've received.

Normally these are fiscal measures such as introducing more taxes on the earnings of the researchers that moved abroad.

These kinds of policies are very controversial: some think it is correct to charge those who decide to move abroad as an instrument of social justice; others believe that these interventions are against individual freedom.

Anyway, this form of policy is considered punitive, and the majority of the governments think that proactive measures are to be preferred.

Policies that use expats' resources and networks

These policies represent an emerging orientation that tends to use the economic and social human capital of researchers who migrated abroad as leverage for developing the nations from which they come and with which they maintain personal ties and nationalities.

In this perspective, the migration of researchers is not seen as negative, but all the positive effects deriving from the networks created are considered.

In Italy, most of the time, these networks emerge spontaneously and not as a direct result of national policies: during our interviews, most of the researchers who decided to move abroad maintained contact with their previous research group, which is very useful for both countries.

An example of how a government policy could help is the possibility given to Romanian scientists: those who moved abroad can come back to their home country for a month each year, funded by the public administration, to connect and share their competencies with local researchers.

In Italy, the closest proposal has been the creation in 2012 of the "Innovitalia" platform, planned by Monti's government.

Innovitalia is a scientific networking platform that aims to maximize the impact of the human capital of Italians abroad by promoting research and seeks to offer opportunities for national and international scientific and technological partnerships, and it is still active.

Conclusions

Analysing what has emerged from the interviews, we can say that all the subjects recognise the influence of the mobility of the researchers on scientific activities.

Mobility is credited as an internal process of a researcher's career apt to develop knowledge (Dosi et al. 2005) and scientific's competencies.

Both short-term and long-term mobility affect scientific production, and they ease the development of an active international scientific network that affects both the country involved.

Although analysing the interview made, it emerged that, at a personal level, some subjects value short term mobility but believe that a long term migration is a detriment for their scientific production and research activity.

As also discussed by Acker and Gill (2009), it is true that nowadays, virtual mobility has improved. ICT assets made virtual communication very easy, but all interviewees stated that virtual seminars and conferences would never replace in-person meetings and conventions.

The value they give to the latter is much higher, and they clearly stated that to start a collaboration or a project, discussion and meetings in person are necessary.

The semantic of "brain drain" indicating a one-sided flow of human capital from a country to others does not seem to correspond to the reality reported by the interviewees.

As described by the subjects, the mobility processes are not unidirectional, and studies that recognise the benefits from brain circulation and a positive return for the supplier countries seems to be more comparable to what they portrayed.

Collaborations are a key factor for the career and productivity of researchers, and both short-term mobility and long-term migration seem to help these processes.

All the interviewee has not confirmed the perception that an international experience is essential for career advancement.

During the interviews, researchers highly valued personal dynamics and cultural issues unrelated to the work environment and their scientific productivity.

The result presented in this work allows us to stress that conducting an investigation in the researchers' mobility field of study, based only on quantitative analysis, is not sufficient, even if necessary, to have a complete overview of the problem.

Instead, there are several personal factors to consider that are often not considered in the available analyses.

Therefore, we have brought to light what can be considered the main variables used in the researchers' choice process.

This analysis can help choose either at the national or administration level which kind of policies could be more helpful.

The working environment and conditions have been highly valued and seem more important than the salary itself: career possibilities, network available (students, PhDs, etc.), and scientific equipment. The administration should be able to provide a healthy environment with sufficient space and equipment to all the researchers; for this purpose, the government should fund more public research institutions (EPR; Universities).

Moreover, personal motivations have a deep impact: policies such as spousal hiring would be really helpful at the national and administration levels.

Finally, as mobility is so valued within the scientific community, and an international network is desirable, a real effort to integrate and embed those who decide to come back after an experience abroad should be made.

If a researcher who comes back from a valuable experience abroad perceives that the competencies learned are not valued, this will discourage him.

Often the management or coordination positions are distributed to internal staff for the mere fact of being on hold.

A change in assessment for career advancement, the introduction of a truly merit-based evaluation system, and a shift in attitude concerning the distribution of top positions is required.

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