MORE4 study

Support data collection and analysis concerning mobility patterns and career paths of researchers

PPMI, IDEA Consult and WIFO
February 2021

Research and Innovation

MORE4 study: Support data collection and analysis concerning mobility patterns and career paths of researchers

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EUROPEAN COMMISSION

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2021

Directorate-General for Research and Innovation
European Research Area

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Researchers and effective research systems are at the core of a knowledge-based economy. Both serve to push forward the frontiers of science and contribute to the use of knowledge to achieve economic and societal aims – helping not only to secure growth and jobs, but also to progress the digital and green transformation. The unified European Research Area contributes significantly to the free circulation of knowledge and researchers, increasing research productivity and the attractiveness of research overall. Since the launch of the ERA in 2000, the policy focus has more recently shifted to deepening the European Research Area (ERA), as outlined in the Communication on the new ERA[1]. This will further enhance the open labour market for researchers, based on transparent and competitive recruitment and facilitating mobility between countries, fields and sectors, with a view to enhancing brain circulation and access to excellence. The MORE4 study updates and expands on previous editions to meet the need for indicators over time and to assess the impact on researchers of policy measures aimed at increasing the attractiveness of research careers in Europe.

The first part of this executive summary presents the main conclusions of the study and its implications for policy making, giving special attention to its implications for the attractiveness and development of the ERA. Many of these conclusions reflect the general findings of consecutive editions of the MORE studies. The second part provides an overview of the main findings of the MORE4 study.

Policy-relevant findings and implications of MORE4 and the previous MORE studies

General cross-study findings

When knowledge is the principal factor behind competitive advantage, leading to increasing competition for talented knowledge workers, the attractiveness of research areas is crucial for sustainable and dynamic knowledge economies.

The consecutive MORE studies have revealed something of a 'global mindset' as to what makes for an attractive research career in academia. Attractiveness – a factor that shows up repeatedly in international mobility indicators – is driven by characteristics of research jobs that influence a researcher's scientific productivity, such as international networking, career perspectives and working with high-quality peers. Material working conditions – that is, those relating to remuneration, pensions, job security and other non-science related conditions – have an influence on job choices, all other things being equal, but are not decisive factors in decisions regarding jobs or mobility. A shared understanding also exists

[1] European Commission. https://ec.europa.eu/info/research-and-innovation/strategy/era_en

with regard to which skills and training (a PhD) matter for a research career, as well as which factors matter for recruitment and career progression in academia. While intersectoral mobility between higher education (HE) institutions and private firms is valued, it is still regarded as less important for recruitment and career progression than international and interdisciplinary mobility.

By contrast, researchers hold much more varied perceptions about the way in which countries organise and structure their research systems (i.e. the conditions they provide for researchers to achieve their maximum creative research potential). While diversity could have the potential to provide wider opportunities for learning, for example the lower levels of satisfaction reported with funding and career perspectives are not a sign that this diversity is always positive.

This discrepancy between a 'global awareness' of what matters for a successful research career, and the differences between national research systems, gives rise to varying perceptions of 'attractiveness' between countries. It also gives rise to varying patterns of international mobility, including asymmetric mobility or 'brain drain'. This is not pertinent not just at global level, between high-income countries with strong research systems and lower-income countries with weaker research systems, but also at European level. The findings of the MORE studies continue to point to persistent heterogeneity among EU countries. This heterogeneity is not just a result of different higher education systems and career structures, but also of economic development influencing public budgets for research, and hence research funding and salaries of researchers. **A continued, and even increased, emphasis on the reform priorities for the ERA and EU academic research systems** is hence a clear policy implication of the MORE study findings. This is also strongly reflected in the 2020 Communication on deepening the ERA in the context of the twin transition to a green and digital economy. Such reform relates not only the ERA's aim of helping weaker research systems to catch up with those at the forefront within the EU ('widening'), but also to helping the top EU research systems catch up with the top research systems globally. The nature of the relationship – win-win or win-lose – between the 'Global Research Area' and the 'European Research Area' will also depend to some extent on how level the playing field will be: Research institutions sharing a similar level of attractiveness will lead to knowledge exchange and brain circulation ("win-win"); major differences may lead to brain drain, i.e. a win-lose situation.

In addition to heterogeneity, and in common with previous MORE studies, the MORE4 study has identified a number of other policy-relevant findings:

- On the one hand, **several positive developments identified in MORE3 continue in MORE4**. Among these are the share of externally advertised positions; the agreement among researchers that recruitment and career progression are merit-based and transparent; the share of fixed-term contracts[2]; and satisfaction with working conditions – although these results need to be interpreted carefully.

[2] Fixed-term contracts are all employment contracts which are not open-ended, i.e. with a set end date.

These positive developments at EU level mask wide variations between countries. In terms of gender balance, almost equal shares can be seen among researchers in the early stages of their careers, but there continues to be a large imbalance in favour male researchers in later career stages. As yet, it is unclear whether this current balance among early career-stage researchers will be maintained in order to significantly change the 'glass ceiling' phenomenon observed in most EU countries.

- Another important finding is that **research careers are attractive by nature**. This was found in previous editions, and is strongly confirmed in MORE4. Intrinsically motivated researchers enjoy the intellectual challenge and level of responsibility that come with the activity of research. Increasing the number of researchers is hence less a task of building motivation, but of improving working conditions and career paths so that researchers are able to do what they are interested in. Poor working conditions lead to people opting out of a research career or to 'forced' international mobility. Attractive working conditions and career paths can also compensate for dissatisfaction with pay.
- Another finding that continues to be valid across MORE studies, is that **several areas remain in further need of reform**. The heterogeneity of research systems with respect to, for example, conditions for research such as funding or career perspectives has been pointed out at the beginning of this section.
- Interest in **intersectoral mobility or industry experience** among academic researchers currently working in higher education institutions (HEIs) in the EU remains low. This relates not only to dual positions or periods of mobility, but also to whether industry exposure or intersectoral mobility is perceived as being important for PhD training, or whether entrepreneurship and understanding of intellectual property rights (IPR) are important skills for a research career. It is important to note that these findings only reflect the perceptions of researchers currently working in the HE sector, and not those of researchers who have already chosen a career in industry (unless they held a dual position within academia). Nevertheless, the low level of interest among academic researchers in these types of experiences is a finding that should be taken into account. Further research is required into whether this lack of interest is simply due to a lack of knowledge about career options outside academia, or relates to a limited recognition of this type of mobility in the criteria for assessing researchers. It should also be pointed out that a similar situation can be seen in non-EU countries.
- Transferable skills are regarded as very important for career progression and recruitment by more than 86% of researchers in the EU, ranking just below international mobility. Yet only 32% of PhD candidates and recent graduates indicate that they have actually received training in transferable skills such as time and people management, grant writing or communication and presentation skills.

With regard to perceptions of the attractiveness of the EU as a place to do research, several findings emerge robustly in successive MORE studies:

- First, the more advanced the non-EU research system from which researchers come, or in which researchers have worked, the less positively the EU is regarded as a place to carry out research. Conversely, researchers with experience in less advanced research systems tend to regard the EU more favourably;

- Second, the relative strengths of the EU are perceived as being linked to working conditions that do not relate to the research itself: social and job security, pension plan and the quality of (undergraduate) education and training. On balance, the EU is perceived to be less good than the most advanced research systems in terms of working conditions that influence researchers' scientific productivity: in particular, career paths, research funding, and the availability of suitable positions.
- Third, in terms of specific countries or regions, the US is perceived as being much more attractive than the European Union.
- Fourth, it is important to stress that the above findings are based on results for the EU as a whole. At the same time, these findings are driven by large differences between Member States and institutions – with certain institutions being very competitive at a global level.

Moving forward: improving the attractiveness of the ERA

Increasing the attractiveness of the ERA as a place to do research hinges on many factors that influence the scientific productivity of researchers. These factors are conceptualised in the study as **drivers and enablers of attractiveness**.

In both MORE3 and MORE4, research funding and the availability of positions are perceived to be the two biggest barriers to mobility. Improving these factors would reduce barriers to mobility and make it easier for researchers to become mobile. We therefore term these two areas **enablers** of attractiveness: factors which, if improved, would no longer represent a barrier to mobility and would instead enable international mobility for all those who are interested in it. Further enablers of attractiveness relate to pension portability or immigration rules. However, these administrative barriers are not perceived to be the main barriers to international mobility.

The quality of working conditions that influence scientific productivity are the main **drivers** of the attractiveness of jobs in research. These include the opportunity to work with leading scientists; long-term career perspectives (e.g. a tenure track model); research autonomy; and the balance between teaching and research. All of these factors drive the decisions of researchers to become mobile. Indeed, previous evidence from the MORE2 study indicates that researchers are "willing to pay", i.e. to sacrifice some level of salary, in exchange for higher-quality working conditions that are relevant to scientific productivity.

In summary, what is needed are attractive working conditions for researchers that help them implement their research agenda. This implies a **strong policy focus on boosting conditions for scientific productivity** in all Member States and at EU level, to foster symmetrical mobility of researchers (brain circulation) and increase the attractiveness of the EU as a place to do research, as reflected in the 2020 Communication on the ERA. The policy instruments intended to bring about a stronger focus on scientific productivity are outlined below, in the section on the implications for the use of policy instruments. First, we provide an illustration regarding policies to encourage return mobility. The MORE studies have consistently shown that the return mobility of researchers is high during the early stages of their careers– once they are established or tenured at a prestigious university, it is very difficult to attract them back to their home country. This means that efforts to recruit the most promising researchers are more likely to be successful during

the early stages of their career, rather than later. In practice, this means offering attractive career perspectives (e.g. those based on a tenure track career model) to early-stage researchers. Trying to recruit leading researchers during the later stages of their careers will be more costly by comparison, as they are less likely to move. This is not to say that return mobility policies are necessarily ineffective, but that they cannot replace an attractive research system for early stage researchers.

Implications for use of policy instruments: in terms of overall instrument use, increasing attractiveness of the ERA in terms of conditions for knowledge production can follow the four-pronged strategy introduced in MORE3 and confirmed by MORE4:

- **Increase research funding**, which continues to be perceived as the working condition in the EU with which researchers are least satisfied; many EU initiatives are well targeted and evaluated, but their impact remains limited due to low success rates in Horizon 2020. While there has been some increase in the budget for Horizon Europe, a substantial increase in research funding will have to come from EU Member States. Without an increase in research funding, it will be difficult to improve the availability of research positions or research projects that can be funded, leading early-stage researchers to look at research systems offering more attractive conditions in that regard.
- **Ensure that this money flows to the most promising researchers and research projects**, particularly within systems in which the overall amount of public research funding is limited. The European Research Council (ERC) and Marie Skłodowska-Curie Actions (MSCA) are funding schemes that are clearly successful in allocating money to highly promising researchers.
- **Attract the most talented researchers** by offering attractive career paths and working conditions for research, as outlined above. Among all working conditions in the EU, satisfaction with career perspectives is third-lowest; in particular, researchers perceive career perspectives to be better outside the EU than inside. Several EU instruments in terms of an open labour market (ERA) and Open, Transparent and Merit-based (OTM) recruitment are also important here.
- **Ensure that knowledge is shared among policy makers** as to how the first three elements can be most effectively achieved, taking account of the heterogeneous nature of national research systems across the EU.

Some specific qualifications need to be added:

- First, satisfaction with the **balance between teaching and research** is second-lowest after funding. Research based on MORE2 data found that 'research-only positions' are actually not a driver of attractiveness, and that even some teaching is preferred to no teaching at all. However, too much teaching clearly reduces the attractiveness of a job in research.
- Second, when a higher share of researchers are in tenured positions, care needs to be taken to **ensure incentives for scientific productivity remain high throughout the life-cycle of researchers**. This can be achieved, for example, through the allocation of funding and through a flexible balance between time for research and time for teaching.

- An increased **emphasis on drivers of attractiveness does not mean that enabling conditions should be overlooked.** For instance, one general enabling prerequisite for international mobility, or for researchers coming to the EU, is also simply the ability to teach in English – not in terms of the researcher speaking English, but in terms of the university allowing the researcher to teach a course in English. Failure to do this often limits the international recruitment of researchers. Lastly, several EU instruments are in place to improve social security/pensions portability (EURAXESS, RESAVER).
- In addition, **synergies** between European funding for regional development and research excellence or innovation can be further explored, with respect to the role they can play in reducing the innovation gap.

These general findings across consecutive MORE studies clearly call for a renewed impetus to increase the attractiveness of the EU as a place to do research. Such efforts could benefit from regular monitoring of the attractiveness of research systems in terms of attractive job offers. Such a regular 'ranking' of the attractiveness of research systems with respect could provide reform incentives for policy-makers, similar to the rationale behind the European Innovation Scoreboard (EIS). It is also in line with EU initiatives announced within the framework of the 2020 Communication on the ERA, such as monitoring brain circulation.

Policy implications for knowledge exchange and mobility

Mobility both mirrors and affects attractiveness. International mobility drives international collaboration, networking and knowledge exchange, which in turn are positive for an individual's research performance. **At individual level**, researchers regard international mobility as having positive effects on advancing their skills and scientific productivity, as well as on their career progression. The mobility perspectives of a research position therefore affect that position's attractiveness. **At system level,** international mobility facilitates capacity building and interconnectivity within the system. The attractiveness of regions, countries or systems for carrying out research is mirrored in their mobility flows. As stated above, asymmetric mobility flows reflect the heterogeneity in national research systems across Europe, and result in unbalanced brain circulation or even brain drain issues. Many of the ideas mentioned above on the attractiveness of the ERA will thus also affect international mobility.

In particular, the study looks at **voluntary mobility**, driven by scientific productivity conditions, as the type of mobility that fosters knowledge exchange, return mobility and strong international networks. It is important to continue policy efforts to improve international mobility conditions (enablers and drivers), as well as to foster symmetrical mobility by reinforcing the attractiveness of national research systems, with research excellence as its first precondition (as stated above).

In this context, it is necessary to give attention to the specific situation of **early-stage researchers**. Even though the drivers of mobility for early-stage researchers are generally the same as those for post-PhD researchers, early-stage researchers are at the same time more focused on their training and on the availability of research funding and positions.

Actions or services can therefore be further addressed towards young researchers by taking these specific needs into account.

Interdisciplinary mobility, defined as moves between fields and collaboration with other fields, is regarded as a positive factor for the recruitment and career progression of **individual researchers** (less so than international mobility, but more so than intersectoral mobility). As in the MORE3 study, MORE4 data indicate that researchers who have worked in projects funded by an MSCA or an ERC grant tend to display higher levels of interdisciplinary mobility and collaboration than the general population of researchers. An opportunity exists for these types of programmes and initiatives to promote a clear-cut definition, and to continue monitoring numbers and the effects of interdisciplinarity in research.

The concept of interdisciplinarity is also of increasing importance **at system level**. The missions introduced under the mission-oriented policy approach applied in Horizon Europe are expected to link activities across disciplines and types of R&I[3]. The scientific and innovation solutions required to help solve some of the most challenging problems of this time will require an interdisciplinary approach, and this will be further supported via the Horizon Europe programme.

Intersectoral mobility is considered a key element in knowledge transfer, at all career stages and in all fields. Initiatives promoting intersectoral mobility – and more generally, strong interconnectivity with other sectors and other actors – can be part of the solution to **close the gap between academia and industry**. Exposing **individual researchers** to other sectors and research environments will also improve their employability in multiple career paths. However, as indicated above, MORE4 findings show that interest in intersectoral mobility remains low among researchers currently working in EU HEIs. In addition to mobility into other sectors, other forms of exchange and collaboration should be fostered to exploit the potential of industry-science linkages and the transfer of ideas. Good examples of this include the MSCA co-funding of doctoral programmes and the MSCA Research and Innovation Staff Exchange (RISE) which are based on flexible intersectoral exchanges (within Europe) and international exchanges (with third countries) involving highly skilled research and innovation staff.

Finally, the concept of **Open Science** is expected to increase efficiency and creativity, reinforce excellence, and strengthen society's trust in science[4]. Reinforcing an Open Science culture begins with education and training. At the same time, one of the main challenges involved is to reward and incentivise Open Science contributions in a variety of possible career paths. Data from the MORE4 study show that training in Open Science approaches is still limited within Europe, and that Open Science practices are less widely regarded as positive for recruitment or career progression by individual researchers, when compared with most other factors. However, there are indications that funding can play a role in better understanding Open Science and encouraging an Open Science culture. The

[3] European Commission. https://ec.europa.eu/info/horizon-europe/missions-horizon-europe_en
[4] COM(2020) 628 final

findings of the MORE4 study thus confirm the need to continue efforts in the field of training and assessment frameworks, as well as providing encouragement by integrating elements of Open Science into EU research funding instruments, to further support an Open Science culture.

Policy implications for gender equality

Although international competition for talents has accelerated, to a certain extent women's talents are underexploited in various areas of social and economic life. While a quantitative catching-up of women in terms of access to academic positions has been observed over recent decades, this trend has stagnated. Both the literature and statistics agree that gender inequalities persist in terms of recruitment and career advancement in higher education systems.

The results of MORE4 show that the **participation of female** researchers in the EU labour market has stagnated since 2012. Compared with the share of female researchers at earlier career stages, women **less often occupy leading scientific positions**, with the gap being particularly high in Health Sciences. Increasing the share of more senior positions held by female researchers may also help them to be more optimistic about their financial situation. Overall, female researchers perceive their **financial situation** in a more pessimistic way than men, and are less likely to be satisfied with their pension plan, social and job security. This is accompanied by an unequal distribution of **contracts and positions** to female and male researchers. Although the overall share of researchers with permanent contracts has increased since 2016, a gender gap still persists, with more women than men being on fixed-term contracts. Female researchers are les likely to be in full-time positions than their male colleagues, although male researchers are more likely to have children.

Gender equality has been deeply integrated into all types of policies and programmes for researchers at EU level for more than 20 years. In March 2020, the European Commission presented its `**Gender Equality Strategy 2020-2025**', which addresses various fields in which gender inequality still persists. New measures to tackle this will be developed under the **Horizon Europe** European Innovation Council. In recent years, there has been growing understanding that action at legislative and institutional levels is crucial to achieving gender equality, which requires the combined effort of various stakeholders including the Member States, research funding organisations (RFOs) and research performing organisations (RPOs). These developments mark a change in direction from `fixing women' to `**fixing institutions**' through comprehensive gender equality plans to achieve institutional change, as well as `**fixing knowledge**' through Horizon 2020 and various national research funds, to ensure that new research incorporates sex and gender analysis.

Gender monitoring already takes place in the large majority of ERA countries[5]. However, more evidence as to what really leads to structural change in the long run could feed into

[5] A screening of the ERA NAPS shows that gender is addressed through many measures.

mutual learning exercises. Attention should be given to evaluating initiatives with a longer-term implementation and effect (e.g. initiatives implemented within education systems, promoting the presence of women in leading positions in science and technology, etc.), which might support such **structural change**.

Such action is even more important, given that existing gender inequalities threaten to worsen as a result of the **COV19** pandemic and economic crisis. This worsening has taken place within just one year, demonstrating once again how deeply rooted gender inequality is within various aspects of European societies. A strategy for economic recovery that improves access to inclusive, high-quality early childhood care, education and upbringing – which is known to compensate for social disadvantages – would bring socioeconomic benefits in the medium and long term, and open up opportunities for women to participate fully in the labour market.

Key figures and findings of the MORE4 study

The MORE4 study was conducted under the framework contract "PO/2016-06/01 – Lot I – Impact assessment, evaluations, and other evaluation-related studies in the field of communication activities". It provides an **update to, and further elaborates on, the set of indicators** reported in the previous MORE studies, thereby addressing the need for indicators needed to assess the impact of policy measures introduced during the implementation of the European Partnership for Researchers (EPR)[6]. It also reflects upon a few new indicators introduced in the MORE4 study to meet emerging policy needs and priorities, such as the concept of Open Science and other developments identified in the impact assessment of the forthcoming framework programme Horizon Europe.

The main objective of the MORE4 study is defined as:

"Carrying out two major surveys and developing indicators to help monitor progress towards an open labour market for researchers"

To achieve this objective, a set of four complementary and interlinked tasks were performed by the study team. These have provided detailed insights into researchers, their career paths, employment and working conditions. The tasks were as follows:

- Task 1: Carry out a survey of researchers currently working in the EU (and EFTA) in higher education institutions (HEI);
- Task 2: Carry out a survey of researchers currently working outside Europe;
- Task 3: Review and update the set of indicators developed for continuous monitoring of relevant trends and progress made in the field; and

[6] COM(2008) 317 final: Communication from the Commission to the Council and the European Parliament of 23 May 2008 "Better careers and more mobility: a European partnership for researchers".

- Task 4: Draft a final report providing policy-relevant comparative analysis on the subject matter.

Box 1 outlines the main dimensions analysed in the MORE4 study. First, the study investigated the situation in Europe with regard to human resources (number of researchers and PhD candidates across countries, career stages and fields of science). Second, the study looked into the main characteristics of researchers´ career paths and working conditions. It combined information on these dimensions (e.g. types of contracts) with data on researchers´ perceptions (e.g. satisfaction with career progression, remuneration, balance between teaching and research, etc.). Third, the MORE4 study analysed researchers´ patterns of mobility and collaboration. International, intersectoral and interdisciplinary types of mobility and collaboration are the main focus of the study.

Box 1: Main dimensions analysed in the MORE4 study.

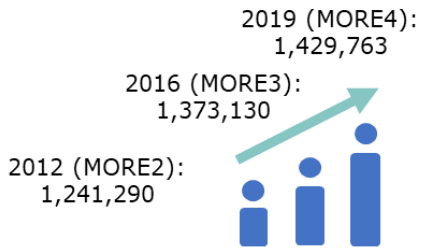
- Human resources: numbers and training
- Career paths
- Working conditions
- Mobility and collaboration:
- International mobility and collaboration
- Interdisciplinary mobility and collaboration
- Intersectoral mobility and collaboration

The following infographics provide an overview of the key statistics and indicators from the MORE4 study. Next, the main findings are summarised in text per dimension of analysis.

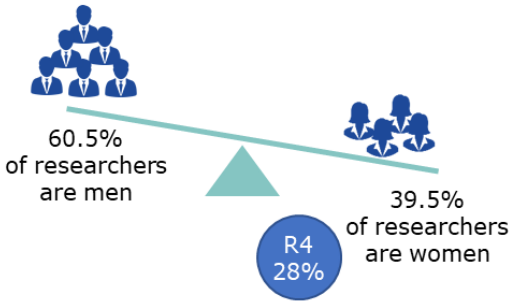
Overview of key statistics and indicators

MORE4 key statistics and indicators

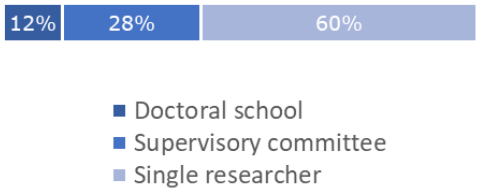
Number of researchers in EU28+3



Gender balance in EU28+3



PhD training in the EU28



Share of researchers receiving training in transferable skills during PhD **32%**

86% Share of researchers finding transferable skills training important

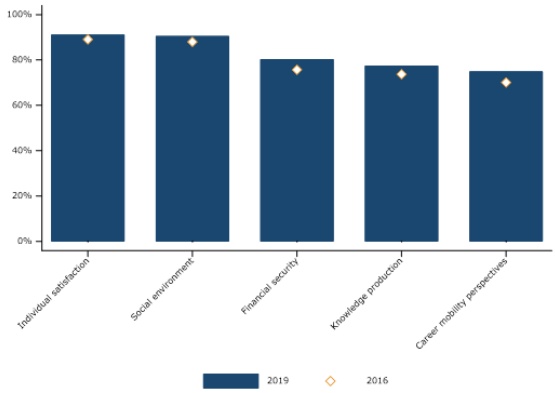
Positive factors for recruitment and career progression in HEI the EU28

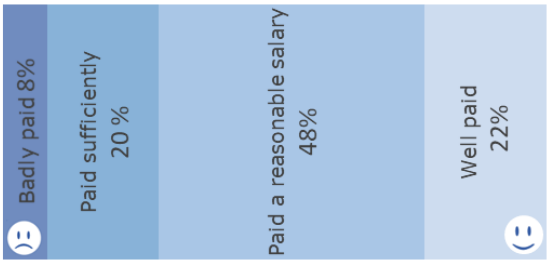
Recruitment		Career progression
91.8	Project-related work experience	91.3
88.4	Knowledge transfer	87.8
86.6	Internat. mobility	85.7
85.8	Transferable skills	86.2
75.1	Interdisciplinary mobility	76.1
73.5	Public awareness activities	76.7
68.5	Publication(s) in open access journals	71.3
59.7	Intersectoral mobility to government sector	62.1
58.9	Intersectoral mobility to private industry	61.1

Vacancies are sufficiently advertised	**87.0%**
The recruitment process is sufficiently transparent	**81.5%**
The recruitment process is sufficiently merit-based	**82.9%**

MORE4 key statistics and indicators

Satisfaction with working conditions in EU28





International mobility for or during PhD

PhD mobility:
16% of R1 and R2 researchers

>3 months during PhD:
23% of R1 and R2 researchers (18% in 2016)

International mobility in post-PhD stages

27% of researchers currently working in the EU have been mobile in the last 10 years for more than 3 months

International collaboration

63.1%
collaborate with researchers in their own country

65.3%
collaborate with researchers in EU countries

48.8%
collaborate with researchers in non-EU countries

Interdisciplinary collaboration

68%
in the same institute

63%
in other universities or research institutes

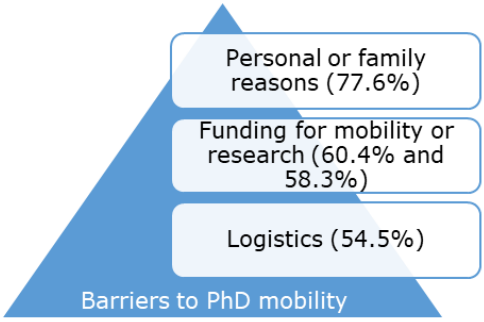
26%
in non-academic sector

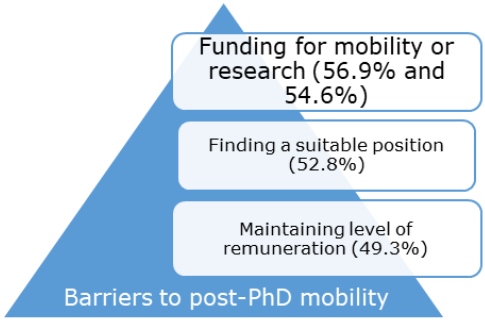
Intersectoral collaboration

32% of researchers collaborate with non-academic sectors

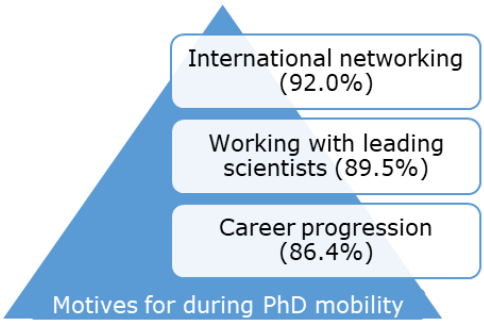
MORE4 key statistics and indicators

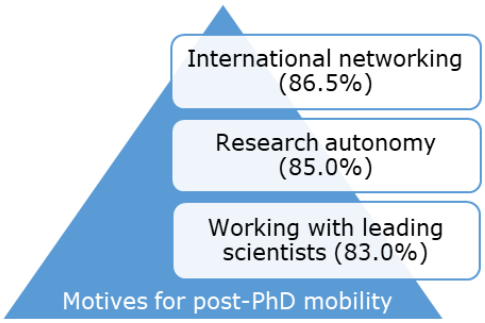
Enablers for international mobility

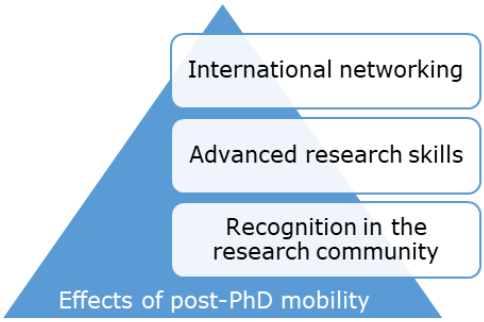




Drivers for international mobility







Strengths and weaknesses of the ERA (direct comparison)

Salaries

Availability of positions

Conditions for knowledge production (funding, career paths, teaching-research balance)

Social security

Quality of life (vs. US)

Education and training

Human resources: gender equality

The MORE4 findings confirm the existing literature: a persistent gender imbalance is also found within the higher education sector. The participation of female researchers in the **EU labour market** has stagnated since 2012 (currently, 40% of researchers are women). In most EU28 countries, **female researchers** are significantly **underrepresented**, particularly in **top scientific positions** (28% of R4 researchers are women). Of all grade A positions, only 26% are occupied by women and the proportion of women on boards was just 31% in 2017. The fact that the proportion of female researchers in early career stages is fairly high (51% of R1 researchers are women) could suggest that a more gender-balanced situation will emerge at all career stages in the future – or equally, it could be interpreted as suggesting the persistence of a 'glass ceiling' at which female researchers drop out before they reach the higher career stages.

Among groups of part-time and full-time workers, more men are to be found at high career stages than female researchers, pointing to a **glass ceiling effect**. Moreover, fewer men with children work **part-time** (4%) than men without children (13%). In contrast, there is no large difference between female researchers with and without children who work part-time (11% versus 14%). This hints at a continuous transition of female researchers from part-time work in early career stages into part-time work induced by childcare responsibilities. To a certain extent, higher shares of part-time working mothers than part-time working fathers are rooted in the unequal distribution of time spent on childcare.

The data from the MORE4 EU HE survey suggest persistent gender differences in researchers' perceptions of **recruitment processes** between countries. In most countries, the share of female researchers who perceive recruitment as open, transparent and merit-based is lower than the respective share of male researchers. This picture corresponds with the fact that female researchers are, on average, more pessimistic about their future **career prospects** than their male colleagues. Only 23% of female researchers feel very confident about their future career prospects (men: 34%). More male (81%) than female (73%) researchers have **permanent contracts**. Although the total share of researchers with permanent contracts has increased within the EU28 since 2016, the gender gap has remained stable.

Gender differences in the perception of **remuneration** vary greatly between countries, though in almost all EU countries, the share of female researchers that perceive themselves as well or reasonably well paid is below that of male researchers. An upward trend in female researchers' satisfaction with **social security, pension system and job security** can be observed in the EU28 since MORE3. This increase, however, is not specific to female researchers, but mirrors an ongoing increase in the average shares of satisfied researchers overall, observed since 2012. On average, fewer female researchers than male are satisfied with their social security (a difference of -5 percentage points); pension system (-8 percentage points) and job security (-6 percentage points).

Box 2: Main findings on gender equality

- Stagnation in female researcher participation in the European labour market
- Wide variation in terms of gender-balance between EU countries and between age groups;
- Significant under-representation of female researchers at the highest career stages, particularly in Health Sciences;
- Improvements in terms of female researchers' perceptions of recruitment and career progression. However, in most countries the share of satisfied female researchers remains below the corresponding share of male researchers.
- Women report lower confidence in their future career prospects;
- More men than women working in research have children;
- The share of researchers with permanent contracts has increased, but the gender gap remains;
- Fewer female researchers regard themselves as 'well paid' or 'reasonably well-paid', irrespective of their career stage;
- Fewer female researchers are satisfied with their social security, pension arrangements and job security.

Human resources: PhD training

PhD training remains the main point of entry into research careers, with 92% of academic researchers who are currently working in the EU holding a PhD or participating in PhD training. This figure remains unchanged from MORE3. As a consequence, the quality and content of PhD training matters: i) in order to attract researchers into research careers; ii) to attract talented researchers from abroad, as there is international mobility of talented students looking for the best training; and iii) for the outcomes of research activity, such as scientific productivity in the EU, industry research performance and wider societal goals that are potentially affected by PhD training.

In spite of the universal role played by the PhD, training structures and content differ considerably, both within the EU and between the EU as a whole and non-EU countries such as the US. Again, these differences are along similar lines to those seen in 2016. First, in terms of the structure of PhD training, PhD candidates in the EU on the whole describe being predominantly supervised by a single researcher (60%). Supervisory committees (28%) or doctoral schools (12%) remain a minority, in contrast to the US. Joint doctorates are much more common among researchers currently working in the EU (31%) than in the non-representative sample of researchers working outside the EU, reflecting the rich diversity of the EU doctoral programmes.

Second, in terms of the content of PhD training other than the core academic specialisation in a research field, we see that while 86% of EU researchers think that transferable skills have an important influence on career progression, only 32% of PhD candidates in the EU receive training in transferable skills. Training generally focuses on skills more closely aligned to core research activities, such as research skills, communication and presentation skills, critical and autonomous thinking, time management, decision making and problem solving (62-90%). Skills such as negotiation and entrepreneurship (both 23%) are less frequently part of transferable skills training.

This is consistent with what PhD candidates think is important in their PhD training: the foremost aspects mentioned by respondents were research excellence (90%); and attractive working conditions for research (such as research independence and career development opportunities: 88%). Intersectoral collaboration and industry funding are perceived to be least valuable, at odds with the principles for innovative doctoral training, of which only 17% of R1 and 13% of R2 researchers are aware. PhD candidates' expectations are more likely to be focused on remaining in (academic) research, and therefore perhaps place a lower value on skills that may be more useful elsewhere. All of these findings remain almost unchanged since MORE3.

Box 3: Main findings on PhD training

- PhDs are main port of entry into research careers – their quality and content matters;
- Wide variations at EU level in terms of the structure and content of PhD studies; joint degrees are more common inside the EU than outside it;
- Single-researcher supervision dominates over more structured forms of training;
- Although regarded as important for career progression, only one-third of PhD graduates received training in transferable skills;
- Intersectoral mobility or industry exposure is seen as less important for PhD training than core research skills.

In terms of policy, the high share of single-researcher supervision and variations between countries with respect to the transparency and accountability of procedures for admission, supervision, evaluation and career development indicate that there is room for the further professionalisation of PhD training in the EU, e.g. through the introduction of more structured PhD training. Given the relatively low levels of structured training in many EU countries, increasing the budget for MSCA co-funding of doctoral programmes could be investigated.

While the Salzburg Principles mention that it is recognised that doctoral training must increasingly meet the needs of an employment market that is wider than academia, PhD candidates' perceptions of what is important in PhD training, as well as the actual training itself, indicate that less value is given to training content that is further away from the core research specialisation, such as opportunities for intersectoral mobility or exposure to industry. While structured training would make it easier for industry-science mobility programmes to be drawn up, further research is needed to illuminate the tensions between the demands of academic excellence in basic research (requiring specialisation in research), and the acquisition of broader skills or more applied industry experience, to keep researchers' labour market options open. The role in mitigating this tension of industry-oriented doctorates – as practiced, for example, by the European Industrial Doctorates – could be further investigated. Other examples exist at national level, such as the COMET funding programme by the Austrian research promotion agency FFG. This promotes research cooperation between businesses and research institutions, including universities, by funding research centres where both industry and academic researchers work together, and where pre-docs also work. Pre-docs hence receive early industry exposure, and get to see what working in industry is like. Such schemes could be a way to

boost both research funding overall, linking science and business as well as opening up avenues for PhD students.

Improving the quality of PhD training is likely to lead to inflows of early-stage researchers into research careers. But it may also lead to an increased outflow of talented young academics at a further stage, when career prospects and the general attractiveness of academic careers in the country of graduation do not follow match expectations, with better-trained PhD holders then being in a better position to access the global market for scientists. Accordingly, the next section will present findings from MORE4 on recruitment, career progression and career paths.

Career paths

After completing their PhD training, researchers often face country-specific recruitment and career progression procedures which lead to country-specific career paths and, more generally, to structural differences between national higher education systems. The structure of career paths is a main determinant of the attractiveness of a research system, as it conditions career perspectives and the time horizons for research agendas: short fixed-term contracts do not allow the pursuit of long-term research strategies involving greater risk. Previous research has found that career perspectives – or, more precisely, career paths – that lead to tenure based on merit alone, are the most important determinant of job choice in academia for early stage researchers.

A relatively high share of researchers agree that their home institution practices open, merit-based and transparent recruitment, particularly with respect to its vacancies being sufficiently publicly advertised. However, as with PhD training, wide difference exist between countries. While on average, career paths are regarded as relatively transparent (76%), in some countries a significant share of researchers disagreed with this. Across the EU28, researchers' assessments of career progression and tenure contracts as being based on merit is not satisfactory on average (74% and 73%, respectively), with one in four researchers stating that it is not merit-based.

Box 4: Main findings on career paths

- A majority of researchers in the EU think that recruitment and career progression are transparent and merit-based; however, wide variations exist between countries;
- Aside from research performance, the main factors for recruitment and career progression are project-related work experience, knowledge transfer, international mobility and transferable skills; on average, intersectoral mobility is less valued in the EU, with some variation between countries;
- While a majority of researchers have open-ended contracts, different career systems give rise to different shapes of the 'pyramid' – young researchers embarking on a research career in HE enjoy different opportunities according to their national research systems, with problems ranging from "getting in" to "getting up".

Positive factors for career progression are very similar to those for recruitment. On average across the EU28, researchers perceive project-related work experience (91%) %) as being most positive for their career progression. This is followed by engagement in knowledge transfer, including the management of research or innovation, contribution to patents or the development of inventions (88%); international mobility (87%); and transferable skills (86%). Mobility experience to the private sector is perceived as having the weakest positive impact (61%) and the greatest negative impact (6%). In the cases of intersectoral and interdisciplinary mobility, and alternative forms of research output (such as project reports or grant writing), wide variations can be seen between countries across the EU. Among those transferable skills regarded as important for career progression in HEIs, the most valued are those at the core of an academic research career, such as decision making and problem solving, critical and autonomous thinking, communication and presentation, networking and grant and/or proposal writing (ranging between 96 and 98%); entrepreneurship (71%) and dealing with IPR (74%) are deemed to be less important on average for career progression in an HEI.

Most researchers in the EU28 have a permanent or open-ended contract (80%). The share of researchers with permanent contracts is higher among male (81%) than among female (73%) researchers. Early stage researchers (career stages R1 and R2) are younger, more likely to be on a fixed-term contract, and less satisfied with research autonomy; R3 and R4 researchers are more likely to be on a permanent contract, male (share of female researchers in R1: 51%; in R4: 28%), and are more satisfied with research autonomy but also face higher teaching loads.

Researchers who combine a position in the HE sector with positions in other sectors (e.g. private industry) are rare (11%), both within- and outside the EU. The share of such researchers is slightly higher among higher career stages. MORE4 findings hence point to the fairly slow emergence of new types of (academic) career paths in terms of a greater number of dual positions with industry, recognition of alternative research outputs, or intersectoral mobility for recruitment and career progression.

Overall, 83% of EU researchers are confident about their future career prospects, with more male researchers feeling confident (86%) than female (77%). Moreover, differences between countries are large. The share of researchers who lack confidence in their future career prospects is highest among early-stage researchers, while established researchers show higher levels of optimism about their future.

In the EU28, it takes an average of 17 years from the early career stage to become a leading scientist (R4). The early career stage itself (R1) lasts an average of five years. However, substantial variation can be seen between countries, particularly with respect to the length of time it takes to finish the first two career stages. The heterogeneity of higher education systems across the EU leads to wide variations in career progression, which also affects the distribution of researchers across the career stages R1-R4. It is natural for this distribution to take the shape of a 'pyramid' with more researchers at early career stages than at later career stages, as not everyone can become a full professor. In line with other research, the MORE studies indicate that the shape of the pyramid differs considerably between countries – for instance, as a consequence of the organisation of universities' working units as collegiate departments or hierarchical chairs. As a result, talented young

researchers face different opportunities to embark on a successful academic career, due to the differing structures of HE systems in their countries. In some research systems, the problem relates more to "getting in", while in others it is "getting up". Policy options for career systems will differ accordingly, accentuating different parts of a tenure track system that many researchers view as the most attractive career model. Both the probability of obtaining tenure and the path to the top of the career ladder matter considerably when academics make decisions about employment options. While the situation in Europe is changing, continued policy efforts are certainly necessary to improve career systems, particularly for early stage researchers.

At EU level, such policy efforts also concern funding for mobility and career perspectives (ERC, MSCA, etc.) – particularly in countries in which there is a lack of funding for mobility stints, as international mobility is very important for career progression and recruitment. Support for mutual learning – such as that provided by the Policy Support Facility (PSF), which works specifically to address the danger of divergence in research and innovation, and also works on higher education and science systems – remains crucial. Mutual learning exercises within the PSF could look at the question of attractive career paths for early stage researchers.

Working conditions

Once researchers have entered a career in research, the working conditions in their job are crucial to their scientific productivity and to their subsequent decisions to remain in research or take another job. MORE4 conceptualises the main relevant working conditions as falling into one of three categories, namely:

- Working conditions not directly affecting scientific knowledge production, such as conditions relating to extrinsic pecuniary motivations to engage in a research career (e.g. salary and pension entitlements); and working conditions affecting social and content-specific motivations to engage in a research career. Individual satisfaction at work and with the social environment and recognition are high (91%) in comparison with remuneration (70%).
- Working conditions affecting scientific knowledge production, where satisfaction varies e.g. between research funding (52%); the balance between time for teaching and research (70%); working with leading scientists (85%); and research autonomy (91%).
- Working conditions relating to both knowledge production and pecuniary motivations, such as career and mobility perspectives, in which three out of four researchers in the EU28 (75%) are satisfied with their current position.

Researchers' satisfaction with working conditions is lowest in relation to funding, the balance between teaching and research, and career perspectives. These findings apply to researchers at all career stages, and remain unchanged since MORE3 (although the levels of satisfaction have increased). The working conditions that are most crucial for researchers when deciding between jobs, or to sustainably attract early-stage researchers into research careers, are mainly those that relate to knowledge production and the ability to carry out research. 'Material' working conditions or quality of life play a less significant role. All other factors being equal, salaries are important, but researchers are "willing to

pay" – in other words, to sacrifice a level of salary – for working conditions that enable them to implement their research agenda. The attractiveness of research jobs is hence a result of factors that influence how well researchers can do their jobs. Among others, these include the extent of research autonomy; the quality of their peers; their funding; the balance of time between teaching and research; as well as long-term career prospects. Compared with MORE2 and MORE3, there is a clear upward trend in satisfaction with working conditions, particularly with regard to employment aspects. However, the results of MORE4 reveal the uncomfortable fact that while research careers provide very high levels of satisfaction with intellectual challenge and job-specific content, satisfaction is much lower satisfaction with other aspects such as uncertain career perspectives, less satisfactory funding of research, and the balance between time for teaching and time for research. The same pattern was found in the survey concentrating on researchers currently working outside the EU. This means that attracting more people into research careers – which is an EU policy goal to tackle the challenges of more knowledge-based competition and the role of knowledge in supporting the twin transition, among others – is clearly linked to funding and career perspectives.

In terms of policy, the MORE4 findings indicate that research jobs are attractive by their nature – researchers are intrinsically motivated because they like what they do. This means that for research careers to be attractive, it is sufficient to provide good working conditions. Researchers are to some extent willing to trade off material working conditions such as salary in return for working conditions for research, including research autonomy and funding, longer time horizons for their research agendas (in the form of long-term career perspectives), etc. Working conditions for research are hence drivers of attractiveness of jobs in research, more so than salaries, quality of life or other non-research-related working conditions.

Moreover, as with career paths and recruitment, a picture of heterogeneity in terms of satisfaction with working conditions emerges across the EU – although this time the fault lines are less related to different higher education systems, but rather to economic development and public budgets for research and research performance. On the assumption that real differences are at least partly responsible for these perceptions, this heterogeneity may have an impact on the completion of the single knowledge market in the EU, as well as on the prospects of achieving symmetrical rather than asymmetrical mobility of talented researchers within the EU (i.e. it may encourage brain drain, rather than brain circulation). Such heterogeneity can be addressed through general economic policies (e.g. through ESIF), greater research funding at EU level, and changing the allocation modes used for funding, as well as sharing best practice and regularly monitoring developments in working conditions.

Box 5: Main findings on working conditions

- Satisfaction with working conditions has improved overall, but major differences between different aspects of working conditions: individual satisfaction with work and with the social environment and recognition are high in comparison with remuneration and certain working conditions affecting scientific knowledge production (research funding, balance between teaching and research, career perspectives);
- Research jobs are attractive by nature – researchers enjoy what they do. As a result, increasing the attractiveness of jobs in research mainly hinges on efforts to improve the working conditions for knowledge production, such as research funding.
- Wide variations exist at EU level in relation to satisfaction. These relate less to countries' different career systems, but to economic differences that have an impact on research funding, remuneration and pension plans.

International mobility and collaboration during PhD stage

A strong ERA will be built on strong researchers. In this context, it is important to offer attractive career prospects to young researchers. PhD training programmes in the EU must be attractive enough to entice the most talented researchers in a worldwide competitive context[7], ensuring brain circulation rather than brain drain. One aspect of the career prospects for young researchers is the internationalisation of PhD training, and thus mobility. The MORE studies contribute to the development of relevant evidence in this field, with a series of indicators on the international mobility of early career stage researchers as well as those at post-PhD stage.

International mobility during PhD stage is considered an important asset for researchers' future careers. PhD mobility can also provide a positive choice for candidates in terms of better-suited training programmes. It is therefore also an indicator of attractiveness for PhD candidates. The MORE4 EU HE survey shows that 16% of EU PhD candidates obtain their PhD in a country other than that of which they are citizens (PhD degree mobility), and 23% experience a move of more than three months to another country during their PhD (mobility during PhD). In the EU28, 64% of R1 and R2 researchers were not mobile for or during their PhD (70% in 2016).

Among EU Member States, largest shares undertaking **PhD degree mobility** are found among researchers who are citizens of Greece, Italy, Bulgaria, the Netherlands and Denmark (25% or more). This means, for example, that more than 40% of all researchers with Greek citizenship undertake mobility to obtain their PhD in a country other than Greece. Conversely, Finnish, Slovenian and UK citizens are the least mobile in obtaining a PhD degree (less than 6%). This means that the large majority of Finnish researchers, for example, obtain their PhD in Finland. When looking at destination countries within the EU, PhD degree mobility is highest (in terms of shares) towards Hungary, Luxemburg and Ireland, but also towards Scandinavian countries such as Norway, Denmark and Sweden.

[7] Hunter, Rosalind S., Andrew J. Oswald, and Bruce G. Charlton. 'The Elite Brain Drain*'. *The Economic Journal* 119, no. 538 (2009): F231–F251.

Comparing these figures with the results of previous MORE studies shows that while the EU average remains relatively stable, there is a great deal of volatility in these figures at country level.

For **moves during the PhD,** the patterns between countries are somewhat more consistent over time. Researchers who will/did obtain their PhD in Spain, Italy and Denmark are considerably more mobile to another country during their PhD than the EU average (between 48% and 59%, compared with 23% across the EU). This means that the majority of researchers of any citizenship who are working on a PhD in Spain, have mobility experience of more than three months outside Spain during their PhD.

Both in terms of PhD degree mobility and mobility during a PhD, we find a stable pattern of motives over time. Young researchers are driven by scientific knowledge production factors such as international networking, working with leading scientists, quality of training and education, and research autonomy. This corresponds with the general consensus that international PhD mobility is expected to have a positive impact on a researcher's academic life and skills.

The barriers to PhD mobility, as perceived by non-mobile researchers, are also stable over time, and are comparable to the mobility barriers seen post-PhD. They emphasise personal or family-related reasons (78%); the difficulty to obtain funding for mobility (60%) or for research (58%); logistics (54%); and finding a suitable position (53%). This is consistent with the existing literature, which sees motivations relating to boosting one's career as crucial for moving somewhere else, while personal or family reasons hold researchers back or lead to return mobility.[8]

Box 6: Main findings on international mobility at PhD stage

- Almost two thirds of EU28 R1 and R2 researchers were not mobile for or during PhD.
- Stable pattern in the relative importance of motives for PhD mobility: international networking; working with leading scientists; quality of training and education; research autonomy; and for PhD degree mobility: availability of funding and positions.
- Stable pattern of barriers to PhD mobility, with an emphasis on personal reasons and on finding positions or funding.
- In 2016, female researchers tended to indicate a greater number of barriers as reasons for not having been mobile. In 2019, we observe male and female researchers tend to converge on this point. Personal and family reasons and logistics remain somewhat more important barriers to female researchers.
- When a researcher is part of a couple, PhD mobility is easier when the partner is also a researcher.

[8] Franzoni, C., Scellato, G. & Stephan, P. (2012). Foreign-born scientists: mobility patterns for 16 countries. Nature Biotechnology, 30(12), 1250-1253.

International mobility and collaboration in post-PhD stages

The MORE4 study also provides some important insights into the evolution of international mobility and collaboration after a PhD. **The share of researchers that have engaged in long-term international mobility (>3 months) remains stable over time: 27% in both 2016 and 2019**. There is also remarkable stability with respect to the impact of family status on international mobility: As with PhD mobility, having children or being in a couple is associated with a lower likelihood of being internationally mobile: the rate of international mobility stands at 26% for researchers with children (the same share as in 2016), versus 37% for researchers without children (38% in 2016) [9].

The disparities between countries revealed in previous MORE studies are also visible in MORE4: international mobility remains less common in Southern and Eastern European countries. This consistency over time also applies to motives and barriers. The most frequently cited **motives** for mobility are the same over time: career progression, working with leading scientists, research autonomy and international networking. With regard to the **barriers**, a lack of positions and/or funding for mobility are even more important barriers to mobility in 2019 than they were in 2016.

- The EU HE survey indicates the most important barriers to mobility within the EU: obtaining funding for mobility (57% in 2019; 36% in 2016); obtaining funding for research (55% in 2019; 38% in 2016); finding a suitable position (53% in 2019; 38% in 2016).
- The Global survey shows that EU researchers experience the following barriers when trying to return to Europe: finding a suitable job position (84% in 2020; 75% in 2017); obtaining funding for research (77% in 2020; 70% in 2017); and obtaining funding for mobility (72% in 2020; 68% in 2017).

The MORE4 study also reveals some interesting insights with respect to **forced mobility** – that is, the extent to which researchers feel forced to move to another country. The share of researchers indicating that they have experienced this type of mobility was slightly lower in 2019 (15%) compared with 2016 (19%). Out of mobile researchers as a whole, 9% indicated that they felt forced to move because there were no options for a research career in their home country (13% in 2016). A further 6% felt forced because international mobility is a requirement for career progression in their home country (the same share as in 2016). Forced mobility has decreased across all career stages since 2016, even among R2 researchers, which were the group most affected by forced mobility in 2016. Only among R3 researchers was there an increase in forced mobility as a requirement for career progression. Among researchers working outside Europe, the Global survey also shows a slight decrease, with 23% of them reporting this type of forced mobility compared with 28% in 2016. However, it is important to note that this type of forced mobility is reported by 32% of EU researchers currently working outside the EU – mostly due to a lack of career opportunities (in 2016, the figure was 37%).

[9] There is a third category of researchers: those that prefer not to indicate their family status.

Like the 2016 survey, the 2019 survey indicates that the effects of mobility are in line with the motives for mobility: the main effects are international networking, advanced research skills, collaboration, and career progression. This pattern has also remained stable over time, and is positive overall for all types of effects. At career stage level R2, researchers tend to have a less positive view of the effects of mobility on their career. The difference between this group and R3 and R4 researchers is larger in terms of those effects relating to the quantity of output, collaboration with other (sub)fields of research, the number of co-authored publications, and national contacts.

Box 7: Main findings on international mobility at post-PhD stages

- Levels of international mobility remain similar to 2016.
- Long-term mobility is less common in Southern and Eastern European countries.
- The long-term mobility of female and male researchers is converging, but family composition still matters.
- 15% of European researchers have felt forced to move to another EU country, a slight decrease on the figure in 2016 across all career stages.
- Career progression, working with leading scientists, research autonomy and international networking are the major drivers for mobility within the EU.
- 34% of non-European researchers with previous work experience in the EU indicate that obtaining a visa was a significant barrier in their move to the EU (29% in 2016).
- R2 researchers tend to encounter more barriers to long-term mobility than R3 and R4 researchers.
- Personal and family reasons are the most important motives for deciding not to move, and their importance has increased (79% in MORE4, 77% in MORE3, 67% in MORE2).
- The effects of international mobility are positive, and are consistent with the main motives.

The above-mentioned findings are consistent with the literature – researchers move to improve their career, while their decision to remain or come back is made more for personal reasons, or due to a lack of funding or position. It is therefore important for policy makers to address both the incentives for mobility – i.e. improving the factors relevant to scientific knowledge production– as well as removing barriers to mobility through an increase in research funding and available positions. This is expected to have a positive impact on fostering international collaboration and knowledge circulation across the EU.

Interdisciplinary mobility and collaboration

Interdisciplinary mobility and collaboration, respectively understood as working in another discipline and working with researchers from other disciplines, have been said to foster certain skills that are of key importance for researchers today. Among these are a greater capacity to communicate effectively beyond the frontiers of one's own field, and to adapt to ever-changing environments. Those in favour of promoting interdisciplinarity argue that interdisciplinary mobility and collaboration are well suited to addressing complex societal challenges, and that interdisciplinarity fosters academic excellence and innovation. However, a number of barriers exist in relation to realising and measuring the impact of interdisciplinary research (e.g. lack of a common definition, lack of common standards and criteria, shortage of peer reviewers with experience in evaluation interdisciplinary research, etc.).

- The MORE4 EU HE survey shows that 19% of researchers working in the EU have switched to another (sub)field of science during their research career[10].
- Although findings and expectations in existing literature regarding the impact of interdisciplinary research are mixed, the MORE4 data indicate that researchers in the EU tend to regard this type of mobility as a positive factor for both recruitment and career progression (75% and 76%, respectively).
- With respect to interdisciplinary collaboration, almost 80% of researchers in the EU HE sector have collaborated with other fields (up 6 percentage points compared with 2016), mainly with other researchers in academia. This is higher than the share of interdisciplinary collaboration among researchers working outside the EU (Global survey: 63%).
- 68% of researchers in the EU collaborate with researchers in other disciplines within the same institution, and 63% with researchers at other universities or research institutes, versus 26% in the non-academic sector (31% in 2016).

[10] This is considerably lower than the 2016 figure of 34%: this difference may be (partly) related to a small change in the questionnaire. In MORE3, researchers are first asked about their interdisciplinary collaboration, and are thus made aware of the reasoning in the framework of the FOS-classification before they are asked about interdisciplinary moves. This introductory question was removed in the MORE4 questionnaire for reasons of simplification. It is possible that this changed the perspective of the researchers for this remaining question on interdisciplinary moves.

Box 8: Main findings on interdisciplinary mobility and collaboration

- Almost one-fifth of all researchers have switched to another field or subfield during their academic career.
- This is considered by researchers to be a positive factor for recruitment and career progression.
- Consistent patterns can be seen for interdisciplinary mobility and collaboration at EU level, yet wide variation exists between countries.
- Increase in interdisciplinary collaboration, but a small decrease in interdisciplinary collaboration with non-academic partners.
- Below-average shares of interdisciplinary collaboration are observed in Social Sciences and Humanities (SSH).

Intersectoral mobility and collaboration

Closing the gap between academia and the business sector is often perceived as one of the ways to address societal challenges and accelerate transitions such as the green and digital transformation, while guaranteeing the future competitiveness and growth of European economies and strengthening their resilience. Intersectoral mobility and exchanges are key to exchanging ideas, exploiting knowledge and increasing the innovation capability of a system, as well as enhancing the employability of individual researchers in multiple settings.

Eurostat data indicate that 51% of EU researchers were working in the private sector in 2017 (not including not-for-profit organisations). This was a small increase compared with 2014 (+3 percentage points). However, the EU still lags behind the US, China, Japan and South Korea with respect to the number of researchers employed in the private sector[11]. Within the EU, there is also considerable variation across countries.

The MORE4 EU HE survey indicates that 24% (25% in 2016) of R2, R3 and R4 researchers (who currently work in a HEI) moved to another sector during their research career. 15% moved at least once to the private sector (6% to large firms, 3% to SMEs or start-ups, and 7% to not-for-profit organisations). The overall share is similar to that for researchers currently working outside the EU (20%).

Networking is still the most important motive for working outside academia, regardless of the destination sector (over 80% of cases). Other motives depend more on the destination sector, e.g. contribution to society is more common as a motive for moving to the government and not-for-profit sectors, whereas gaining first-hand experience of industry, better remuneration and bringing research to the market are more common motives for

[11] Cf. indicator 1.6 in the MORE4 Indicators report on researchers, based on 2017 Eurostat data: the share of researchers in the private sector was significantly higher in the US (71%), China (61%), Japan (74%) and South Korea (81%) compared with the EU28 (51%).

moving into private industry. This indicates that any future policy instrument to encourage intersectoral mobility would ideally need to take into account researchers' motivations.

Between 65% and 67% of researchers consider that either (1) mobility towards the private sector, (2) mobility towards the non-profit, public or government sectors, or (3) both, are positive factors for recruitment and career progression. This positive perception is significantly higher among those with experience in a large private firm (76-77%) and lower for those with experience in an SME or startup (54-55%). Less positive results are found among researchers working outside Europe: 51% of these researchers consider intersectoral mobility a positive factor for recruitment; 47% for career progression.

When looking into intersectoral collaboration, the MORE4 EU HE survey indicates that 32% of researchers working in HEIs (35% in 2016) collaborate with researchers in non-academic sectors. This is more common in later career stages (40% in R4), and less common in SSH fields (26% in Humanities and 30% in Social Sciences).

Box 9: Main findings on intersectoral mobility and collaboration

- 15% of post-PhD researchers currently working in European HEIs have moved to the private sector at least once.
- Intersectoral moves are considered to be regarded positively in recruitment or career progression – though less strongly than international and interdisciplinary mobility. This positive perception is higher among those with experience in a large private firm.
- Networking is the most important motive for engaging in an experience in another sector.
- 32% of researchers collaborate with non-academic sectors. Of these, nearly a third (32%) state that this collaboration is the result of a previous mobility experience.

Attractiveness of the ERA

When knowledge is the principal factor behind competitive advantage, leading to increasing competition for talented knowledge workers, the attractiveness of research areas is crucial for sustainable and dynamic knowledge economies. The attractiveness of postgraduate research jobs is a result of the structure of recruitment, career paths and the quality of working conditions. The attractiveness of research areas is also determined by the attractiveness of PhD studies. International or intersectoral mobility may be driven by perceptions of varying attractiveness. In turn, mobility indicators such as which countries researchers choose for their international mobility experience, can also be interpreted as indicators of attractiveness. Meanwhile, mobility perspectives influence working conditions, as they enable international collaboration – a driver of scientific productivity. Attractiveness is driven by the characteristics of a research job that influence a researcher's scientific productivity, such as research autonomy, career perspectives and working with high-quality peers. All other factors being equal, 'material' working conditions relating to remuneration, pensions and job security have an influence on job choice, along with other non-science related conditions – but these are not decisive factors in job or mobility decisions.

Career perspectives are cross-cutting working conditions, as they influence both financial conditions and scientific knowledge production, and therefore have an impact on setting time horizons for long-term research agendas. Long-term research agendas are more conducive to fundamental breakthroughs than research agendas limited by fixed-term contracts. Career perspectives are particularly important to early stage researchers, for whom a performance-based model ('tenure-track' versus a seniority-based model) can make a significant difference to their careers. MORE4 presents findings on the attractiveness of the EU, based on survey questions asking EU and non-EU researchers to directly compare the EU with non-EU research systems in relation to a number of such determinants of attractiveness. These are: working conditions for research, material working conditions, and cross-cutting working conditions. In addition, respondents were asked to compare attractiveness in terms of a range of additional characteristics such as ease of industry collaboration.

The main insights remain practically unchanged since MORE3, in that:

- The more advanced the non-EU research system that researchers come from, or in which they have worked, the less positively the EU is regarded as a place to do research.
- The EU's strengths are perceived as relating to material working conditions such as social security, job security, quality of life (vs. the US, but not overall) and pension plans (not for salaries), as well as education and training. Its weaknesses are perceived as relating in particular to attractive career paths, conditions for knowledge production and, to a certain extent, the availability of suitable positions.
- Within the group of EU researchers who are currently abroad, researchers in the US perceive the US to be a much better place to do research, with the exception of social and job security as well as quality of life.
- Within the EU, there is wide variation in perceptions. Researchers who have been mobile outside the EU and who are now working in Eastern and Southern Europe find it are more likely to find it more attractive to work outside the EU than within it, compared with researchers who are now working in Western and Northern Europe. This indirectly reflects the attractiveness of their current countries of employment.

In a nutshell, key career-related job characteristics or characteristics influencing researchers' productivity are perceived to be better, on balance, in a number of economically advanced (OECD) countries with strong research systems, than in the EU. The EU is, however, regarded as being better for quality of life and job/social security. The MORE surveys show that career-related aspects (e.g. independence, working with leading scientists and attractive career paths) are decisive factors for researchers in moving away from their home country, while they tend to move back for personal or family reasons. Barriers to mobility relate to research and mobility funding, the availability of positions, and to issues such as the portability of pensions.

This general finding means that the current advantages of the EU in terms of quality of life and job characteristics relating to social and job security are less effective as drivers of attractiveness than characteristics that influence researchers' scientific productivity – an

area in which the advantages of the EU are less clear cut (again, depending on the strength of the research system the EU is being compared with). The survey results therefore reveal a clear opportunity for the EU to strengthen its attractiveness as a place to do research by improving conditions for scientific knowledge production. As presented in the first part of this executive summary, many policies at EU, national and regional level address factors that are potentially relevant for attractiveness. In the subsequent parts of the report, we present the MORE4 findings, which are very similar to those of MORE3 on the role of EU funding, and on the availability of positions (the EURAXESS jobs portal) for attractiveness.

The two most important barriers to mobility are the availability of a suitable position and the availability of research funding. As a result, EURAXESS and EU research funding can (alongside instruments at national level) play a potentially very important role as enablers of mobility or of attractiveness, as they directly address the availability of positions and research funding. The MORE4 findings indicate that EU instruments succeed in reaching their intended target group. EU funding and EURAXESS can, in principle, therefore contribute to attractiveness by enabling mobility to the EU – or preventing the forced outward mobility of talents – if researchers wish to come to the EU in the first place. Both in terms of awareness, e.g. among non-EU researchers who have not previously been mobile to the EU, but also in terms of actual usage, there is room for improvement – although awareness of EURAXESS has increased significantly. There are, for example, high levels of general interest by non-EU researchers in EU research funding, but a frequently indicated barrier to accessing it is the lack of knowledge about specific EU research programmes.

Box 10: Main findings on attractiveness of the ERA, based on a direct comparison of systems

- The EU's strengths largely relate to material working conditions such as social security, job security, quality of life (vs. the US, but not overall) and pension plans (not for salaries), as well as education and training; its weaknesses relate to attractive career paths and the availability of suitable positions.
- Key characteristics influencing researchers' productivity are perceived to be better, on balance, in a number of countries with strong research systems, than in the EU.
- The current advantages of the EU in terms of quality of life and job characteristics relating to social and job security work less as drivers of attractiveness, than characteristics that influence the scientific productivity of researchers – an area in which the advantages of the EU are less clear cut.
- EURAXESS and EU research funding address the two most important barriers to mobility. As a result, they can play a potentially very important role as enablers of attractiveness; however, there remains room for their increased use.

Part 1. Study, policy context and concepts

1. INTRODUCTION

1.1. Objectives of the MORE4 study

The MORE4 study was conducted under the framework contract "PO/2016-06/01 – Lot I – Impact assessment, evaluations, and other evaluation-related studies in the field of communication activities". It provides an **update to, and further elaborates on, the set of indicators** reported in the previous MORE studies, thereby addressing the need for indicators to assess the impact of policy measures introduced during the implementation of the European Partnership for Researchers (EPR)[12]. It also reflects upon a few new indicators introduced in the MORE4 study to meet emerging policy needs and priorities, such as the concept of Open Science and other developments identified in the impact assessment of the forthcoming framework programme Horizon Europe.

The main objective of the MORE4 study is defined as:

"Carrying out two major surveys and developing indicators to help monitor progress towards an open labour market for researchers"

To meet this objective, a set of four complementary and interlinked tasks were performed by the study team. These have provided detailed insights into researchers, their career paths, employment and working conditions. The tasks were as follows:

- Task 1: Carry out a survey of researchers currently working in the EU (and EFTA) in higher education institutions (HEI);
- Task 2: Carry out a survey of researchers currently working outside Europe;
- Task 3: Review and update the set of indicators developed for continuous monitoring of relevant trends and progress made in the field; and
- Task 4: Draft a final report providing policy-relevant comparative analysis on the subject matter.

The execution of these tasks took into consideration and purposefully built on the methodologies and results of the previous MORE studies. In fact, certain parts of the MORE3 final report[13] have been reused in this report, due to the continuing relevance and

[12] Journal of the European Union (2008), Communication from the Commission to the Council and the European Parliament of 23 May 2008 "Better careers and more mobility: a European partnership for researchers".
[13] IDEA Consult et al. (2017). MORE3 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final Report. European Commission, DG Research and Innovation.

consistency of the findings over time. The study has also been strongly influenced, informed and complemented by our analysis of the most recent EU policy developments, as well as a detailed review of the results and conclusions of the most recent research on the topic, including the ERA Progress Report 2018[14], the Final Report on Monitoring ERA Priorities with ERA Roadmap National Actions Plans (NAPs)[15], the study "Fostering Industrial Talents in Research at European Level"[16], and others.

This report is the Final Report of the MORE4 study. It presents the final results of Task 4, the comparative analysis of all findings in the MORE4 study, including the EU Higher Education survey (Task 1), the Global survey (Task 2), and the indicator framework based on existing data (Task 3). It also provides policy-relevant insights by reflecting on lessons that can be drawn from the comparative analysis in MORE4 on research mobility, career paths, employment and working conditions in the context of both existing policy and recent policy developments.

1.2. Acknowledgements

The present report has been prepared by:

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- Lidia Núñez López (IDEA Consult, Belgium)
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The report is based on information collected via two surveys and desk research. This information collection has been the result of a coordinated work of:

- The partners within the MORE4 consortium:

[14] European Commission (2018). *European Research Area. Progress Report 2018. Country Profile Ireland*. Retrieved from: https://ec.europa.eu/info/publications/era-progress-report-2018_en

[15] European Research Area and Innovation Committee (2020). *Final Report on Monitoring ERA Priorities with ERA Roadmap National Action Plans.* Retrieved from https://data.consilium.europa.eu/doc/document/ST-1209-2020-INIT/en/pdf

[16] European Commission (2018). *Study on Fostering Industrial Talents in Research at European Level. Final Report*. Retrieved from https://cdn5.euraxess.org/sites/default/files/policy_library/final_report_intersectoral_mobility.pdf

  - IDEA Consult (Belgium)
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  - Mark Whittle (CSES, UK)

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1.3. Guide to the structure of the report

In the remainder of Part 1 of the report, we summarise the relevant policy context for the study (Section 2) and present the general conceptual framework of the MORE4 study, according to which the analysis is structured and the results are discussed (Section 3).

In the Part 2 of the report, we elaborate on the results of the MORE4 study. The sections are structured according to the conceptual framework of the study, with the addition of a horizontal section on gender-related issues:

- Section 4 - Human resources: researchers
- Section 5 - Human resources: PhD training
- Section 6 - Recruitment, career progression and career paths
- Section 7 - Working conditions
- Section 8 - International mobility during PhD stage
- Section 9 - International mobility after PhD stage
- Section 10 - Other forms of international exchange
- Section 11 - Interdisciplinary mobility and collaboration
- Section 12 - Intersectoral mobility
- Section 13 - Attractiveness of the European Research Area
- Section 14 - Gender

In each case, we present in the first subsection the key findings and results of a comparative analysis between the EU HE survey, the Global survey and Indicators report

on researchers. Then, in the second subsection, these findings are situated within the policy context and used to discuss policy-relevant questions.

Part 3 of the report summarises the overarching policy implications of the study, including an overview of the policy implications for the two main areas of the study: the attractiveness of the ERA and optimal exchange and circulation, as well as for two overarching topics: achieving gender equality in science, and reflections on the current policy instruments. It concludes with a number of recommendations for further research.

Before elaborating on the conceptual framework and the results of the study, we briefly present a guide to the interpretation of the results, including a discussion of the quality of the various data sources and caveats with regard to the interpretation thereof.

1.4. Guide to the interpretation of the results

1.4.1. Strengths and weaknesses of using surveys to analyse researchers´ mobility patterns

Several methods can be used to collect information relating to researchers´ mobility patterns. Each has its own strengths and weaknesses. The two most frequently used methodologies in this field are surveys[17] and bibliometric analysis[18;19]. In a survey-based approach, researchers are contacted and asked to provide information about their mobility experiences. Using a bibliometrics-based approach, the analysis is based on publications databases and countries of origin, or on the academic affiliation of the authors of these publications. Compared with other methods – and most notably with bibliometric analysis

[17] Apart from the MORE studies, there are other important examples of surveys used in the field of researchers´ mobility, such as:

- Franzoni, Chiara, Scellato, Giuseppe, et Stephan, Paula. International mobility of research scientists: lessons from GlobSci. In: Global mobility of research scientists. Academic Press, 2015. p. 35-65.
- Thorn, Kristian, and Lauritz B. Holm-Nielsen. "International mobility of researchers and scientists: Policy options for turning a drain into a gain." The international mobility of talent: types, causes, and development impact (2008): 145-167.

[18] Some examples of bibliometric analysis in the field are:

- Franzoni, C., Scellato, G. & Stephan, P. (2014). The mover's advantage: The superior performance of migrant scientists. *Economics Letters*, vol. 122, no 1, p. 89-93.
- Jonkers, K. & Tijssen, R. (2008). Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics*, 77(2), 309-333.

[19] There are other methods, such as the analysis of researchers´ CVs (e.g. Cañibano, C., Otamendi, F.J., & Solís, F. (2011). International temporary mobility of researchers: a cross-discipline study. *Scientometrics*, 89(2), 653-675.) or qualitative methods (e.g. for an example of use of semi-structured interviews, see Jöns, Heike. "Transnational academic mobility and gender." *Globalisation, Societies and Education* 9, no. 2 (2011): 183-209.

– the main advantages of surveys (as used in MORE4 and the previous MORE studies) are as follows:

- Surveys can be designed in such way that the final sample is representative of the population in terms of country, field of science, gender or other important variables of interest. Related to this is the capacity to apply probability sampling and the possibility of obtaining findings that are generalisable in a stronger and more accurate way[20]. When using bibliometrics, considerations about publication patterns need to be accounted for in the methodological design:
    - Fields of science: publication and co-authoring are more frequent in some fields or disciplines than in others, and this has an impact on the types of information collected during the analysis.
    - Career stages: depending on the research design or the target of the research, experienced researchers might be overrepresented, as this group tends to have published more than early career researchers.
    - Incomplete data: the tools used to gather bibliometric data do not cover all research areas or index all publications. The results will vary depending on the tool that is used.
- Surveys can provide information not only about behaviours (e.g. mobility patterns) but also more detailed sociodemographic information about the researchers (which can be analysed on an anonymised basis to reflect GDPR considerations relating to the protection of personal data and privacy). This additional information allows for the findings to be interpreted in greater depth, reducing the possibility of establishing spurious relationships.
- Surveys are probably the most commonly used method in studies covering large samples and with a wide geographical dispersion (e.g. covering several countries). A standardised questionnaire can be developed that can be translated into several languages and applied at the same time to a large number of respondents. This results in an approach that is not only less labour-intensive compared with other methods (e.g. interviews or focus groups), but also findings that are comparable between countries and over time[21].
- Surveys are one of the most commonly used methodologies to collect information about people´s attitudes and opinions. The MORE studies are important, as they complement the factual data collected by Eurostat or the statistical offices in Member States (number of researchers working in the country, distribution across career stages or gender, etc). Surveys can therefore go beyond the merely factual to provide valuable information helping to understand the motivations of respondents. In this sense, the MORE studies

[20] Fielding, N. G., Lee, R. M. & Blank, G. (Eds.). (2008). The SAGE handbook of online research methods. Sage.
Kelley, K., Clark, B., Brown, V. & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. International *Journal for Quality in health care*, 15(3), 261-266.
Nardi, P.M. (2018). Doing survey research: A guide to quantitative methods. Routledge.
[21] Nardi, P.M. (2018). Doing survey research: A guide to quantitative methods. Routledge.

provide information about how researchers evaluate their own working conditions, their own motives for moving abroad, and the barriers that might hinder their mobility. More qualitative approaches (e.g. focus groups, interviews) are also appropriate methods for collecting this information, and often do so with a greater degree of detail than any survey can provide. However, the advantage of surveys is that the collection of the information is carried out systematically across a large group of individuals living in different contexts. This allows for a more systematic comparison of the findings across contexts: e.g. across countries, fields of science, gender, career stages, etc.

- Lastly, surveys allow new developments, concepts and/or policies to be investigated in a flexible way while guaranteeing the comparability of the results over time. This is the case, for instance, with the introduction of new items in the MORE4 questionnaire that probe researchers on their attitudes towards Open Science approaches. Hence, the MORE4 survey constitutes a unique source of information, as there are so far no other data sources that offer such a complete view on this topic at EU level.

1.4.2. Characteristics and interpretation of the MORE4 data

The MORE4 study was informed by several sources of evidence. Data from each of these sources has been collected using different approaches. Interpretation of the study's results should, therefore, take these factors into consideration.

> It is important to note that the MORE4 EU HE survey was designed to offer maximum accuracy at both EU and individual country levels. The MORE4 Global survey follows a convenience sampling approach. As such, although this survey is not designed to offer representative data at country level, it offers relevant insights on a number of policy-relevant issues relating to European researchers currently working outside Europe.

The following paragraphs present in further detail the main characteristics of the data analysed in the MORE4 study and presented in this report, along with caveats relating to their interpretation.

MORE4 EU Higher Education (HE) Survey

The MORE4 EU Higher Education (HE) survey[22] was the most important source of information used in the preparation of this report. Most of the findings described in this report refer to this survey. The survey was administered in 31 European countries (the 28

[22] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.

Member States[23] of the European Union and three Associated Countries: Iceland, Switzerland and Norway) using CAWI (Computer-assisted web interviewing) and CATI (Computer-assisted telephone interviewing) techniques.

The sampling process was developed to provide estimates on researchers in the EU28+3 HE sector with maximum accuracy at both EU and individual country level[24] (5% max error p-value of 0.05), and including a stratification by fields of science (FOS). The survey reached a total of 9,321 respondents.

- **Margin of error:** in most countries, the number of validated questionnaires achieved a margin of error of 5.5%; in eight countries the margin of error was between 5.5% and 6.5% (Switzerland, Lithuania, Slovakia, Finland, Poland, Hungary, Malta, Slovenia). In five further countries (Latvia, Cyprus, Estonia, Iceland and Luxembourg), a margin of error of between 6.5% and 8.0% was achieved. Overall, response rates are less equally distributed across countries than in MORE3, but comparable to those obtained in MORE2.
- **Comparability with MORE2 and MORE3 estimates:** this was one of the main goals when designing the approach and developing the sample and the questionnaire for MORE4. For this reason, the sampling approach and data editing approach used is the same as in MORE2 and MORE3 (more information on this is presented in Annex 1 to this report and in the MORE4 EU HE report). Implementation was improved based on the lessons learned in the previous studies (see the MORE4 EU HE report for more details). The majority of the questionnaire, including the key questions, were the same as those applied in MORE2 and MORE3, but improvements were also implemented here (see the MORE4 EU HE report for more details).
- **Cross-sectional surveys:** it is important to stress the fact that the studies do not follow a panel design. This means that MORE2, MORE3 and MORE4 EU HE surveys are independent from each other in the sense that the two surveys do not by definition follow the same individuals over time. Nevertheless, the possibility cannot be excluded that the same researcher may have replied to consecutive surveys.
- **Head count (HC)-based estimates:** all estimates are expressed in terms of HC only and correspond to the accuracy level mentioned above.
- **Career stage estimates:** caution is also needed in the interpretation of the career stage estimates. The information on career stages is based on a survey question (self-selection by the researchers). The distribution over career stages can therefore not be considered without bias. However, as clarified in the annex to the MORE4 EU HE report, post stratification weights by career stage were applied to test the bias relating to the fact that the data included larger shares

[23] The MORE4 EU HE survey was implemented while the United Kingdom was still considered an EU Member State.

[24] If the survey were to be repeated a hundred times, in 95 cases the outcomes at country level would deviate by no more than +/-5% from the outcomes of the MORE4 survey (5% max error -p value of 0.05).

of R3 researchers and smaller shares of R1 researchers compared with what we would expect based on the information available in the literature and in Eurostat data on R1 researchers. In general, the results were minimally affected by this bias. Nevertheless, it is important to take this point into account when comparing MORE4 with MORE2 or MORE3 indicators, as each of the surveys features a slightly different distribution across career stages.

Finally, it is important to be aware of the fact that the survey data include information about different countries of reference, such as a researcher's country of residence, country of citizenship or country of employment. When results refer to 'country' without further indications, they are based on the country variable used in the sampling strategy and proxy to the country of current employment. In other cases, it is specifically mentioned that the analysis is based on another point of reference, e.g. country of PhD/graduation, country of citizenship, etc.

MORE4 Global Survey

The sampling approach used for the Global survey is characterised as 'convenience' sampling (similar to the MORE2 and MORE3 Extra-EU surveys). This approach was selected due to the absence of internationally comparable data on the population of researchers worldwide. This means that, unlike the MORE4 EU HE survey, no information on the population of researchers was considered in the sample design or the sample validation processes. Instead, a multichannel approach was applied to identify researchers working outside the EU: first, through a web-based contact collection approach; second, through the EURAXESS links (officers); and third, through an open communication strategy in which a non-personalised link to the online survey was distributed on the websites of the MORE4 project, the European Commission and the project partners, as well as via intermediary organisations.

As indicated, the Global survey does not provide representative data at the level of the countries covered, or researchers' mobility patterns from and to specific countries. This sample does not reflect the proportion of EU researchers currently working outside the EU within the overall population of researchers currently working outside the EU. Therefore, results need to be interpreted with care, and no generalisations/extrapolations can be made in this regard. Its value lies more in contextualising the results of the MORE4 EU HE survey and further suggesting trends and hypotheses that can be tested with future surveys.

Indicators report on researchers

The third source of evidence analysed in this report comes from the MORE4 Indicators report on Researchers. This report gathers data from different existing sources and elaborates indicators at country level for the main dimensions covered in the MORE4 project: human resources; working conditions; career paths; international, intersectoral and interdisciplinary mobility; open access; and the attractiveness of the ERA.

The following sources are used in the elaboration of this report:

- MORE4 surveys;
- Eurostat;
- SHE Figures;
- EURAXESS;
- SCOPUS;
- World Bank.

The comparative analysis presented in this report is essentially a synthesis of findings drawn from the sources described above, presented and analysed in the context of relevant policy developments identified through desk research. Accordingly, the sections that follow provide a brief overview of key policy developments in the field covered by MORE4 and its predecessor studies (Section 2), and how these are reflected in the updated conceptual framework of the MORE4 study (Section 3).

2. POLICY CONTEXT

In June 2020, the Croatian presidency of the Council of the European Union announced the 'Zagreb Call for Action on Brain Circulation 2020' initiative[25]. This Call for Action reiterates that the free circulation of researchers, scientific knowledge and technology are the cornerstones for research and technological development in the European Research Area (ERA). At the same time, it points to a number of key challenges hindering the possibility of fully exploiting the potential for excellence in European research, such as:

- an inadequate funding system;
- the heterogeneity of national research systems;
- a lack of incentives for knowledge, technology transfer and Open Science;
- differences in remuneration and research career opportunities;
- inadequate working conditions and a reduced number of permanent positions;
- employment that is insufficiently transparent and not based on merit;
- neglect of the importance of collaborative networks;
- a lack of facilitation for the transferability of grants.

These challenges also result in significant outward-migration and unwanted 'brain drain' for some EU countries and regions, usually those with low R&I intensity. This Call for Action is therefore defined as a "reminder of the necessity to include brain circulation and equality in opportunities as strong pillars of the European Research Area".

The concept of the **European Research Area** was introduced in the 2000 Communication 'Towards a European Research Area'[26] and endorsed by the Lisbon European Council. Its primary objective was to create a "unified research area open to the world based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges".[27] The underlying motivation for this concept was that in order to remain competitive at a global level, Europe needed to increase its number of researchers and foster the quality of research outputs.

As indicated above, the major prerequisite for a critical mass of researchers capable of making an impact on Europe's role in global competition was the creation of a **true**

[25] Croatian Presidency of the Council of the European (2020). Zagreb Call for Action on Brain Circulation. Retrieved from https://cdn4.euraxess.org/sites/default/files/news/zagreb_call_for_action_on_brain_circulation_2020_3.pdf
[26] European Commission (2000), Communication. Towards a European Research Area (ERA).
[27] European Commission (2012), Communication. A Reinforced European Research Area Partnership for Excellence and Growth.

'internal market' for researchers. The internal market encompasses measures to promote transnational mobility, foster interdisciplinary collaboration, and encourage collaboration and movement between the public and private sectors. As such, it contributes to the increased circulation of knowledge and technology across Europe by lowering barriers to free movement, and by promoting the coordination of programmes, research activities and policies at EU level. Removing barriers to free movement in such an internal market means addressing administrative or financial obstacles that hinder researchers' mobility, both within and between countries, while at the same time improving working conditions for men and women.

The ERA was enshrined in the Lisbon Treaty in 2009, making its implementation a 'constitutional commitment' and the joint responsibility of the European Commission and the Member States. According to Article 179(1), the mission of the ERA policy is defined as follows:

> *"The union shall have the objective of strengthening its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encouraging it to become more competitive, including in its industry, while promoting all the research activities deemed necessary by virtue of other Chapters of the Treaties."*

In 2010, the ERA was anchored in the EU2020 strategy[28], as a cornerstone of the Flagship Initiative 'Innovation Union'. In the area of 'Strengthening the knowledge base and reducing fragmentation', the Innovation Union committed, among other things, to actions (i) promoting excellence in education and skills development, and (ii) delivering the European Research Area.[29] The latter led to development of the ERA framework defined in the 2012 Commission communication 'A Reinforced European Research Area Partnership for Excellence and Growth'.[30] In the Communication, measures for a more efficient and effective public research system were defined, with a view to completing the ERA by 2014. The measures envisaged increased cooperation to reduce duplication of research efforts, and increased competition to ensure that the best researchers and teams receive funding and can compete in the global research landscape. The following five **ERA priorities** were put forward in the Communication:

- More effective national research systems;
- Optimal transnational cooperation and competition;

[28] European Commission (2010). *Communication. Europe 2020. A strategy for smart, sustainable and inclusive growth*.
[29] European Commission (2010). *Communication. Europe 2020 Flagship Initiative Innovation Union.*
[30] European Commission (2012). *Communication. A Reinforced European Research Area Partnership for Excellence and Growth.*

- An open labour market for researchers (facilitating mobility, supporting training and ensuring attractive careers);
- Gender equality and gender mainstreaming in research; and
- Optimal circulation and transfer of scientific knowledge.

The Communication reinforced the idea of merit-based recruitment to make research careers more attractive, called for brain circulation and included the ERA in the national reform programmes and in the European Semester. It also specified concrete commitments linked to maximising excellence, and maintained an emphasis on the knowledge triangle. Shortly afterwards, international cooperation was incorporated as a sixth ERA priority, by way of Council conclusions.[31]

To reinforce the ERA partnership and achieve its objectives, the **ERA Roadmap 2015-2020** was elaborated in 2015. The purpose of the Roadmap is to identify a limited number of key priorities that are likely to have the biggest impact on Europe's science, research and innovation systems if all members of the ERA Partnership get them right. When it comes to implementing these actions, Member States have full autonomy in identifying the approaches most suited to the structures and dynamics of their national research and innovation systems. Almost all countries have developed **ERA Roadmap National Strategies and Action Plans (NAPs)** comprising a set of measures, actions and initiatives. These include the top action priorities of the ERA Roadmap, but also other actions that are country and context specific. Progress in the implementation of ERA priorities through the NAPs is the responsibility of the European Research Area and Innovation Committee (ERAC) and ERA-related groups[32].

The overall progress made towards completing the ERA and its priorities is monitored regularly in the ERA Progress Reports. These reports show the progress of ERA, as measured by a specific set of 24 indicators. These include eight headline indicators defined by ERAC, which are known as the ERA Monitoring Mechanism. The most recent ERA Progress Report dates from 2018.[33] This assessment concluded that "**progress towards the ERA priorities has continued** across the majority of the headline indicators albeit **at a slower pace**. In terms of EU28 averages, most headline indicators still show progress over time, although large disparities persist between countries in terms of both

[31] Council of the European Union (2012). Council conclusions on 'A Reinforced European Research Area Partnership for Excellence and Growth' (17649/12).
[32] High Level Group on Joint Programming-GPC, European Strategy Forum on Research Infrastructures-ESFRI, Standing Working Group on Human Resources and Mobility - SWG HRM, Standing Working Group on Gender in Research and Innovation - SWG GRI, Standing Working Group on Open Science and Innovation - SWG OSI, Strategic Forum for International Scientific and Technological Cooperation - SFIC.
[33] Directorate General for Research and Innovation (2018). *European Research Area Progress Report 2018.* Retrieved from: https://ec.europa.eu/info/publications/era-progress-report-2018_en

performance levels and growth rates."[34] Among the ERA's major achievements is the progress it has made in removing geographical barriers to researchers' mobility, while facilitating open, transparent and merit-based recruitment processes, facilitated by development of the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers[35] (Charter and Code for Researchers) and the pan-European pension fund RESAVER[36].

A new ambition for the ERA was defined recently in the 2020 Communication of the Commission on a **new ERA for Research and Innovation**.[37] This new approach will be instrumental in accelerating Europe's green and digital transformation, strengthening Europe's resilience and preparedness to face future crises, and in supporting Europe's competitive edge in the global race for knowledge. Four strategic objectives of the new ERA are defined in the Communication:

- Prioritising investments and reforms in research and innovation, to support the digital and green transition and Europe's recovery.
- Improving access to excellent research and innovation for researchers across the EU.
- Translating R&I results into the economy to ensure market uptake of research output and Europe's competitive leadership in technology.
- Making progress on the free circulation of knowledge, researchers and technology by moving from an approach of coordination towards deeper integration between national policies.

Despite broadening the ERA (as reflected in these strategic objectives) and promoting its evolution in general, the new ERA approach retains a very strong commitment to strengthening the mobility of researchers, their expertise, and the flow of knowledge. In fact, the **move from an approach of coordination towards deeper integration** between national policies indicates a stronger than ever commitment to help develop the skills that researchers need for excellent science, as well as promoting adequate framework conditions and inclusiveness, driving the modernisation of reward systems and the attractiveness of remuneration packages, etc. A set of updated, enhanced or new EU policy initiatives identified in the new ERA Communication, such as the European competence framework for research careers, ERA Talent Platform, ERA4You and European Open Science Cloud, will play a pivotal role in ensuring that further progress in these areas goes **beyond the traditional 'single market' elements of the ERA**. Horizon Europe will continue to provide an important impetus towards achieving this goal through its support

[34] Ibid.
[35] European Charter & Code for Researchers. Retrieved from: https://euraxess.ec.europa.eu/euraxess/charter-code-researchers
[36] https://www.resaver.eu/
[37] European Commission (2020) *Communication. A New Era for Research and Innovation*. COM(2020) 628 final.

to lower-performing Member States via the Widening Participation and Strengthening the ERA package, designed to improve their access to excellence and to address the imbalanced 'brain circulation' issues emphasised by the Croatian presidency of the Council of the European Union.

As also highlighted in the Programme of Germany's Presidency of the Council of the European Union in the Fields of Education, Research and Innovation, the new role of the ERA needs to be embraced by all Member States and must not be perceived as an "elite project".[38] This is crucial to enabling the highest possible degree of seamlessness and solidarity in the exchange of knowledge between national research and innovation systems and unlocking the full potential of the ERA.

In conclusion, the EU policy context is characterised by a multitude of objectives, instruments, and monitoring and reporting tools to assess progress. MORE4 can provide first-hand information based on a survey among researchers, which can inform the development of evidence-based policies in the academic research policy context:

1) The results are useful for tracking progress toward objectives, e.g. as regards the adoption of open and transparent recruitment practices, innovative doctoral training, or more generally toward the attractiveness of the EU as a location for excellent academic research. The perceptions of researchers complement other sources of information such as surveys carried out within research institutions.
2) MORE4 also sheds light on the success of policies in terms of reaching their target audience (implementation performance), e.g. whether researchers are aware of, and use the EURAXESS platform. Such a representative survey of the target population of research policies is an asset for policy design and evaluation.

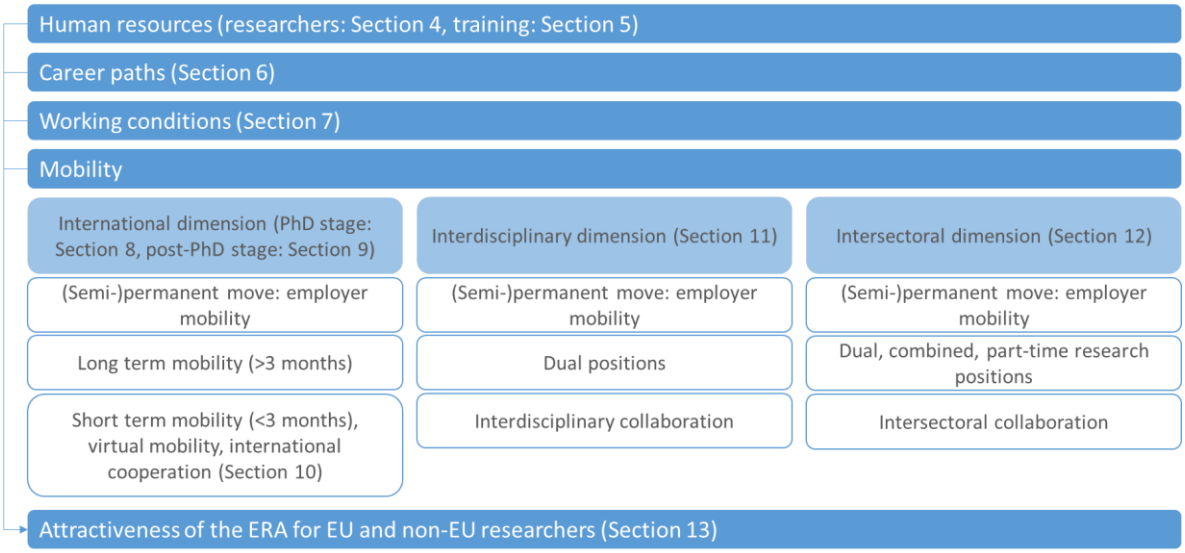
The results of MORE4 also inform policy design itself, as they pinpoint crucial issues in the ERA, such as heterogeneity in the structures and performances of the research systems of the EU Member States. The MORE studies not only feed into the development of policy reports such as the ERA progress report, but are also used analytically and for academic research purposes, to research the determinants and measurement of attractiveness, as they contain information as to what matters to researchers from an attractiveness perspective.

[38] Germany's Presidency of the Council of the European Union (2020). *Programme of Germany's Presidency of the Council of the European Union in the Fields of Education, Research and Innovation*. Retrieved from: https://www.bmbf.de/upload_filestore/pub/Programme_of_Germanys_Presidency_of_the_Council_of_the_European_Union_in_the_Fields_of_Education_Research_and_Innovation.pdf

3. CONCEPTUAL FRAMEWORK

MORE4 is a detailed and comprehensive study covering a wide range of aspects of the mobility patterns and career paths of researchers (including the drivers and enablers that affect both). It also encompasses broader policy-relevant issues such as gender equality in European R&I or the overall attractiveness of the ERA. All of these aspects are observed not only at certain points in time, but over time. All insights from the study are drawn from the findings of the MORE surveys and from desk research, and are further assessed in the context of policy developments reviewed in Section 2. To ensure that such broad and detailed analysis is performed consistently across all four tasks of the study, the research team was guided by and constantly referred to the same set of overarching concepts defined and structured in the **MORE4 conceptual framework**. Notably, as MORE4 is the fourth iteration of the MORE studies, the conceptual framework used in MORE4 was closely aligned with those used in the MORE2 (2012-2013) and MORE3 (2016-2017) studies[39], to ensure consistency.

Figure 1: Conceptual framework for the MORE4 study



Source: MORE4, based on MORE1-MORE3 and literature review.

[39] IDEA Consult et al. (2013). MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final report. European Commission, DG Research and Innovation.
IDEA Consult et al. (2017). MORE3 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final Report. European Commission, DG Research and Innovation.

As shown in Figure 1, human resources are the starting point for this conceptual framework: the stock of human resources is basically the population of interest in the MORE studies. Researchers' career paths can be seen as an important element of the overall working conditions of jobs in research; taken together, both are important factors which influence the various forms of mobility. For example, taking the next career step may necessarily involve international mobility to gain access to international networks; alternatively, inadequate working conditions may drive researchers away to other countries within the same sector or to other sectors within the same country. Perspectives for international mobility may also be seen as part of the working conditions of a job, as they influence potential international collaborations, which are associated with scientific productivity, knowledge gain, accumulation of experiences, learning hew techniques, etc. The quality of doctoral training, working conditions and career paths determine to a large extent the attractiveness of the European Research Area to both EU and non-EU researchers, whereas different forms of mobility can *inter alia* be seen as indicators for issues of attractiveness.

The conceptual framework of the MORE studies was intentionally developed to inform the **analysis at three different levels**: (i) variables and indicators concerning human resources and working conditions provide evidence of progress made at both system and organisation levels; (ii) study findings on career paths and mobility patterns provide information about changes from the perspective of individual researchers; whereas (iii) study insights on the overall attractiveness of the ERA elaborate on trends and developments at system level.

In the following paragraphs, we briefly discuss how the concepts analysed in the MORE4 study and the MORE4 conceptual framework in general are linked to the policy developments and policy instruments discussed in Section 2. This overview and contextualisation of the conceptual framework highlights how MORE4 provides evidence-based input that is relevant for ongoing policy discussions.

The MORE4 conceptual framework was originally defined in the context of six ERA priorities outlined in the ERA Roadmap 2015-2020[40] (cf. supra), in which policy lines can be divided analytically into two broad – and interrelated – categories:

- Attractiveness of career paths for researchers, i.e. the aim to achieve the full potential of the research base in Europe in terms of number of researchers, gender balance, attracting young researchers to the profession, etc.
- Optimal exchange and circulation of knowledge, i.e. the aim to valorise collaboration and mobility and optimise knowledge exchange without borders. Indicators of mobility, such as barriers to or motives for mobility, provide

[40] European Research Area and Innovation Committee (2015). ERAC Opinion on the European Research Area Roadmap 2015-2020. Retrieved from: https://data.consilium.europa.eu/doc/document/ST-1208-2015-INIT/en/pdf

important insights into what makes for an attractive place to do research and can also be used to monitor progress made with regard to attractiveness.

The elements of the MORE4 conceptual framework (marked in blue in Figure 2) were primarily inspired by ERA Priority 3 'An Open Labour Market for Researchers', but also drew on the concepts covered by other ERA priorities:

- Priority 1: More effective national research systems
- Priority 4: Gender equality and gender mainstreaming in research (from a HEI sector perspective)
- Priority 5: Optimal circulation, access to and transfer to scientific knowledge (from the perspective of intersectoral experiences in early career stages)
- Priority 6: International cooperation (from the perspectives of non-EU recruitment to the EU and effects of global exchanges)

Links between the MORE4 conceptual framework and ERA priorities defined in the ERA Roadmap 2015-2020 are indicated in grey in Figure 2 and marked as 'legacy priorities' (LP).

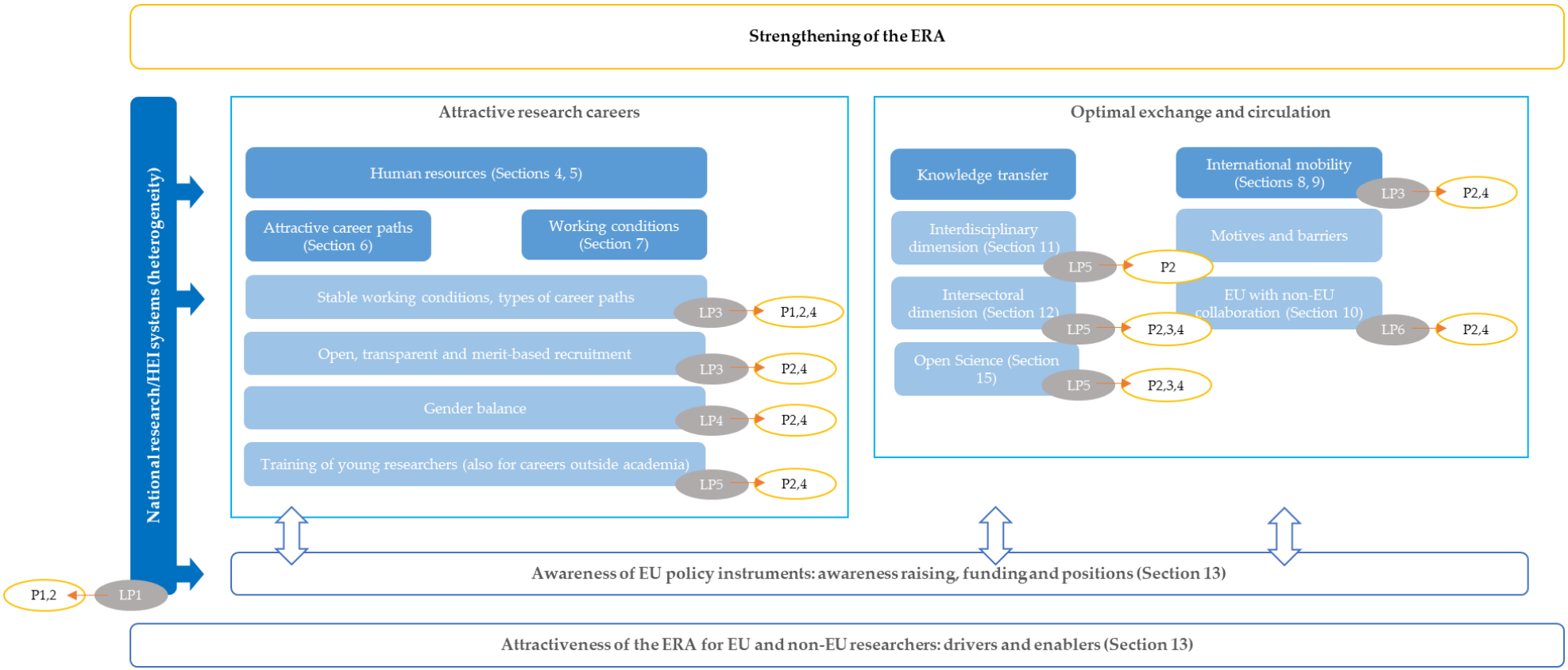
A few important additions have been introduced into the original MORE4 conceptual framework developed at the outset of the study, with the aim of addressing the most recent policy developments, namely the adoption of the 2020 Communication of the Commission on a **new ERA for Research and Innovation**. It has been clarified that under this new approach, policy focus has shifted from 'realisation of the ERA' to 'strengthening of the ERA'. In addition, links have been identified between the MORE4 conceptual framework and following strategic objectives of the new ERA (indicated in orange in Figure 2):

- Strategic objective 1: Prioritising investments and reforms
- Strategic objective 2: Improving access to excellence
- Strategic objective 3: Translating R&I results into the economy
- Strategic objective 4: Deepening the ERA

It should be noted that all of these new additions were incorporated into the MORE4 conceptual framework only during late stages of the study, which originally began in December 2018 (almost two years before the Communication was adopted in September 2020). Accordingly, only Task 4 (reporting on the findings of policy-relevant comparative analysis in the final study report) was guided by this updated and newly contextualised conceptual framework.

The analytical part of this report (Part 2) is structured according to the conceptual framework of the MORE4 study. More specifically, topics relating to doctoral training, attractive career paths for researchers and working conditions are covered in Sections 4 to 7; findings on exchanges and circulation are presented in Sections 8 to 12; and study findings on the attractiveness of the ERA to both EU and non-EU researchers, as well as the policy instruments supporting progress in this field, are summarised in Section 13. Each section begins with an introduction to the relevant concepts by presenting a summary of key figures and findings from the comparative analysis. These findings are then situated within the policy context and used to discuss policy-relevant questions.

Figure 2: Conceptual framework in the policy context

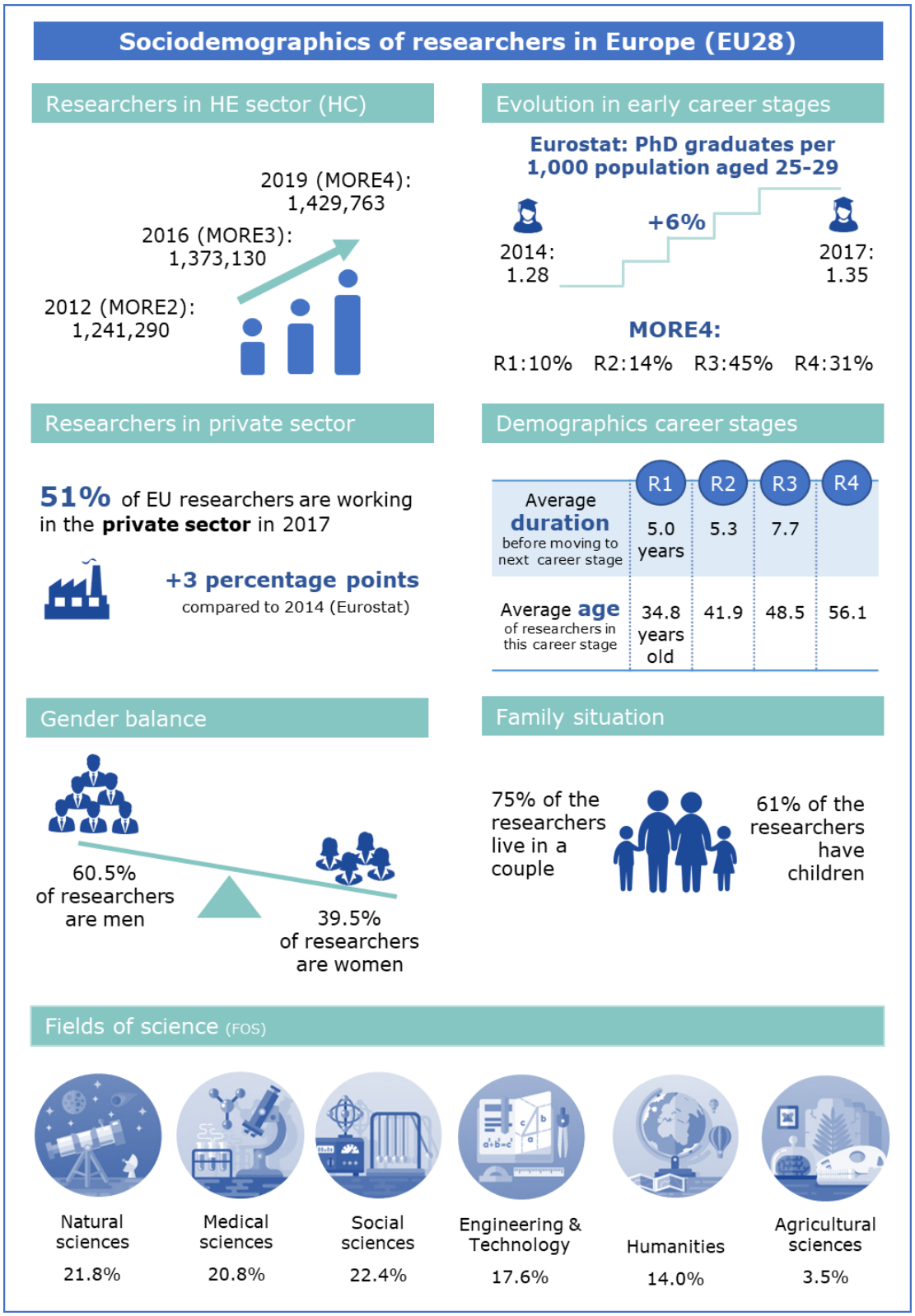


Source: MORE4.

Note: LP – Legacy Priorities from ERA Communication 2012, P – Priorities from new ERA Communication 2020.

Part 2. Comparative and policy-relevant analysis

4. HUMAN RESOURCES: RESEARCHERS



Source: Based on MORE4 EU HE report (Section 5.1) and MORE4 Indicators report on researchers (based on Eurostat data).

Note: For definitions of fields of science and research career stages see Annex 1.

4.1. Key findings

In the MORE4 Indicators report[41] on researchers, a number of indicators on human resources were developed on the basis of Eurostat data. Particularly relevant are those concerning the total number of researchers, young researchers (PhD graduates), researchers working in private industry, and gender differences (the last of these is also discussed in detail in Section 14). Moreover, the population of the EU HE survey reflects the demographics of researchers currently working in higher education institutions in Europe. In this section, we summarise the key findings on the quantity of human resources in EU HE sector.

On the number of researchers in general: slow progress is being made towards a more knowledge-intensive Europe: the number of researchers is increasing, as well as the relative number of researchers per 1,000 employees[42].

- The number of researchers (FTE) per 1,000 employees in the EU28 increased by 7% between 2014 and 2017, and has been increasing since 2000.
- In 2017, there were 8.9 researchers (FTE) per 1,000 employees in the EU28.
- The relative number ranges from 2.2 in Romania to 16.2 in Denmark. Europe shows a fairly clear and persistent divide in this indicator: as in MORE3, we see that the Nordic countries Denmark, Finland and Sweden have shares of 14-16 researchers per 1,000 employees. Most of the central Western European countries have numbers of 9-10 (e.g. Austria, Belgium, France, Germany, Ireland, Luxembourg, the Netherlands, Portugal and the UK). Slovenia is the only Eastern European country with an equally high number of 9.0. The Southern countries follow, with a relative number of 6.0 researchers per 1,000 employees in Italy, 7.0 in Spain and 8.1 in Greece. Among the remaining new Member States, the indicator value ranges from 2.2 in Romania (followed closely by Cyprus with 2.5) to 7.4 in the Czech Republic.
- In 2017, the EU28 had a higher relative number than the US (8.4), and a significantly higher number than China (2.2). At the same time, the value for EU28 was lower than those of Japan (10.1) and South Korea (13.7).

On researchers by sector of R&D performance: 51% of EU researchers work in the private sector[43], although this share varies between Member States, from 19% to 72%.

- The figure is relatively stable, with a 3pp increase compared with 2014, but wide variation is found between Member States. The countries with the highest shares of researchers in the private sector, as a proportion of the total number of researchers, are Sweden (72%), the Netherlands (63%), and Austria, Hungary and Slovenia (62% each). The lowest overall numbers are found in Latvia (19%), Croatia (21%), Slovakia (22%) and Romania (25%). These shares depend on

[41] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Researcher Indicators report. European Commission, DG Research and Innovation.
[42] Based on Eurostat, Total R&D personnel (researchers) by sectors of performance, occupation and sex (rd_p_persocc, occupation 'researchers' and unit 'FTE') and Employment and activity by sex and age, total employed from 15 to 64 years in thousand persons (lfsi_emp_a). Cf. indicator 1.1 in the MORE4 Indicators report on researchers.
[43] Based on Eurostat, Total R&D personnel (researchers) by sectors of performance, occupation and sex (rd_p_persocc, occupation 'researchers', unit 'FTE', sector 'business enterprise sector'). Cf. indicator 1.6 in the MORE4 Indicators report on researchers.

industry structures (low-tech versus medium- and high-tech industries, size of companies, etc.) and changes, but also on established research and innovation infrastructures, opportunities and incentives. Industry structures that are dominated by small firms and established research systems are among the reasons for the relatively low shares of private-sector researchers in many Eastern Member States - but also Portugal and Greece have experienced low shares of researchers in the private sector over long periods.

- Over time, we can observe large increases in the share of private-sector researchers in a number of Eastern Member States such as Bulgaria (from 14% in 2009 to 27% in 2014 and 43% in 2017) and Poland (from 16% in 2009 to 32% in 2014 and 47% in 2017). Greece also achieved an increase from 17% to 30% (+13pp) in the period 2014-2017. These countries typically start from very low shares of researchers in the private sector. This suggests that if the private sector is developing towards more research-intensive processes, it also creates opportunities for skilled personnel. Another reason for these shifts could, however, be fewer opportunities in the public sector. Most countries with high shares of researchers in the private sector, such as Sweden, Austria, Denmark, France, Germany, Hungary, Malta, the Netherlands and Slovenia, already had these high shares in 2014, and several of them even in 2009. An exception is Ireland, where the share decreased by 11pp, from 64% to 53% between 2014 and 2017. This could in part be explained by a sharp decrease in business enterprise R&D expenditure (BERD) in Ireland during this period: BERD intensity was stable at around 1-1.1% of GDP in the post 2008-09 crisis period up until 2015, when a sharp decline to 0.85% of GDP occurred[44].
- The share of researchers in the private sector is significantly higher in the US (71%), China (61%), Japan (74%) and South Korea (81%) compared with the EU28 (51%).

On the number of young researchers: both the number of young PhD graduates per 1,000 population aged 25-29, and the total number of PhD graduates per 1,000 population increased by 6% between 2014-2017.

- In 2017, the EU average was 1.35 young PhD graduates per 1,000 population aged 25-29[45], and 0.27 PhD graduates (ISCED 6/8) per 1,000 population overall.
- Even though the EU-level indicator increased by 6% compared with 2014, the relative numbers have decreased in 20 of the 28 Member States. During the period 2014-2017, the largest decreases were observed in Latvia (0.26 to 0.07, -75%), Portugal (1.18 to 0.53, -55%), Croatia (0.28 to 0.15, -47%) and Romania (0.60 to 0.32, -46%). The largest increases in the number of young PhD graduates per 1,000 population aged 25-29 were registered in Greece (0.25 to 0.51, +105%), Luxembourg (0.46 to 0.95, +105%) and Malta (0.19 to 0.38, +95%).

[44] Jordan, D. & Fákó, P., RIO Country Report 2017: Ireland, EUR 29167 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81278-1, doi: 10.2760/646408, JRC111329.

[45] Based on Eurostat, Graduates (educ_uoe_grad01 from 2013, age class from 25 to 29 years, ISCED8; educ_grad4 until 2012, age class from 25 to 29 years, ISCED6); Population statistics (migr_pop1ctz, age class from 25 to 29 years). Cf. indicator 1.2 in the MORE4 Indicators report on researchers.

- Overall, the pattern remains stable compared with 2014: the highest overall numbers of young PhD graduates per 1,000 population in 2017 are found in the UK (2.45), France (2.05) and Slovakia (2.04). More than one PhD graduate per 1,000 young inhabitants is also seen in Austria, Belgium, Denmark, Germany, Ireland, Italy, the Netherlands and Slovenia, while all other countries have an indicator value of less than 1. Bulgaria, Croatia, Cyprus, Finland, Latvia, Malta, Poland and Romania have even fewer than 0.5 young PhD graduates per thousand population in 2017.
- The total number of PhD graduates[46] in Europe follows this trend, with an increase of 6% between 2014 and 2017. For this indicator, however, there is an increase in 13 of the 28 EU Member States. The largest growth rates can typically be found in countries with small absolute numbers such as Cyprus (+54%), Malta (+127%), or Luxembourg (+73%), but also in Spain (+84%). The largest decrease is observed in Romania (-49%), Slovenia (-49%), Portugal (-46%) and Latvia (-41%). In general, the increase of the number of PhD graduates in Europe is partly explained by the better employment opportunities that come with higher educational achievements. According to a 2019 OECD report, employment rates continue to increase with further levels of tertiary education attainment. On average across OECD countries, the employment rate is 82% for adults with a short-cycle tertiary qualification, rising to 84% for those with a Bachelor's or equivalent degree, 88% with a Master's or equivalent degree, and 92% with a doctoral or equivalent degree[47].

Romania, Cyprus, Latvia, Malta, Croatia and Poland are characterised to varying extents by a combination of low shares of researchers, low shares of PhD graduates, and low shares of new PhD graduates as a proportion of the young population. These countries are among the lowest 10 for all three indicators. Bulgaria, Hungary, Italy and Greece have low figures for two out of these three indicators.

On gender balance: overall, the relative number of female researchers per thousand female employees is considerably lower than the total for both men and women. However, as a proportion of the young population aged 25-29, both the relative number and the increase in female young PhD graduates are similar to the overall total.

- The relative number of female researchers per 1,000 female employees[48] stood at 5.5 FTE in the EU in 2017, which is considerably lower than the overall figure of 8.9 (2017). The pace of increase is slow (1% between 2014 and 2017).
- Denmark has the highest relative number, with 12.4 female FTE researchers per 1,000 female employees in 2017, followed by Greece and Portugal with around 8 female FTE per 1,000 female employees. The lowest numbers are observed in

[46] Based on Eurostat, Graduates (educ_uoe_grad01 from 2013, ISCED8; educ_grad4 until 2012; ISCED6) and Population statistics (migr_pop1ctz). Cf. indicator 1.3 in the MORE3 Indicators report on researchers.
[47] OECD (2019). Indicator A3. How does educational attainment affect participation in the labour market? Retrieved from https://www.oecd-ilibrary.org/docserver/9572b9a6-en.pdf?expires=1608291221&id=id&accname=guest&checksum=8A3FF13F7002C6191FC51B552D6CDB4B
[48] Excluding Finland and the UK, as breakdowns by gender is not available for these countries. Cf. indicator 1.1 in the MORE4 Indicators report on researchers.

Cyprus (1.9), Romania (2.3) and Malta (2.7). The indicator increases strongly between 2014 and 2017 in Ireland (+34%), Denmark (+18%) and Bulgaria (+14%).

- Among the young population (25-29), the pattern for the relative number of female PhD graduates[49] is similar to that for the total. The female indicator score stood at 1.33 in 2017, with a small increase of 4% between 2014 and 2017. Across a number of countries, patterns for female FTE researchers are similar to those for researchers overall: the highest numbers are observed in the UK (2.25), Slovakia (2.08) and Germany (1.87), while the lowest shares are in Latvia (0.07), Cyprus (0.11) and Croatia (0.31).

Comparing the share of young female PhD graduates to the total share of female researchers thus indicates that in the early career stages female researchers are better represented.

On gender equality: there is an overall improvement in the representation of women in grade A positions[50] in all Member States, but they remain under-represented in all countries. 26% of all grade A positions are occupied by women, and the proportion of women on scientific boards is 31% in 2017. These indicators on gender equality are discussed in detail in Section 14.

4.2. EU policy aims and implications of MORE4 findings

In previous decades, policy lines were set out to make Europe the most dynamic and competitive knowledge economy in the world. These include the development of the European Research Area and commitment to the 3% objective for R&D expenditure. The 2000 Communication on the ERA emphasised the need for more abundant and more mobile human resources[51]. In the years following this Communication, the European Council repeatedly endorsed the ERA and emphasised the potential shortage of human resources in R&D. This challenge was also identified and warned against in the context of the 3% objective: the Communication on 'More Research for Europe – towards 3% of GDP'[52] warned against the risk that a lack of sufficient human resources in R&D would constitute a bottleneck to the attainment of the 3% objective. The increased attention given to human resources for R&D since 2000 is also linked to parallel policy lines on the labour market and working conditions in general, which emphasise the development of human capital and lifelong learning among other aims.

The recent 2020 Communication on the ERA[53] confirms the importance of R&D investments and the need to attract and retain talented researchers to support knowledge diffusion

[49] Based on Eurostat, Graduates (educ_uoe_grad01 from 2013, age class from 25 to 29 years, ISCED8; educ_grad4 until 2012, age class from 25 to 29 years, ISCED6). Cf. indicator 1.2 in the MORE4 Indicators report on researchers.
[50] Grade A positions - equivalent to full professors in most countries.
[51] Commission of the European Communities (2000). Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions. Towards a European Research Area.
[52] Commission of the European Communities (2002). Communication on the collection and use of expertise by the Commission: Principles and guidelines. "Improving the knowledge base for better policies".
[53] European Commission (2020). Communication. A new ERA for Research and Innovation.

across the EU. In this, it strongly emphasises the priority of strengthening national and European R&I systems, as well as the interplay between them, through investments and reforms. In addition, it emphasises the need to improve access to excellence and broaden talent capacity, e.g. by supporting mobility.

In the same policy context of the full deployment of research capacity in Europe, the inclusion of women in the research profession, at all stages and in all sectors and disciplines, is high on the agenda. It is an ERA objective to "foster scientific excellence by fully utilising gender diversity and equality and avoiding an indefensible waste of talent". Under the priority of deepening the ERA, the new ERA Communication[54] reaffirms the importance of gender equality to the strengthening of R&I potential in Europe.

These goals have created a context in which an increasing number of researchers are needed in Europe, together with the full exploitation of the potential of human capital, independent of sector, geographical location or gender. The main policy goals relating to the topics in this section are thus:

- **Quantity of researchers**: ensure a sufficient number of researchers at all career stages, and in all fields and sectors, so as to exploit the full potential of the human capital in Europe to the benefit of the European knowledge economy.
- **Gender equality** among researchers: ensure the balanced representation of women in research, at all career stages, and in all fields and sectors, so as to exploit the full potential of the human capital in Europe to the benefit of the European knowledge economy.

However, perceptions of difficult working conditions or career paths may lead people interested in a research career towards other fields or sectors instead. Continuous efforts are therefore required to improve the attractiveness of working conditions and career paths for researchers in Europe, in order to develop the profession's full potential. Over the following paragraphs, we discuss this from the point of view of the number of researchers. Topics that relate more to the effects of training, career paths and working conditions are discussed in detail in Sections 5, 6 and 7. Section 14 focuses specifically on topics relating to gender equality.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on the number of researchers and gender balance?

The MORE4 analysis does indeed show an **increase in the number of researchers** in the higher education sector from 1.2 to 1.4 million between 2009 and 2016 (based on the Eurostat total).

It is, however, equally important that researchers find their way to career paths outside academia. Important indicators for this are the number of PhD graduates (overall stock of researchers for all sectors) and the number of researchers already working in private industry.

[54] European Commission (2020). Communication. A new ERA for Research and Innovation.

- Analysis of Eurostat data reveals that the total **number of PhD graduates**[55] in Europe shows a general positive trend. This suggests that the number of researchers in Europe can potentially grow at a relatively fast pace compared with growth in overall employment, increasing the number of researchers relative to the total workforce. This depends, however, on attractive training and careers in both academic and industry research settings (see Section 4 on PhD training and Section 6 on research careers).
- In terms of the proportion of **researchers working in the private sector**[56] between 2014 and 2017, Eurostat data also indicate a small increase from 48% to 51%. This is, however, considerable given the overall rate of growth in researcher stock. This type of indicator is not expected to fluctuate or evolve significantly, and will need to be monitored in the longer run to determine the effect of policy actions and external factors such as the COVID-19 pandemic. As in the previous MORE reports, we continue to observe large differences between countries that relate to the economic structure and research intensity in individual Member States. Policy initiatives to promote attractive career paths in industry research settings will thus need to take into account this diversity in national contexts by allowing sufficiently flexible approaches. The issue of intersectoral mobility and exchange is discussed in further detail in Section 12.

With regard to **gender balance**, the MORE4 EU HE survey data[57] show a persistent pattern of gender imbalance, particularly in later career stages, with women making up just 28% of R4 researchers, corresponding with the 26% of Grade A positions in HEI occupied by women in 2017. A 'glass ceiling' still impedes women from reaching higher positions, although wide variations can be seen between countries. The fact that a more equal balance exists among early career stages could either be an indication of improvements in the future, or further evidence of the glass ceiling at which female researchers drop out before they reach R3 or R4 career stages. Progress has, however, been observed and further improvements are expected, although at a slow pace, given the nature of the research systems and index. This positive development can already be seen from the Eurostat indicators and ERA Progress Report 2018[58]. According to the latter source, the average EU28 score for the headline indicator 'Share of women in Grade A positions in the higher education sector' has moved up from 23% in 2014 to 24% in 2016 (compound annual growth rate = 1%). As mentioned above, gender equality will be discussed in greater detail in Section 14.

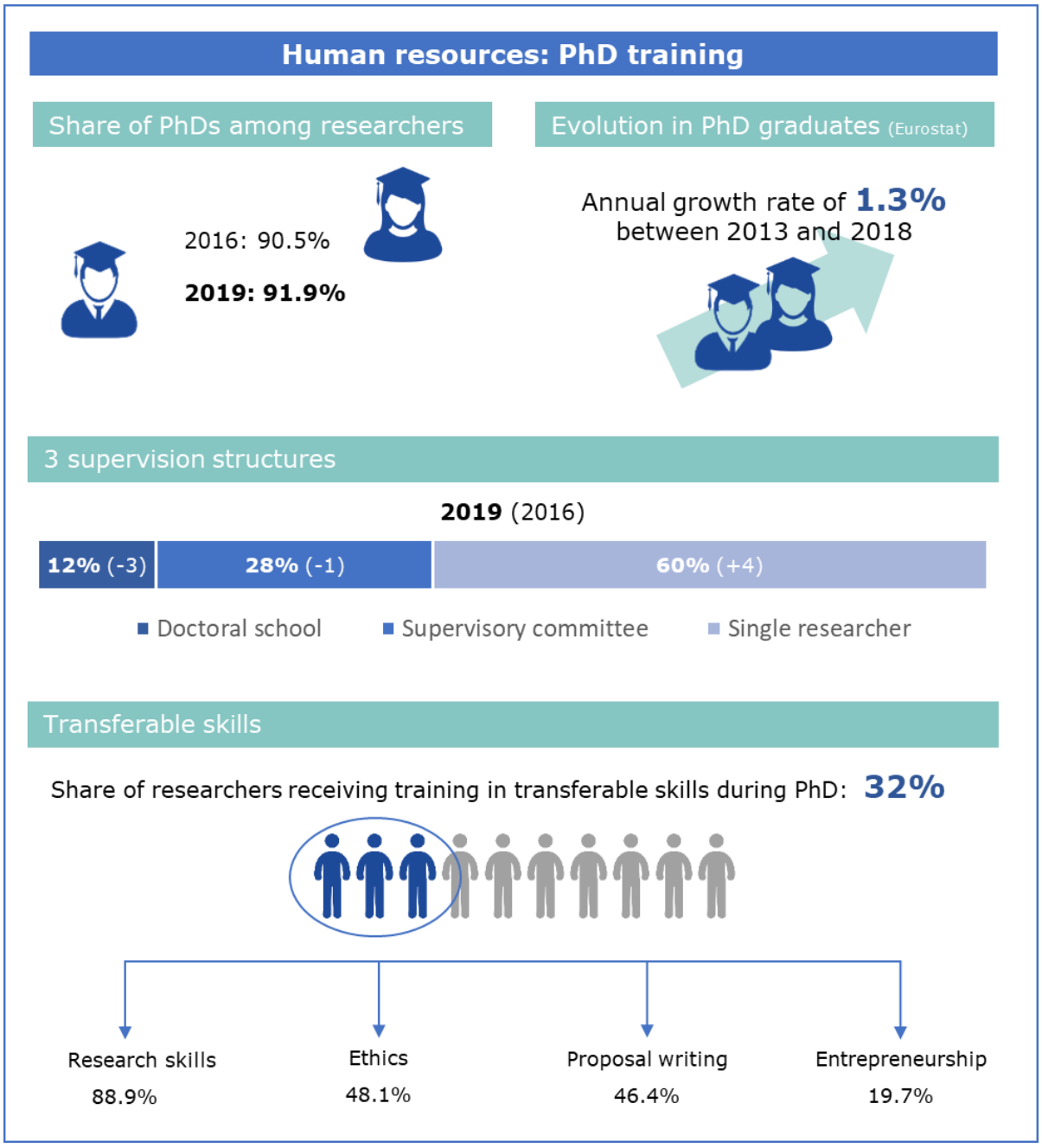
[55] Based on Eurostat, Graduates (educ_uoe_grad from 2013, educ_grad until 2012) and Population statistics (migr_pop1ctz). Cf. indicator 1.3 in the MORE3 Indicators report on researchers.
[56] Based on Eurostat, Total R&D personnel (researchers) by sectors of performance, occupation and sex (rd_p_persocc, occupation 'researchers', unit 'FTE', sector 'business enterprise sector'). Cf. indicator 1.6 in the MORE4 Indicators report on researchers.
[57] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[58] European Commission (2018). *ERA Progress Report. Data gathering and information for the 2018 ERA monitoring – Technical Report*. Retrieved from https://ec.europa.eu/info/sites/info/files/research_and_innovation/era/era_progress_report_2018-technical.pdf

EU-level and national policy instruments

The discussion above confirms that socio-demographic indicators change at a slow pace and that, despite mainly positive trends in the number of researchers, young researchers, researchers in private industry and gender balance, continuous efforts are needed to support the further realisation of structural changes and at the same time take into account the wide variation between national R&I systems in Europe.

Policy instruments that address the attractiveness of training, working conditions and career paths for researchers in Europe will have an impact on the number of researchers choosing and remaining in a research career in Europe. These instruments are discussed in Sections 5, 6 and 7, which cover PhD training, career paths and working conditions, respectively. Research careers in industry settings and intersectoral collaboration are discussed in Section 12. Section 14 focuses on policies aimed at improving **gender equality,** and the needs that have been identified in this respect.

5. HUMAN RESOURCES: PHD TRAINING



Source: Based on MORE4 EU HE report (Section 5.2) and MORE4 Indicators report on researchers (based on Eurostat data)

This section reports MORE4's key findings in relation to PhD training at EU and global level, specifically PhD graduation rates, the organisation and structure of PhD training, the content of PhD training (mainly in terms of transferable skills), as well as PhD candidates' views on innovative principles for doctoral training.

5.1. Key findings[59]

Share of researchers currently enrolled in a PhD programme or already holding a PhD				
	EU28 total	**By career stage**	**By FOS**	**By gender**
2012 (n=9,016)	90.5%	R1: 89.7% R2: 90.4% R3. 92.0% R4: 91.1%	MED: 87.4% NAT: 91.9% SOC: 91.0%	F: 89.1% M: 91.3%
2016 (n=9,412)	91.9%	R1: 72.5% R2: 94.3% R3. 95.6% R4: 95.2%	MED: 92.9% NAT: 92.6% SOC: 90.6%	F: 90.9% M: 92.6%
2019 (n=8,420)	91.7%	R1: 80.3% R2: 92.5% R3. 92.2% R4: 94.5%	MED: 90.0% NAT: 93.4% SOC: 91.1%	F: 92.5% M: 91.3%

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)

Note:

Based on question 25: "Are you currently working on a PhD or are you enrolled in a doctoral programme?" and question 9: "Please indicate below all higher education (=post-secondary) diplomas/degrees you have obtained so far and their details."

In 2018, almost 772,000 (2014: 738,000) students participated in doctoral training in the EU28[60]. The number of PhD graduates per 1,000 inhabitants aged 25-34[61] in the EU28 has risen from 1.9 in 2013 to 2.1 in 2018 (see also Section 4 for a more detailed elaboration).

Globally, PhD training remains the main point of entry into research careers, with 92% of academic researchers currently working in the EU (see table above), and 88% of the Global survey sample of researchers currently working outside the EU, holding a PhD or participating in PhD training.[62] As a consequence, the quality and content of PhD training matters (i) in order to attract researchers into research careers when they face a decision between pursuing research or other labour market options; (ii) to attract talented researchers from abroad, as there is international mobility of talented students looking for the best training (see Section 8 on PhD mobility); and (iii) for the outcomes of research activity, such as scientific productivity in the EU, industry research performance and wider

[59] Due to the often unchanged nature of the results and the continuing policy relevance of the topics raised, also in light of the new ERA communication 2020, several parts of this text are unchanged with respect to the MORE3 study.

[60] Based on Eurostat, Students enrolled in tertiary education by education level, programme orientation, sex, type of institution and intensity of participation (EDUC_UOE_ENRT01)

[61] Based on Eurostat, Graduates (educ_uoe_grad06) and Population on 1 January by age and sex (demo_pjan).

[62] On this point, also see Ates, G., Brechelmacher, A., 'Academic career paths'. In: Work Situation, Views and Activities of the Academic Professions: Findings of a Survey in Twelve European Countries, Teichler, U. & EHöhle, .A. (eds.), 13–35, 2012. In some countries, such as with Germany's "Habilitation", further qualifications after the PhD are required to successfully enter an academic career.

societal goals potentially affected by PhD training. Transformative R&I is at the centre of the new ERA Communication, and PhD training can contribute significantly towards meeting the objectives set – for example, with respect to tackling the twin transition (digitalisation and greening the economy). In spite of this universal role of the PhD, training structures and content differ considerably within the EU, as well as between the EU as a whole and non-EU regions or countries such as the US, as also previously observed in the MORE3 study.

First, in terms of the **structure of PhD training** (Figure 3), PhD candidates in the EU as a whole state that they are predominantly supervised by a single researcher (60%). Supervisory committees (28%) or doctoral schools (12%) remain a minority. Based on our sample of researchers in the Global survey[63], 62% of PhD graduates in the US were embedded in a doctoral school, with only 9% supervised by a single researcher[64] . Within the EU, structures also vary widely, with single-researcher supervision very commonplace in the Poland (approx. 80% of the respondents obtained their PhD in this setting) and much less so in Norway (approx. 26%). Doctoral schools are most common in Denmark (40%), Hungary and Norway (38% each), but non-existent in our sample in Ireland, Switzerland and Poland. In comparison to MORE3, there are only minor changes at EU-level, which are within the margin of error. At country level, there are larger changes; however, the study did not involve a network of national country experts to explain recent developments regarding PhD-students. The R1 sample population is also the population subject to the most change between different editions of the MORE surveys.

In data not shown here in the final report (but contained in the EU and Global Survey), PhD-students were also asked about more detailed characteristics of their PhD-studies. Transparent and accountable procedures for admission, supervision, evaluation and career development are, according to this additional information, more common in the Anglo-Saxon and Nordic system (with the exception of Malta) than in the Southern (except Greece) and Continental systems. The countries in which the lowest shares of PhD candidates perceived procedures as transparent and accountable were Luxembourg (9%), Switzerland (20%), Germany (21%), and Slovakia (21%). Joint doctorates are much more common among researchers currently working in the EU (31%) than in the non-representative sample of researchers working outside the EU, reflecting the rich diversity of EU doctoral programmes.

Second, in terms of the **content of PhD training** (Figure 4) other than the core academic specialisation in a research field, we see that while 86% of EU researchers think that transferable skills have an important influence on career progression, only 32% of PhD candidates in the EU receive training in transferable skills such as research skills, people and project management. Within the EU, there are large differences between countries regarding the share of young researchers receiving training in such transferable skills. Countries such as Lithuania, Bulgaria, Germany and Poland show low levels of PhD candidates stating that they have received training in transferable skills during their PhD. On the other hand, in Romania, Hungary, Denmark and Italy, the share of PhD candidates

[63] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.
[64] Details on PhD supervision structures for researchers currently working outside the EU are reported in the MORE4 Global Survey.

who state that training in transferable skills forms a part of their PhD training is relatively high.

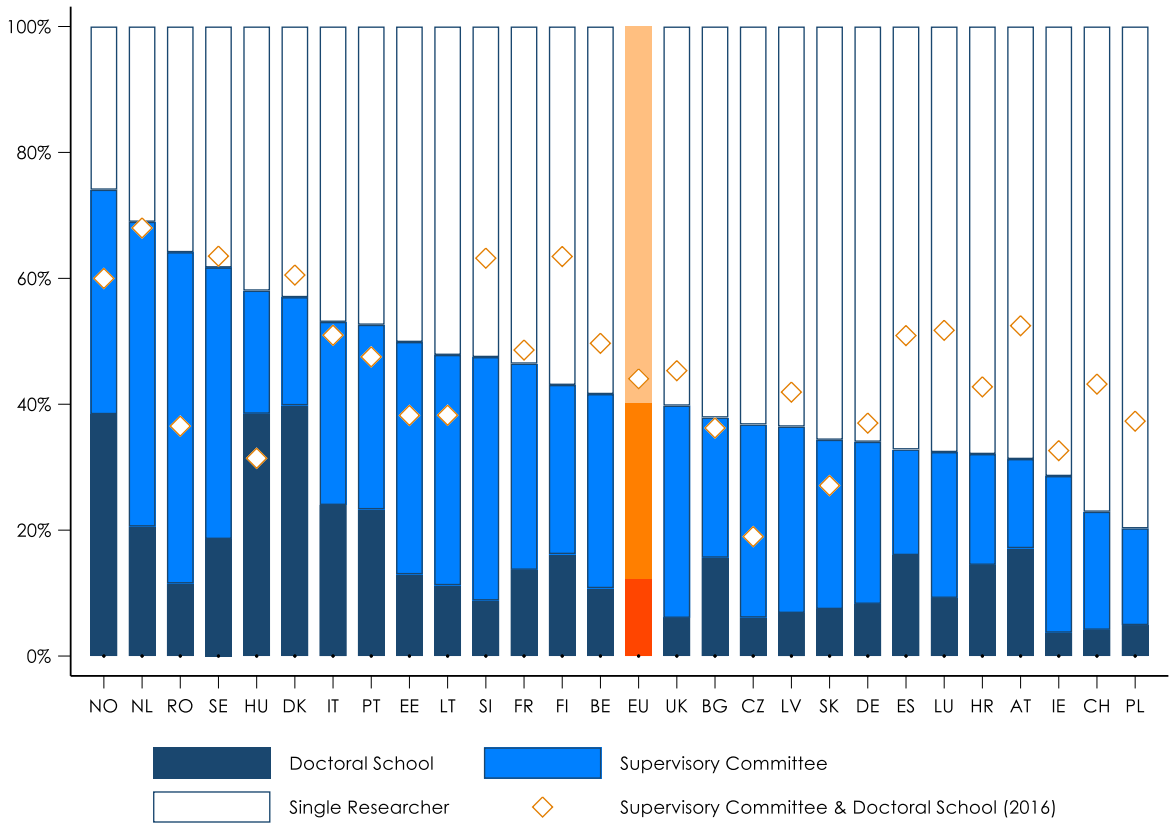
Training in transferable skills focuses on skills more closely related to core research activities, such as research skills, communication and presentation skills, decision making and problem solving, and critical and autonomous thinking (>80%). Skills such as engagement with society, IPR, negotiation and entrepreneurship are less frequently part of transferable skills training (<40%). Among the Global survey sample of researchers, while researchers who graduated in a non-EU country have on average received more training in transferable skills, the same pattern of skills taught prevails. Researchers who graduated from a US institution are more likely to have received training in transferable skills; however, training in entrepreneurship and IPR is even slightly lower in the US than in the EU. This may be explained by US PhD programmes focusing on excellence in basic research[65].

A more detailed analysis of how PhD training looks in individual EU countries is provided in the MORE4 EU HE survey[66]. For example, there is wide variation between countries with respect to international networking as a part of PhD training, with 77% of PhD candidates in Romania declaring that they have developed international networks, compared with only 17% of PhD candidates in the UK.

[65] The US-American higher education system is overall very heterogeneous, with low-quality institutions operating alongside top institutions. Our results seem to reflect respondents working at high-quality institutions, as international mobility to low-quality institutions is probably low. However, in terms of attractiveness and of asymmetric mobility of EU researchers towards US research universities, it is precisely these high-quality US institutions which are interesting as a benchmark for the EU's ambitions.

[66] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.

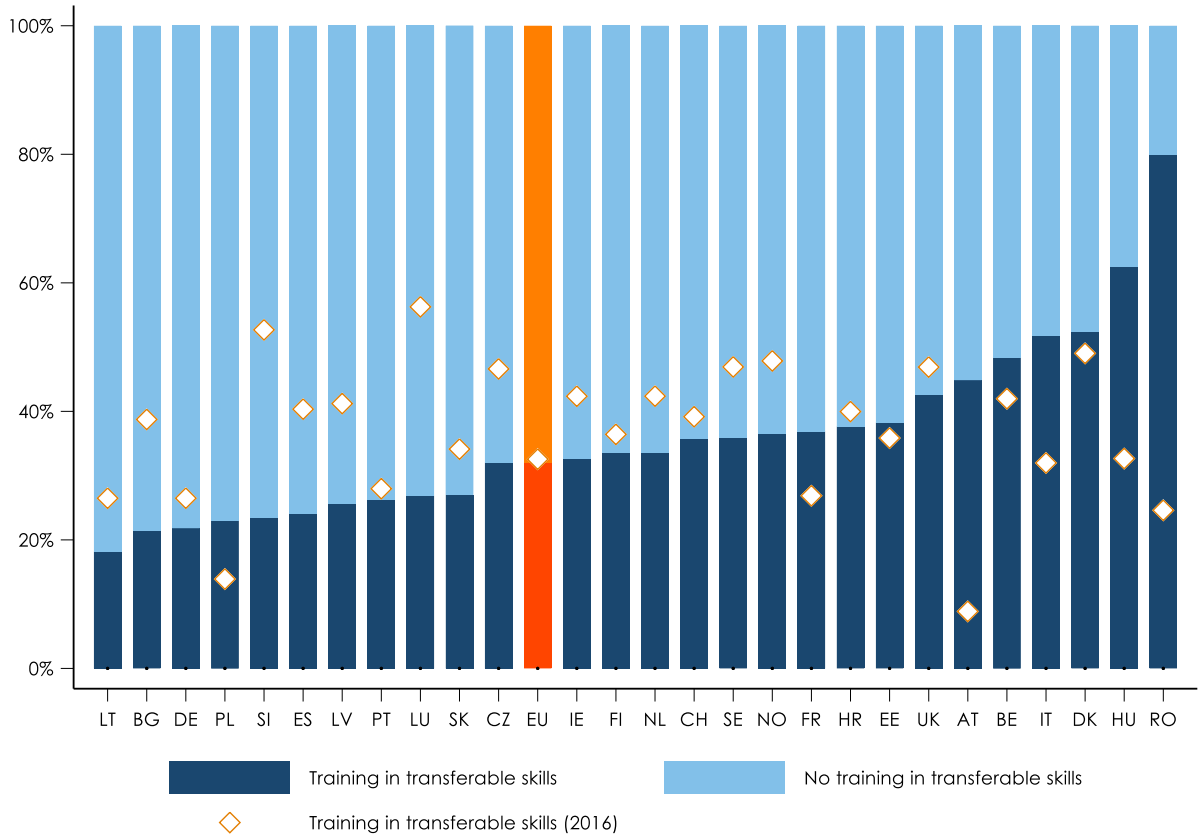
Figure 3: PhD supervision structures by country, researchers working inside the EU



Source: MORE4 EU HE Survey (2019) and MORE3 EU HE survey (2016) – Figure 13 in MORE4 EU HE report
Notes:
Only R1 PhD candidates and R2 PhD holders.
Possible answers were that PhD supervision was undertaken by just one senior researcher, by a supervisory committee, embedded in a doctoral school, or took another form.
Based on question 48: "How would you describe your PhD in terms of supervision structure?"
(2019: n=1,843; 2016: n=2,786)

Third, the results with regard to the composition of training in transferable skills are in line with **what PhD candidates think is important in their PhD training**: research excellence is foremost (90%), and attractive working conditions for research (88%; e.g. research independence, career perspectives). Intersectoral collaboration and industry funding are least valued – at odds not only with the principles for innovative doctoral training, but also with the goals stated in the new ERA Communication for greater intersectoral mobility to provide outside career options and boost the valorisation of research results. PhD candidates' expectations are more likely to focus on remaining in (academic) research; thus, they perhaps place less value on skills more necessary outside the academic sector. Among different fields of science, the highest share of PhD candidates co-funded by industry is unsurprisingly found in Engineering (12%), where there is strong industry interest. This is followed by Agriculture (7%), while it is lowest in Social Sciences (3%). On average, heterogeneity across the EU is less pronounced in terms of co-funding than it is in relation to the structure and content of PhD studies. This points towards a more unified perception of early-stage researchers and what matters with respect to PhD training, contrasting with real and significant heterogeneity in terms of actual PhD training. 17% of R1 and 11% of R2 researchers are aware of the principles for innovative doctoral training –still very low, but an increase of 8 percentage points among R1 researchers compared with MORE3.

Figure 4: Share of researchers receiving training in transferable skills during their PhD, by country of graduation



Source: MORE4 EU HE survey (2019) and MORE3 EU HE Survey (2016) – Figure 16 in MORE3 EU HE report

Notes:

Only R1 PhD candidates and R2 PhD holders.
Fewer than 30 observations were made in Cyprus, Greece, Iceland, Malta. These countries are, therefore not displayed in the graph.
Share of researchers receiving training in transferable skills by country of PhD (i.e. the country in which the researcher obtained a PhD, or is currently enrolled in a PhD programme).
Based on question 50: "Which of the following statements are applicable to your PhD training?"
(2019: n=1,936; 2016: n=2,810)

5.2. EU policy aims and implications of MORE4 findings

The policy context for PhD training in the EU is characterised by a variety of policy aims emanating, for example, from the Council Conclusions on young researchers, the EU innovative doctoral training principles, and the four ERA priorities from the recent Communication on the new ERA:

- **Quantity of researchers trained at PhD level**: industry requires more researchers, not only because international competition is increasingly based on R&D and innovation, but also because it is becoming harder to originate new ideas, leading to declining R&D productivity[67]. The twin green and digital transition will require substantial research efforts. PhD studies hence need to be attractive in order to draw in growing numbers of talented students against the backdrop of an overall decline in the number of students in several countries of the EU.
- **Quality of PhD studies**: worldwide competition for the most talented researchers[68] requires that PhD training programmes in the EU must be attractive enough to entice the best talents, ensuring brain circulation rather than brain drain. High-quality PhD training is a pillar for later research excellence, which is linked to both economic competitiveness and meeting societal challenges.
- **Content of PhD training**: higher demand for PhDs by industry, and the pyramidal nature of career options in academia, require that options for PhD candidates should be kept broad. PhD studies need to ensure that general and transferable skills are part of the curriculum, to equip students for changing expectations in terms of career paths outside academia.
- **Composition of the student body**: without gender equality in PhD training, it is unlikely that gender equality among researchers will ever be achieved. This is equally true for the representation of students from disadvantaged social backgrounds. Both gender equality and greater inclusiveness feed back into the goal of quantity of researchers. These issues will be further addressed in section 14.

In terms of policies to achieve these aims, there are EU-level funding instruments such as the MSCA co-funding of structured PhD training, but also a variety of guidelines and principles for doctoral training (the Salzburg Principles and Innovative Doctoral Training Principles, see Box 10) which universities or Member States can draw upon to improve doctoral training.

[67] R&D productivity appears to be falling in several industries, as it is "getting harder to find ideas". For example, it now takes 18 times as many researchers to double the computing power of microtransistors every two years as it did in 1970 (Moore's Law). See Bloom, N., Jones, C.I., Van Reenen, J. & Webb, M. 'Are Ideas Getting Harder to Find?' Working Paper N. 23782. National Bureau of Economic Research, September 2017.

[68] Hunter, R.S., Oswald, A.J. & Charlton, B.G. (2009). 'The Elite Brain Drain*'. *The Economic Journal* 119, no. 538: F231–F251.

Box 11: Seven principles for innovative doctoral training

In 2005, the European University Association (EUA) conducted the Doctoral Programme project[69], which led to the Salzburg conference and the 10 **Salzburg Principles**[70] (reproduced in the Bergen declaration), which provide the basis for the reforms of doctoral education in Europe. These principles reflected the key role of doctoral programmes and research training in the Bologna process. They were further developed into the Salzburg Recommendations II (2010)[71]. The European Commission consequently used this basis, together with good practices in the Member States and Marie Curie experiences, to develop its seven '**Innovative Doctoral Training Principles**'[72] in the framework of the ERA:

1. Research excellence

Striving for excellent research is fundamental to all doctoral education, and from this all other elements flow. Academic standards set via peer review procedures and research environments representing a critical mass are required. The new academic generation should be trained to become creative, critical and autonomous intellectual risk takers, pushing the boundaries of frontier research.

2. Attractive institutional environment

Doctoral candidates should find good working conditions to empower them to become independent researchers taking responsibility at an early stage for the scope, direction and progress of their project. These should include career development opportunities, in line with the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.

3. Interdisciplinary research options

Doctoral training must be embedded in an open research environment and culture to ensure that any appropriate opportunities for cross-fertilisation between disciplines can foster the necessary breadth and interdisciplinary approach.

4. Exposure to industry and other relevant employment sectors

The term 'industry' is used in the widest sense, including all fields of future workplaces and public engagement, from industry to business, government, NGO's, charities and cultural institutions (e.g. museums). This can include placements during research training; shared funding; involvement of non-academics from relevant industries in informing/delivering teaching and supervision; promoting financial contributions from relevant industries into doctoral programmes;

[69] European University Association (2007). Doctoral Programmes in Europe's Universities: Achievements and Challenges. Retrieved from http://www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doctoral-programmes-project/

[70] European University Association (2005). Salzburg 2005 – Conclusions and Recommendations. Retrieved from http://www.eua.be/eua/jsp/en/upload/Salzburg_Conclusions.1108990538850.pdf

[71] European University Association (2010). *Salzburg II – Recommendations.* Retrieved from http://www.eua.be/Libraries/Publications_homepage_list/Salzburg_II_Recommendations. sflb.ashx

[72] Based on the "Report of Mapping Exercise on Doctoral Training in Europe: Towards a common approach" of 27 June 2011(final), adopted by the ERA Steering Group on Human Resources and Mobility. The seven principles were defined with the help of experts from university associations; industry and funding organisations.

fostering alumni networks that can support the candidate (for example mentoring schemes) and the programme; and a wide array of people/technology/knowledge transfer activities.

5. International networking

Doctoral training should provide opportunities for international networking, e.g. through collaborative research, co-tutelle, dual and joint degrees. Mobility should be encouraged, be it through conferences, short research visits and secondments, or longer stays abroad.

6. Transferable skills training

"Transferable skills are skills learned in one context (for example research) that are useful in another (for example future employment whether that is in research, business etc.). They enable subject- and research-related skills to be applied and developed effectively. Transferable skills may be acquired through training or through work experience". It is essential to ensure that enough researchers have the skills demanded by the knowledge-based economy. Examples include communication, teamwork, entrepreneurship, project management, IPR, ethics, standardisation, etc.

Business should also be more involved in curriculum development and doctoral training so that researchers' skills better match industry needs, building on the work of the University Business Forum and the outcomes of the EUA DOC-CAREERS project. Good examples exist of interdisciplinary approaches in universities that bring together skills, ranging from research to financial and business skills, creativity and design to intercultural skills.

7. Quality assurance

Accountability procedures must be established with regard to the research base of doctoral education. For this reason, they should be developed separately from quality assurance in the first and second cycle. The goal of quality assurance in doctoral education should be to enhance the quality of the research environment as well as promoting transparent and accountable procedures for topics such as admission, supervision, awarding the doctorate degree and career development. It is important to stress that this is not about the quality assurance of the PhD itself, but rather the process or life cycle, from recruitment to graduation.

The 'Principles for Innovative Doctoral Training' were endorsed by the EU Council of Ministers in their conclusions on the modernisation of higher education on 28/29 November 2011, and by the ERA Standing Group on Human Resources and Mobility[73].

[73] Report of the ERA Steering Group Human Resources and Mobility (ERA SGHRM): Using the Principles for Innovative Doctoral Training as a Tool for Guiding Reforms of Doctoral Education in Europe.

Source: Report of Mapping Exercise on Doctoral Training in Europe: Towards a common approach (2011) and IDEA Consult and Cheps (2011) Exploration of the implementation of the Principles for Innovative Doctoral Training in Europe, Final report.

The 2011 study to explore the acceptance and implementation of the Innovative Doctoral Training Principles (IDTP) in European institutions[74] concluded that there is an important interplay between these seven principles. This was recognised in the adoption paper of the SGHRM[75]. European stakeholders of doctoral education, which considers "research excellence" based on internal "quality assurance" and the "attractiveness of the institutional environment" as core elements that should form the basis for every doctoral training offered. Exposure to industry and other relevant employment sectors, interdisciplinary research options, international networking and transferable skills are seen as complementary but nonetheless important principles influencing the success of doctoral training and the future careers of doctoral candidates. These principles are linked, among other things, to disciplinary demands, considerations relating to the candidate's specific research topic, or special features of the doctoral programme. The interplay between these principles is further influenced by the economic conditions and structure of the Member States, the regulatory stability and legal framework of doctoral education, the academic culture (national traditions, disciplinary cultures etc.), and by the sustainability of funding provided to universities.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on PhD mobility?

On a positive note, the known strength of the diversity of EU doctoral programmes is also reflected in our survey data on joint degrees and PhD studies, which are seen as focusing on the advancement of knowledge through original research, in line with the core mission of PhD studies[76]. However, comparison with the Innovative Doctoral Training Principles (IDTP) indicates several areas of potential improvement.[77] The high level of single-researcher supervision and country heterogeneity with respect to the transparency and accountability of procedures for admission, supervision, evaluation and career development, indicate that there is room for the further professionalisation of PhD training in the EU. This could occur, for example, through the introduction of more structured PhD training. While other sources document significant progress in reforming doctoral education in Europe, MORE4 survey data point to the ongoing need for reform.[78]

As such, doctoral schools or programmes require a critical mass in terms of research activity; the introduction of more structured training could also lead to wider reforms within universities, e.g. in terms of profile building or the allocation of funding. Institutional transformation is also an objective of the new ERA Communication. A more structured programme that brings together a larger number of PhD candidates would also provide

[74] IDEA Consult and Cheps (2011) Exploration of the implementation of the Principles for Innovative Doctoral Training in Europe, Final report.
[75] Report of the ERA Standing Group on Human Resources and Mobility (ERA SGHRM), Retrieved from https://cdn5.euraxess.org/sites/default/files/principles_for_innovative_doctoral_training.pdf
[76] Training in creative, critical and autonomous thinking seems to be relatively high, as called for by the Council Conclusions on measures to support early stage researchers.
[77] Only approximately 10% of PhD candidates are aware of the Innovative Doctoral Training Principles.
[78] Report of the ERA Standing Group on Human Resources and Mobility (ERA SGHRM), Retrieved from https://cdn5.euraxess.org/sites/default/files/principles_for_innovative_doctoral_training.pdf

more competition between students, allowing for earlier selection – so that students can see early on whether a career in research is likely, or whether alternative career paths are more appropriate.

Furthermore, more structured training would also facilitate the introduction of more interdisciplinary training and the development of transferable skills through taught courses, as well as allowing more international collaboration. The increase in administrative capacity that should accompany more structured training would also make it easier to conclude international exchange programmes, such as short-term PhD mobility. Structured training programmes or doctoral schools would also enable transparent recruitment policies, which could take into account criteria such as international recruitment, gender equality and social background, as indicated in the follow-up to the Salzburg Recommendations (Salzburg II Recommendations).

Intersectoral mobility also has an important role to play with respect to early-career researchers. The notion that doctoral programmes need to be adapted to the needs of an employment market that extends beyond academia is a view increasingly shared among stakeholders and policy makers. In this sense, the Salzburg II Recommendations and the Principles for Innovative Doctoral Training are paradigmatic. According to these, "Doctoral programmes should seek to offer geographical as well as interdisciplinary and intersectoral mobility and international collaboration within an integrated framework of cooperation between universities and other partners." In a similar vein, the Council conclusions on 'Measures to support early stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development' also explicitly stress the need to support early-stage researchers in their careers by promoting intersectoral mobility, dual-career opportunities and PhD training in collaboration with industry, among others[79]. These aims were reiterated by the ERA Communication 2020.

While the Salzburg Principles recognise that doctoral training must increasingly meet the needs of an employment market that is wider than academia, and the IDTP call for exposure to industry in various ways, both PhD candidates' perceptions of what is important in PhD training, and their actual training, indicate that training content which is further away from the core research specialisation, such as opportunities for intersectoral mobility or exposure to industry, is less valued[80]. While structured training would also make it easier to draw up programmes for industry-science mobility, more research is needed to illuminate the tension between the demands of academic excellence in basic research (requiring specialisation in research), and the acquisition of broader skills or more applied industry experience to keep labour market options open. Studies point to disincentives to engaging in applied research prior to tenure, due to the fact that early-stage researchers are assessed on the excellence of their publication output, which is usually harder to achieve by engaging in applied problem-solving. Such problems are less general, and

[79] Council of the European Union (2016). *Draft Council conclusions on 'Measures to support early stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development'* Retrieved from http://data.consilium.europa.eu/doc/document/ST-14301-2016-INIT/en/pdf.

[80] It is also interesting to note that researchers working in the EU with a US PhD value above all research excellence and working conditions for research as guiding principles of doctoral training, while entrepreneurship and IPR issues are valued even less on average than in the EU.

hence less publishable in the top basic research journals[81]. Of course, there are exceptions to this, when industry is very close to basic research, e.g. in pharmaceuticals.

Potential ways to ease this tension could consist of increasing the provision of different types of PhD programmes: those preparing candidates for academic basic research, and others oriented towards working in industry, as practiced in Denmark[82], for instance, or by the European Industrial Doctorates (EID) in the framework of the MSCA Innovative Training Networks (ITN).

This does not mean that basic research-oriented PhD programmes will no longer offer taught courses to prepare PhD candidates for engagement with society, or for entrepreneurship: there are instances in which basic research leads to discoveries that can (only) be commercialised by the researchers behind the discovery.[83] Career development opportunities can also be part of basic research-oriented PhD programmes. However, intersectoral mobility during PhD training and work on applied problems is easier in industry PhD programmes, followed by quick labour market transitions from PhD training to industry research. Industry-oriented PhD programmes could also involve business in curriculum development, as suggested by the IDTP to reduce skill mismatch. Furthermore, the design and execution of industry-oriented PhDs could benefit from the key characteristics of MBA programmes, including exposure to specific industries or regions, interaction with business leaders or use of the case method or hands-on training.

However, offering different types of PhDs clearly requires further research and evaluation of existing programmes such as those in Denmark. Evaluation of EIDs has shown that they are almost exclusively set up in engineering and information sciences, which are closer to industry than certain basic natural sciences, for example.[84] Moreover, EID fellows were usually already interested in industry before they began a PhD. While their career prospects have usually improved due to the high quality of the EID and their networks, the overall effect of such schemes in terms of their aim of increasing exposure to industry or interest in careers in industrial research remains unclear. Other examples exist at national level, such as the COMET funding programme by the Austrian research promotion agency FFG. This funds research cooperation between firms and research institutions, including universities, by funding research centres at which both industry and academic researchers work together, and where pre-docs work. Thus, pre-docs obtain early industry exposure and get to see what working in industry is like. This could also be a way to boost overall research funding, link science and business, and open up avenues for PhD students. This could be particularly interesting for countries with low levels of business-science cooperation, or with very low interest by academics in industry exposure, as well as low research funding (e.g. Spain, Italy).

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[81] Thursby, M., Thursby, J. & Gupta-Mukherjee, S. 'Are There Real Effects of Licensing on Academic Research? A Life Cycle View'. *Journal of Economic Behavior & Organization*, Academic Science and Entrepreneurship: Dual engines of growth, 63, no. 4 (August 2007): 577–98.
[82] See, for example, the Danish programme on industrial PhDs, https://innovationsfonden.dk/en/application/erhvervsphd.
[83] Zucker star scientists in commercialisation of academic research.
[84] There is an example in Germany for the funding of stronger practical orientation in doctoral education at German universities in the Humanities, Cultural Studies and Social Sciences https://www.volkswagenstiftung.de/en/funding/humanities-cultural-studies-social-sciences-and-professional-practice-in-graduate-education

EU-level and national policy instruments

Given the findings of MORE4 on the relatively low prominence of structured training programmes, EU co-funding of graduate schools or doctoral programmes (as carried out, for instance, through the MSCA co-funding initiative or via the ESIF) certainly addresses important issues in the ERA. Co-funding helps to cover the fixed cost of establishing structured PhD training and the necessary conditions, such as transparent recruitment policies in line with EU policy objectives, research excellence and gender equality, among others. Given the relatively low levels of structured training in many EU countries, increasing the budget for MSCA co-funding of doctoral programmes could be investigated.

With regard to industry doctorates or initiatives to broaden the skills acquired through doctoral training, the low success rates among applications to EIDs would speak in favour of increasing the budget of this action[85]. An increase in the number of industry-oriented PhD programmes could also make it easier for applications to succeed from universities that are not at the forefront of basic research, and are more likely to be in economically poorer EU countries. This could boost equity within the ERA and contribute to a convergence, rather than divergence in research excellence among EU countries, as opening up labour markets for researchers always runs the risk of triggering processes of concentration of the most talented researchers to the most attractive places to carry out research. Widening is also a clear objective of the new priorities in the ERA Communication. Partnering with companies to set up industry PhD programmes in 'catching-up' countries could also help these firms to assess the potential added value of qualified workers with advanced research skills, potentially increasing innovation activities.[86] However, industry doctorates may not help to boost excellence in basic research.

Returning to reforming PhD training more generally, not just with respect to industry doctorates, further reforms at national level are a necessary complement to efforts at EU level. Improved doctoral training can be regarded as a key feature of countries' efforts to improve the effectiveness of their national research systems, to deepen the ERA (e.g. through open labour markets and industry-science knowledge exchange). Improving the quality of PhD training is likely to lead to inflows of early-stage researchers into research careers in the given country. But in a further stage, it may also lead to an increased international outflow of talented young academics when career prospects and, more generally, the attractiveness of academic careers do not match expectations within that country, as better-trained PhD holders are then in a more advantageous position to access the global market for scientists. Accordingly, the next section will present MORE4's findings on recruitment, career progression and career paths, after presenting a number of measures at national level.

According to the ERA Progress Report 2018, different types of measures were launched or continuously implemented at **national level** to improve both doctoral training and its

[85] European Commission, DG Education, Youth and Culture, European Industrial Doctorates – towards increased employability and innovation. Final report, Prepared by ICF and Technopolis.
[86] In countries far from the forefront of technology, firms are much less likely to adopt innovation strategies as elements of their competitive strategy, due to a number of barriers to innovation, such as lack of qualified workers, but also failure to perceive the benefits of innovation (see Hölzl, W. & Janger, J. 'Distance to the Frontier and the Perception of Innovation Barriers across European Countries'. *Research Policy* 43, no. 4 (May 2014): 707–25.

quality assurance. Without aiming to be exhaustive, and without any further information on the effectiveness of the measures, we hereby list some of these initiatives:

- In some cases, innovative doctoral training is being implemented by streamlining the research and education funding system. In Italy, each PhD course specifies the ways in which its programme is innovative, with regard to international cooperation, or intersectoral or multidisciplinary collaboration. Each course is evaluated by ANVUR (the National Agency for the Evaluation of the University and Research Systems) on the basis of these criteria. A small portion of general government funding is also distributed on the basis of the innovative principles of doctoral training. In addition, the funding mechanisms applied in Italy for ESIF support measures for R&I were streamlined in 2017: generic, repeated calls (rather than multiple small and focused calls) supporting innovative research programmes, internships and doctoral studies were introduced for National Centre for Research and Development (NCBR)-managed ESIF-funded calls, based on relatively simple, standardised rules.

- In France, the professionalisation of French doctoral schools has recently been observed, with a more careful and professional monitoring of PhD candidates. The 2016 reform of the PhD track complemented this evolution, in which the main change was the introduction of a PhD committee for each PhD candidate.

- In Greece, international reviewers are used in the evaluation and prioritisation of proposals. These even include specialists in Smart Specialisation Strategy, which is the basic strategy for the programming period 2014-2020 and funding from Structural Funds (ESIF). The ELIDEK or HFRI (Hellenic Foundation for Research & Innovation), which finances doctoral and postdoctoral research, also uses international evaluators, since proposals are submitted in English.

- In Hungary, over recent years there has been an extension of PhD programmes by one year, and an increase in grants for PhDs. In addition, a new tutoring system for PhD students has been introduced.

- The major development with regard to the implementation of the Dutch NAP under Priority 3 is an extension in the awarding PhDs, under which a wider range of researchers, specifically associate professors, are now allowed to supervise PhD candidates and award PhDs. This increase in supervisors is expected to ensure closer and more intensive supervision, contributing to improved quality in doctoral training. Despite concerns that it could create 'second-class' PhDs and lead to an over-saturation of PhDs in the job market, the law was approved in 2017.

- Over recent years, higher education institutions in the Flemish region of Belgium have established an increasing number of doctoral schools for PhD training, with a specific focus on the training of horizontal skills among early-stage researchers.

- In Estonia, the scholarships offered to PhD students were increased slightly in 2016. In 2015, some other support measures were introduced such as the covering of social and health tax contributions for PhD students. Tallinn University of Technology decided to pay all new PhD student the equivalent of the average salary in Estonia. In addition, the Estonian government set a goal to reach 300 PhDs a year by 2020.

- In Ireland, the National Skills Strategy 2025 was launched in 2016: this notes the need for a solid pipeline of research skills development that supports early-stage researchers, researcher mobility into industry and internationally, as well as the development, retention and attraction of advanced researchers from abroad. In addition, the planned National Framework for Doctoral Education was published in 2015.

- In Norway, in order to strengthen initiatives on the professional development of researchers, a scheme was started in 2016 to provide PhD scholarships to research institutes (STIPINST).

6. RECRUITMENT, CAREER PROGRESSION AND CAREER PATHS

Recruitment, career progression and career paths

Recruitment (2019)

Share of researchers who agree that the recruitment process in their home institution is sufficiently…

Open *(job vacancies sufficiently publicly advertised)*	**87.0%**
Transparent	**81.5%**
Merit-based	**82.9%**

Share of fixed-term contracts

2019 total: **22.2%**

R1	R2	R3	R4
72%	46%	12%	4%

Dual positions

2019 total: **10.9%**

Of which:

- 6,0% HE-HE
- 1.0% HE-private sector
- 3.0% HE-public sector
- 0.9% HE-not-for-profit sector

Positive factors for recruitment and career progression in the EU28 among researchers in higher education (2019)

Recruitment		Career progression
91.8	Project-related work experience	91.3
88.4	Knowledge transfer	87.8
86.6	Internat. mobility	85.7
85.8	Transferable skills	86.2
75.1	Interdisciplinary mobility	76.1
73.5	Public awareness activities	76.7
68.5	Publication(s) in open access journals	71.3
59.7	Intersectoral mobility to government sector	62.1
58.9	Intersectoral mobility to private industry	61.1

Source: Based on MORE4 EU HE report (Section 5.3) and MORE4 Indicators report on researchers (based on Eurostat data)

6.1. Key findings[87]

Perception of recruitment and career progression

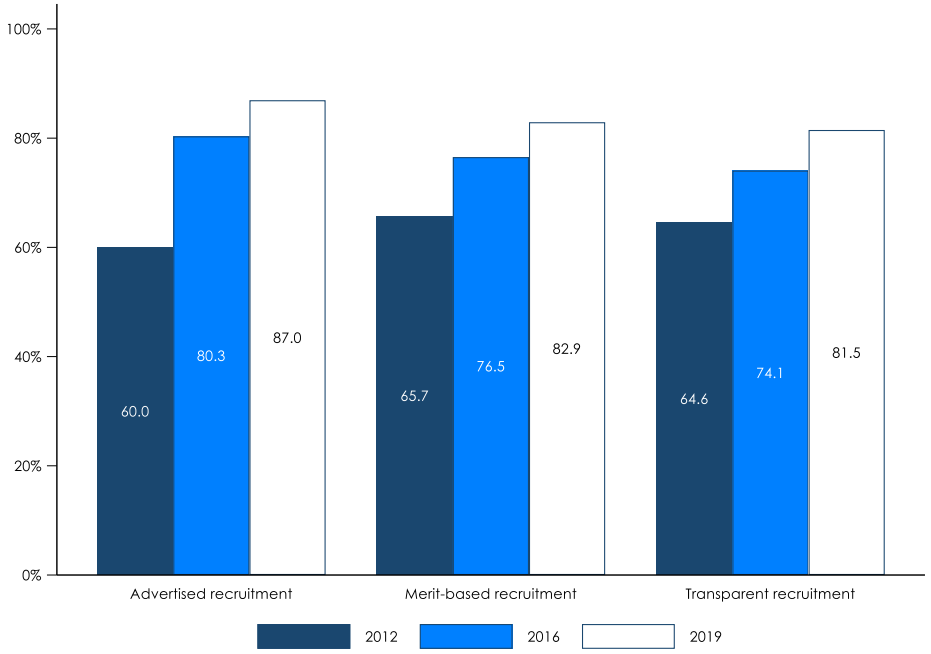
The design of recruitment and career progression are crucial to the attractiveness of research systems, as they determine whether those with better training and future potential get jobs, choose to stay and/or are promoted. Over time, since 2012 (from MORE2 to MORE4) there has been a steady improvement in the share of researchers who agree that their home institution practises open, merit-based and transparent recruitment (Figure 5), particularly with respect to its vacancies being sufficiently publicly advertised[88]. However, differences exist between countries with regard to recruitment procedures. For instance, within the EU, fewer Southern European researchers (74%) think that merit-based recruitment is less standard, compared with the average across the EU28 (82%). Moreover, external advertising of positions does not necessarily imply that a position is opened up to more intense competition, as additional criteria may make it difficult for researchers to successfully apply for the position. For example, if applicants are required to teach in the language of the country where the position is offered, this may substantially reduce the number of foreign candidates for a position.

Career paths show a similar pattern of responses to recruitment. They are seen as relatively transparent on average (76%), while in some countries a significant share of researchers disagrees on this (e.g. in Portugal, the figure is just 40%). Similar shares of researchers regard career progression as merit-based and tenured positions being common practice – roughly three quarters of researchers in 2019 (Table 1). In general, the perceived lack of merit-based career progression was considerable in some Southern European countries, e.g. Portugal and Italy, as well as in France, while the highest shares of researchers agreeing that career progression is merit-based can be seen in Anglo-Saxon and Nordic countries, i.e. the Netherlands, Denmark, the UK and Sweden.

Perceptions regarding recruitment transparency and merit-based career progress differ among researchers currently working inside the EU compared with those currently working outside the EU. Researchers working inside the EU tend to perceive higher levels of transparency and merit. The group of Anglo-Saxon countries, especially the US, is an exception here, with similar shares of researchers in agreement to those in the EU28 averages (cf. MORE4 Global survey report[89]).

[87] Due to the often unchanged nature of the results and the continuing policy relevance of the topics raised, also in light of the new ERA communication 2020, several parts of this text are unchanged with respect to the MORE3 study.
[88] Comparison with 2012 needs to be made with caution, as the wording of the questionnaire changed slightly.
[89] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.

Figure 5: Researchers' perceptions of recruitment in their home institutions (EU28)



Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012) – Figure 20 in MORE4 EU HE report

Notes:

Shares of researchers agreeing with the statement in the question.
Based on question 37: "What is your opinion on the following issues with respect to recruitment in your home institution: 1) Research job vacancies are sufficiently externally and publicly advertised and made known by the institution. 2) The recruitment process is sufficiently transparent. 3) Recruitment is sufficiently merit-based.", with answer categories "I agree", "I don't agree" and "N/A".
The difference with 2012 data needs to be interpreted with caution since the respective question in MORE2 was stated slightly differently, in particular the item on external advertising, and the question had a different position in the questionnaire. In MORE2: "What is your opinion on the following issues: 1) Are you satisfied with the extent to which job vacancies are publicly advertised and made known by your institution? 2) Do you think that the recruitment process at your home institution is sufficiently transparent? 3) Do you think that recruitment at your home institution is sufficiently merit-based?", with answer categories "yes", "no" and "N/A / no opinion".
(2019: n=7,705-7,940; 2016: n=8,317-8,632; 2012: n=7,210-7,710)

Table 1: Perception of career progression by country, 2019

	Merit-based	Transparent	Tenure is common practice
Austria	69,9%	63,5%	53,6%
Belgium	77,2%	73,0%	73,6%
Bulgaria	76,0%	72,4%	74,3%
Croatia	78,8%	76,2%	78,1%
Cyprus	70,8%	71,7%	74,0%
Czech Republic	86,3%	86,0%	86,4%
Denmark	80,7%	77,5%	71,8%
Estonia	71,5%	82,0%	73,3%
Finland	78,0%	66,6%	67,2%
France	70,3%	70,6%	69,3%
Germany	76,3%	73,9%	73,3%
Greece	66,9%	75,1%	74,3%

	Merit-based	Transparent	Tenure is common practice
Hungary	74,0%	62,0%	64,3%
Iceland	70,2%	63,3%	70,7%
Ireland	70,8%	69,0%	64,5%
Italy	68,5%	63,0%	69,7%
Latvia	83,0%	84,9%	83,6%
Lithuania	65,9%	60,9%	58,8%
Luxembourg	68,7%	76,3%	78,4%
Malta	62,0%	58,4%	57,9%
Netherlands	84,0%	83,7%	81,4%
Norway	82,1%	78,6%	80,8%
Poland	80,3%	83,7%	83,5%
Portugal	79,6%	83,7%	73,6%
Romania	77,9%	80,2%	81,5%
Slovakia	60,3%	45,3%	45,2%
Slovenia	90,1%	86,7%	88,0%
Spain	68,7%	79,3%	77,8%
Sweden	87,1%	80,5%	81,2%
Switzerland	86,0%	76,9%	77,4%
United Kingdom	81,2%	80,4%	82,9%
EU	**77,1%**	**73,6%**	**72,0%**

Source: MORE4 EU HE survey (2019)

Notes:

Shares of researchers agreeing with the statement in the question.
Based on question 38: "What is your opinion on the following issues with respect to career progression in your home institution: 1) The different types of career paths are clear and transparent at your home institution (I agree/I don't agree); 2) Career progression is sufficiently merit-based (I agree/I don't agree); 3) Obtaining a tenured contract based on merit only is common practice at your home institution (I agree/I don't agree).
The size of the sample for each of the items is: for the question on transparency, n=7,999; for the question on merit, n=7,797; for the question on tenure, n=7,333.

Factors influencing recruitment and career progression

MORE4 asked researchers how a range of different factors (various forms of mobility, alternative forms of research output and transferable skills) impacted recruitment and career progression. Standard research output or publication performance was not part of these factors, as it was assumed to be central for any researcher.

Positive factors for career progression (lower panel in Figure 6) are very similar to those for recruitment (upper panel of Figure 6). On average in the EU28, researchers perceive project-related work experience (91%), knowledge transfer (88%), international mobility (86%) and transferable skills (86%) as being most positive for their career progression, while a mobility experience to the private sector is perceived as having the weakest positive impact (61%) and the highest negative impact (6%). In the cases of intersectoral and interdisciplinary mobility and alternative forms of research output (such as project reports or grant writing), wide variations between EU countries are observed.

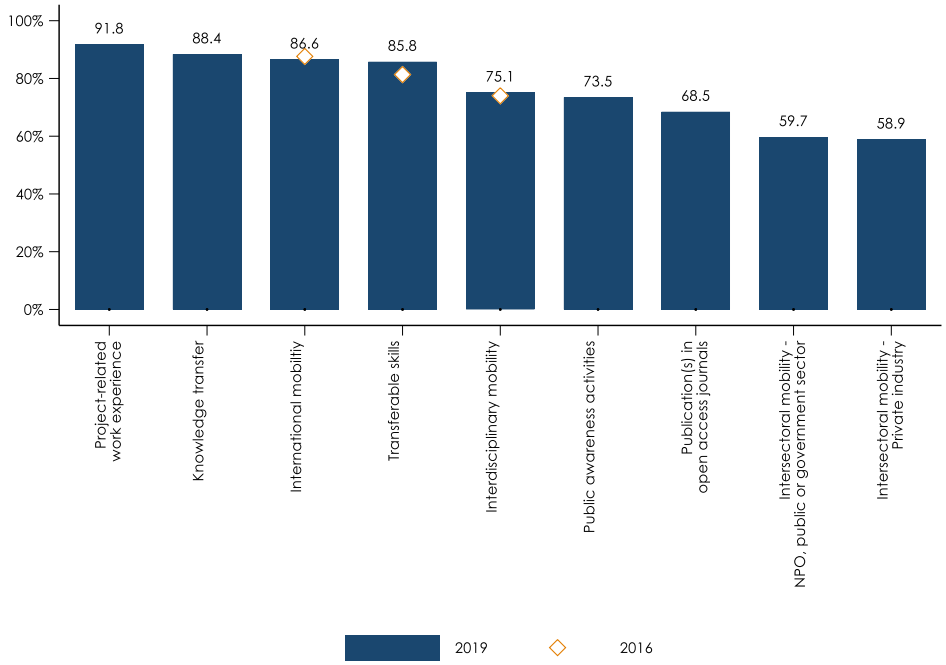
Intersectoral mobility experiences, publishing in open access journals, and public awareness activities are, on average, perceived as less valuable by researchers in Southern Europe (e.g. in Italy or Portugal), and more valuable in Continental European countries, such as the Netherlands. Regarding intersectoral mobility to the private sector or to the government sector, the share of researchers perceiving it as positive for career progression

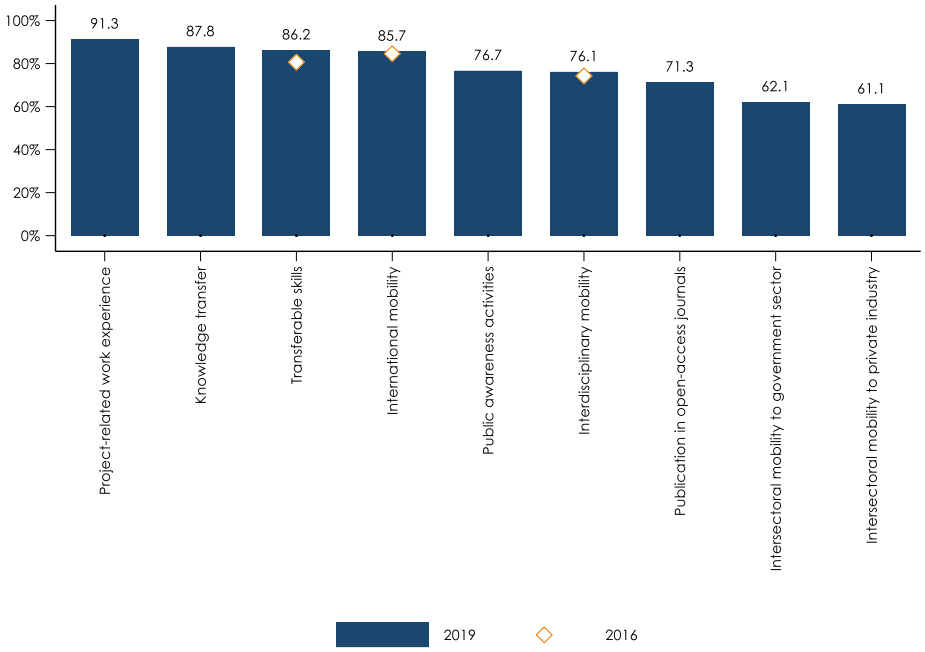
ranges from 28% (private sector) and 36% (government sector) for researchers in Italy, to and 78% (private sector) of researchers in Latvia 77% and (government sector) of researchers in the Netherlands.

The relatively low importance of international mobility as a factor for recruitment or career progression in Anglo-Saxon countries (62%, incl. the US with 64%) compared with other non-EU country groups (non-EU OECD: 68%; others: >80%) or the EU28 (86%) is presumably a consequence of the high quality of the Anglo-Saxon research systems in comparison to other national research systems, so that international mobility may be less beneficial for researchers based in Anglo-Saxon countries. Intersectoral mobility in the US is valued even less than in the EU, at just 43%. As outlined in Section 5, this may reflect pressure to excel academically by publishing in top journals. Otherwise, the results are similar to those found in the MORE4 Global survey – a universally positive role for international mobility in recruitment and career progression, and a less positive role for intersectoral mobility.

Among those transferable skills seen as important for career progression in HEIs, those skills that are most closely related to academic research are perceived as most valuable. These include decision-making and problem solving, critical and autonomous thinking, communication and presentation, networking and grant and/or proposal writing, teamwork and time management (>95%). Entrepreneurship (71%) and dealing with IPR (74%) are deemed less important on average for career progression within an HEI, although differences are apparent between disciplines, with researchers in Medical Sciences and Agricultural Sciences stating that IPR skills are important (80% and 83%, respectively).

Figure 6: Positive factors for recruitment (upper panel) and career progression (lower panel) in the EU28





Source: MORE4 EU HE Survey (2019), MORE3 EU HE survey (2016) – Figure 24 and Figure 36 in MORE3 EU HE report

Note:

Share of researchers agreeing that these factors are positive for recruitment or career progression (EU28 average).
Based on question 39: "In your experience, would you say the following factors are regarded as positive or negative factors for recruitment in your home institution?", and question 40: "In your experience, would you say the following factors are regarded as positive or negative factors for career progression in your home institution?" Note that 2016 a smaller range of options were given.
(2019:7,570-8,540; 2016: n=8,483-9,421)

Characteristics of career paths

Different recruitment and career progression procedures give rise to country-specific career paths and systems. The structure of career paths is a major determinant of the attractiveness of a research system, as it conditions career perspectives and time horizons for research agendas: short, fixed-term contracts do not allow the pursuit of long-term, risky research strategies.[90] Moreover, in quasi-experimental analysis using MORE2 data, it was found that career perspectives – or, more precisely, career paths that lead to tenure based on merit alone – are the most important determinants of job choice in academia.[91] This section outlines how long it takes to reach later career stages in the EU, the distribution of researchers across the various career stages (i.e. the shape of the 'pyramid'), as well as the contractual situation of researchers and the prevalence of dual positions.

In the EU28 it takes 18 years, on average, from early career stage to become a leading scientist (R4). However, there is substantial variation between countries, particularly with

[90] Short-term contracts may also reduce the incentives for a young scientist to invest in the accumulation of human and social capital; it leads them to favour quantity over quality, and may even be detrimental to Open Science, an EU policy priority (for a thorough discussion of this, see Petersen et al., 2012).

[91] Janger, J. & Nowotny, K. (2016). Job choice in academia. *Research Policy*, *45*(8), 1672-1683.

respect to the length of time it takes to finish the first two career stages.[92] Average time in the EU28 to reach R3 is 10 years, ranging from six years (Romania) to 14 years (Austria). The heterogeneity of higher education systems across the EU leads to heterogeneous careers, and also affects the distribution of researchers over career stages R1-R4 (Figure 7). While it is natural for this distribution to take the form of a 'pyramid' with more researchers at early career stages than at later career stages – not everyone can become a full professor – MORE4 indicates, in line with other research[93], that the shape of the pyramid differs considerably between countries. Countries with hierarchical chair-based systems and few tenured positions, such as in Germany, tend to have a smaller share of R4 and R3 researchers (60%), while Southern European systems such as in Spain, Greece and Italy, tend to feature higher shares of tenured R3 and R4 researchers (85-93%). Such structural differences have remained persistent since 2012.

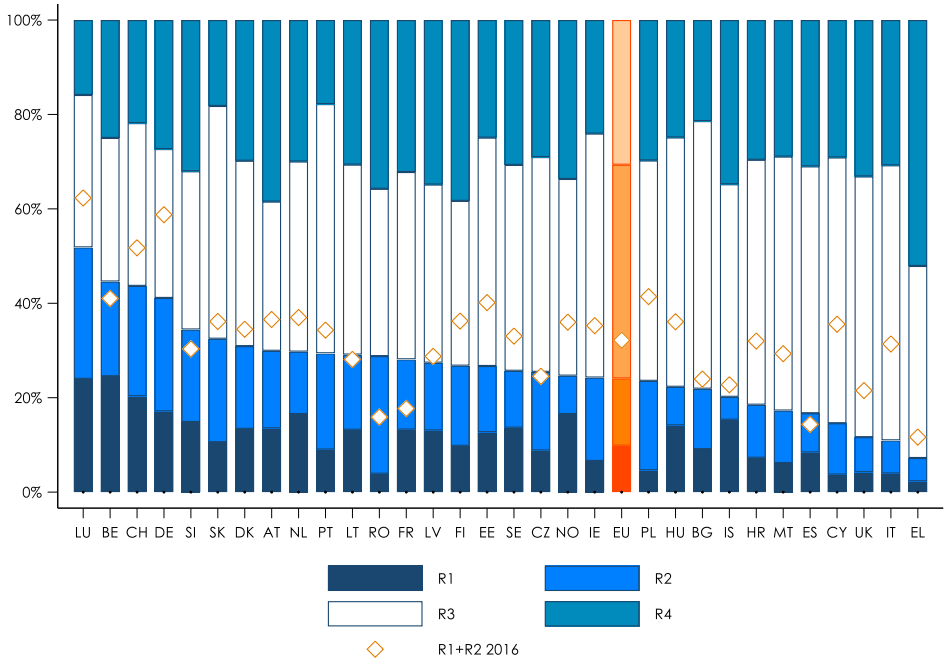
Most of the researchers in the EU28 have a permanent or open-ended contract. Compared with 2016 (and also 2012), especially in Continental European countries but also in Anglo-Saxon countries, the average share of permanent contracts has increased while the share of fixed-term contracts has decreased. In 2019, 87% of researchers sampled in Anglo-Saxon countries have permanent contracts, along with 69% of researchers in Continental European countries, and 78% of researchers in Southern European countries. This implies that fewer researchers are now on fixed-term contracts (EU28 2012: 34%, 2016: 26%, 2019: 20%).

Established patterns in researcher characteristics across career stages remains unchanged from previous analyses (MORE2 and MORE3). Early-stage researchers (career stages R1 and R2) are younger (below 44 - R1: 87%, R2: 68%); more likely to be on a fixed-term contract (share of permanent contract: R1: 17%, R2: 52%); and have less research autonomy; R3 and R4 are more likely to be on a permanent contract (R3: 86%, in R4 95%); male (share of female researchers in R1: 51%, in R4: 28%); and have more research autonomy but also higher teaching workloads.

[92] Ates, G., Brechelmacher, A. (2012) "Academic career paths". In: Work Situation, Views and Activities of the Academic Professions: Findings of a Survey in Twelve European Countries, Teichler, U. & Höhle, E.A. (eds.), 13–35, find for selected EU countries an average time span of 7-8 years from PhD graduation to first full-time employment, also with wide variation between countries.

[93] See, for example, Kreckel, R. "University Career Models and International Staff Mobility. Germany, France, Great Britain, USA and Russia Compared." (2017).

Figure 7: Distribution of researchers across career stages R1 to R4, by country



Source: MORE4 EU HE survey (2019) and MORE3 EU HE Survey (2016)

Notes:

Based on question 13: "In which career stage would you currently situate yourself?" (2019: n=9,321 2016: n= 10,394;)

Variation between countries in terms of permanent contracts is substantial. This is in line with the literature, since the Anglo-Saxon/Nordic systems are characterised by an intermediate share and the Southern European systems by high shares of tenured researchers[94], while the Continental higher education system usually shows higher shares of fixed-term researchers. Looking outside Europe shows that the EU average for permanent contracts is higher than the non-EU average. 65% of researchers employed in the US have permanent contracts, while all other non-EU country groups report shares of between 53% ('other' countries) and 74% (Anglo-Saxon countries).

Having a dual position is a marginal situation on average in Europe; in total only 11% (2016: 10%) of researchers in R2-R4 are employed by several institutions, either inside or outside the higher education sector, while 20% of all the respondents to the Global survey report having a dual position, with higher shares in BRICS[95] (19%) and `other' countries (33%) than in the US (11%). The shares of researchers with a dual position vary only a little across career stages, with the lowest shares among R3 researchers (9%) and the highest shares among leading R4 researchers (14%). Within Europe, dual positions are generally much more common in Eastern and South-Eastern Europe than in other European

[94] The Southern European system refers to systems also called a "protective pyramid", with early access to a permanent position following strict competition and promotions depending on job availability. See Janger, J., Strauss, A. & Campbell, D. (2019). "Attractiveness of jobs in academia: a cross-country perspective". *Higher Education* 78(6), p. 991-1010, 2019.

[95] BRICS is a grouping acronym referring to the countries of Brazil, Russia, India, and China.

countries. The combination of positions in the HE sector with positions in other sectors (e.g. private industry) is rare (5%) within the EU.

Confidence in future career

Overall, 83% of EU researchers are confident about their future career prospects, with more male (86%) than female (77%) researchers expressing confidence. Large difference can be seen between countries. Overall, career confidence tends to dominate in Northern Europe, while the countries with the highest share of researchers who feel 'somewhat' or 'very' confident about their future careers are Iceland (96%), Austria (93%), Malta (93%), Slovenia (93%) and Norway (92%). By contrast, in Southern European countries, particularly Italy (63%) and Portugal (68%), the shares of researchers who feel confident about their professional future are comparatively low. Overall, the share of confident researchers outside Europe is similar (80%). In line with the findings of the EU survey, the share of non-EU researchers who lack confidence is the highest among early-stage researchers, while leading or established researchers show higher levels of confidence about their future (see MORE4 Global survey).

6.2. EU policy aims and implications of MORE4 findings

The policy context for researcher careers in the EU is characterised by a variety of policy aims emanating, for example, from the Council Conclusions on young researchers, the Communications on creating and strengthening ERA, and the agenda for higher education in the EU. Similar to findings regarding PhD training, a number of general performance goals follow on from these polices:

- **Quantity of researchers**: as with PhD training, research careers –with respect to both recruitment and career progression procedures – need to be attractive (i.e. open, transparent and merit-based), to ensure that a sufficient number of PhD graduates embark upon a career in research. Diversity of career path options is also important with regard to the quantity of researchers.
- **International competitiveness of research careers offered**: worldwide competition for the most talented researchers means that career paths in the EU must be attractive enough to entice the best, ensuring brain circulation rather than brain drain.
- **Reducing intra-EU variation in research performance**: it is a key aim of ERA to reduce both brain drain, notably from weaker regions, as well as helping weaker regions to catch up, in order to reduce wide regional variations in research and innovation performance.
- **Diversity of career paths**: higher demand by industry for researchers, as well as the pyramidal nature of career options in academia, call for keeping researchers' options broad. Career paths should include all forms of mobility, including intersectoral mobility to the private sector, or dual positions.
- **Gender equality among researchers**: lower shares of female researchers compared with male counterparts, particularly at later career stages and in natural sciences, point to the need to tackle the under-representation of women in general, but especially in leading research positions, and in scientific and technical professions, as well as in fields where skills shortages exist. These issues are addressed in Section 14.

Making progress towards all of these aims would be beneficial both in terms of the quantity of researchers and the quality of research (as measured, for example, through bibliometric indicators), as it would become easier to recruit the most talented for a career in research. In addition to many initiatives at national level, these goals are addressed from various angles at EU level:

- Recommendations and guidelines for Member States, as in the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers, stressing the need for career development opportunities, mobility perspectives, or transparent and merit-based recruitment;
- Deepening the ERA: in relation to a new skills agenda for researchers[96], the European Commission intends to develop a European Competence Framework for researchers and support the development of a set of core skills for researchers, as well as defining a taxonomy of skills for researchers that aims to allow the statistical monitoring of brain circulation;
- Along with the new proposals from 2020, a variety of instruments will continue:
    - EU-wide (and even global) advertisement of job openings on EURAXESS (ERA4you) and the provision of information on careers in Europe
    - EU vehicle for portable pensions (Retirement Savings Vehicle for European Research Institutions or RESAVER)
    - Providing funding for individual researchers, e.g. through ERC and MSCA schemes, which provide career development opportunities and mobility perspectives;
- Encouraging young people to embark on scientific careers and promoting science education.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on research careers?

Overall, several positive developments have occurred with respect to recruitment[97], career progression and other features of academic careers in the EU. Compared with MORE3, more positions are externally advertised, and more researchers agree that their institution recruits researchers in a **transparent and merit-based** way. Several countries have addressed recruitment and external advertising through reforms. Although MORE4 cannot establish causal links between these reforms and the MORE4 survey results, the MORE4 findings are encouraging in this regard. Moreover, trends are positive compared with both MORE2 and MORE3 (i.e. since 2012), with fewer researchers experiencing insecure working conditions in terms of fixed-term contracts, particularly in later career stages. However, fixed-term contracts often come with grant-based research funding, so that a lower number of fixed-term contracts may also be a result of less research funding, rather than any deliberate reforms of career structures. In terms of policy, this result needs to be further investigated, as the MORE4 findings generally show that structural heterogeneity between EU Member States persists in terms of their national career and higher education systems, given that these structural features are naturally slow to evolve.

Recruitment, career progression and career paths are characterised by many **national and institutional-level specificities.** Researchers are sometimes employed as civil servants

[96] European Commission (2020). *Communication. European Skills Agenda for sustainable competitiveness, social fairness and resilience*. Retrieved from https://ec.europa.eu/transparency/regdoc/rep/1/2020/EN/COM-2020-274-F1-EN-MAIN-PART-1.PDF

[97] However, there is no information on how HEIs have changed their recruitment policies as a result of the awareness-building measures promoted by the EU. While there are encouraging signs, there needs to be further evidence to conclude whether or not the openness of the EU labour market for researchers has improved.

(particularly in France and Greece, but also in Germany at the level of professors), or may have standard contracts that are also used in the private sector; PhDs and post-docs may depend on third-party funding rather than university funds; the organisation of universities' working units as collegiate departments or hierarchical chairs may affects the shape of the 'pyramid' (i.e. the potential for early-stage researchers to make it to later career stages). Practices of recruitment are sometimes centralised, as in Italy, or decentralised, as in many other countries[98]. This wide variety of structural differences between EU countries gives rise to different policy priorities. This diversity need not always be negative: heterogeneity may also be a rich and positive source of learning and experimentation. However, just like MORE3, the MORE4 findings point to persistent features that impact the attractiveness of careers in research, not just within the EU, but also by comparison with leading non-EU countries such as the US. Talented young researchers face different opportunities to embark on a successful academic career, due to the different structures of HE systems.

As an example, in certain Southern European systems, the problem faced by early-stage researchers relates to "getting into a protective pyramid". There is a low availability of positions, and while entry positions are frequently tenured, the journey further up the career ladder is not always merit-based[99]. Some Continental European systems follow hierarchical, chair-based organisation models of universities, making it difficult for young researchers to move up to permanent positions. While there are many fixed-term positions and getting in is easy, a comparatively long entry phase due to the "habilitation" that comes with reduced research autonomy and unclear long-term career perspectives, makes it difficult to "get up". This system is clearly unattractive in comparison to the "tenure track"-model in US research universities, which are organised according to the collegiate department model[100]; however, the tenure track model is also under stress in the US, with the share of tenured positions decreasing.

Policy options for both career systems – Southern European and Continental – will accordingly differ. The former is in need of a higher number of entry positions, linked to reforms of funding, not just career structures (see also Section 7 on working conditions) and more merit-based promotion with a clear-cut path to the top. The latter needs more positions at later career stages, allowing for the introduction or more widespread adoption of a tenure track model that will provide clear-cut career perspectives to a higher number

[98] See, for example, Teichler, U. & Höhle, E.A.H. (eds.), The Work Situation of the Academic Profession in Europe: Findings of a Survey in Twelve Countries. Springer London, Limited, 2013; Janger, J., Strauss, A. Ų Campbell, D. (2019). "Attractiveness of jobs in academia: a cross-country perspective ". *Higher Education* 78(6), p. 991-1010, 2019.

[99] Enders, J.& Musselin, C. (2008). "Back to the future? The academic professions in the 21st century", *High. Educ.* 2030,, Vol.1 Demography, pp. 125–150; Lissoni, F., Mairesse, J., Montobbio, F. & Pezzoni, M. (2011). "Scientific productivity and academic promotion: a study on French and Italian physicists", Ind. Corp. Change, 20(1), pp. 253 –294; Pezzoni, M., Sterzi, V. & Lissoni, F. (2012). "Career progress in centralized academic systems: Social capital and institutions in France and Italy", *Res. Policy*, 41(4), pp. 704–719.

[100] To illustrate this using the MORE4 findings, the question on satisfaction with working conditions includes career perspectives (see Section 7). Southern European countries are at the bottom for satisfaction levels, with Portugal on 46%, Italy on 53% and France on 58%. This is certainly also linked to a lack of positions due to the economic difficulties in these countries; economically strong countries such as Germany (79%) are just at the EU average of 75%, possibly owing to the peculiar career paths there.

of researchers than in a hierarchical, chair-based system.[101] Hence, both systems would accentuate different parts of a US-style **tenure track system,** which many researchers view as the most attractive career model[102].

Both the probability of getting tenure and the path to the top of the career ladder matter considerably to academics making decisions about their employment options. The tenure-track-model is very attractive, in that it already combines a very clear career perspective from the position of a fixed-term researcher with clear merit-based criteria for promotion to a tenured position. The "up or out" characteristics of this model make it fairer to young academics, because they know at an early stage whether a career in academia is possible or not. Particularly for women, the earlier option to stay at a university may be beneficial in terms of work-life balance, on condition that the "tenure clock" takes account of maternity leave. Broadly speaking, the compulsory change of university follows in the US after the PhD studies; academics in a tenure-track position can then stay at the university, rather than having to switch to another university (like, for example, in the German "habilitation system"), but of course there are exceptions.

In studies on the determinants of job choice in academia, clear-cut career perspectives as in a US-style tenure track model are the most important determinant for deciding between job offers. Early-stage researchers reveal a substantial willingness to 'pay' for clear-cut career perspectives, i.e. they are willing to accept lower salaries in return for a career path that leads them to a tenured position based on their performance alone.[103] More attractive career paths are hence a major lever for increasing the attractiveness of research careers vs. outside options, and also vs. competing systems such as the US, where we still see asymmetrical mobility and a brain drain of the most talented towards elite US universities. While the situation in Europe is changing, with several institutions (e.g. in Germany) having now introduced specific tenure track models – and the tenure track becoming less commonplace at research universities in the US – continued policy efforts are certainly necessary, particularly in terms of making this model the standard career path rather than a special career path reserved for only a few.[104]

From a system-wide perspective, with the aim of improving the overall research quality of universities, potential problems arise from having large shares of tenured academics, in that incentives for continuous scientific productivity over the life cycle may diminish.[105]

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[101] Recent reforms, e.g. in Germany and Austria, have created national versions of a tenure track path.

[102] See, for example, Brechelmacher, A., Park, E., Ates, G. & Campbell, D.F. (2015). The rocky road to tenure–Career paths in academia. In: *Academic work and careers in Europe: Trends, challenges, perspectives* (pp. 13-40). Springer International Publishing, page 23: "Interviewees in the countries which recently implemented the tenure-track model expressed hopes that the tenure-track will provide perspectives to academics and give more clarity and predictability to the academic career path. Generally, the introduction and underlying idea behind the tenure-track is regarded overwhelmingly positively by junior and senior academics alike."

[103] Janger, J. & Nowotny, K. (2016). Job choice in academia. *Research Policy*, *45*(8), 1672-1683.

[104] In the US, universities struggle to keep the share of tenured positions constant, as there is mismatch between the growth of funding and the growth of early-stage researchers, particular in biomedical research (see, for example, Stephan, P. (2012). How economics shapes science, Harvard University Press.

[105] Thursby, M., Thursby, J. & Gupta-Mukherjee, S. (2007). 'Are There Real Effects of Licensing on Academic Research? A Life Cycle View'. *Journal of Economic Behavior & Organization*, Academic Science and Entrepreneurship: Dual engines of growth, 63, no. 4: 577–98; Levin, S.G. & Stephan,

This may create negative feedback effects on an institution's ability to attract highly talented scientists, via the role played by the quality of peers: while it may be possible to recruit many talented scientists in a first round, as they age and do not face incentives to maintain research productivity, it is possible that their research productivity will diminish, so that their role as an attractor of other, early-stage scientists will be reduced. Several different options are practised in higher education systems to ensure that high shares of tenured academics remains incentivised to engage in continuous scientific productivity. Each of these options, such as adjusting teaching responsibilities or providing more research funding for tenured researchers on a competitive project funding basis, has its own advantages and drawbacks.[106]

With regard to **gender equality**, female researchers are still underrepresented in most of the EU28 countries, particularly in later career stages. Since 2012 their share has stagnated. Section 14 analyses gender equality in detail.

Similarly to PhD training, neither EU nor non-EU researchers view **intersectoral mobility** as very positive **for recruitment and career progression**, and entrepreneurship and IPR skills are deemed to be much less important for future careers than transferable skills that are closer to core research activities[107]. Moreover, dual careers involving a position in a private firm and at an HEI or public research organisation are also rare. The pressure to excel academically in terms of publications may reduce incentives to engage with sectors outside academia. This merits further research, as in principle a more diverse set of career paths, including positions more oriented towards teaching or research on applied problems might make it easier for researchers to keep one foot in academia at a time when the rising number of researchers is increasing competition for available positions. The MORE4 findings hence point to the fairly slow emergence of new types of (academic) career paths such as dual positions with industry or the recognition of alternative research outputs or intersectoral mobility for recruitment and career progression; academic researchers seem to value more traditional research careers.

EU-level and national policy instruments

Current efforts in terms of recruitment, career progression and career paths should clearly be continued and intensified. This includes funding for mobility and career perspectives (ERC, MSCA, etc.), particularly in countries where there is a lack of funding for mobility stints, as international mobility is perceived to be very important for career progression and recruitment. Support for mutual learning continues to be crucial, such as in the form of the Policy Support Facility (PSF) which works specifically to address the danger of divergence between research and innovation, and also works on the higher education and science system. Mutual learning exercises within the PSF could look at the question of attractive career paths for early-stage researchers. Further opening up the ERA, and making it easier for talented researchers to move to another country within the EU, could

P.E. (1991). 'Research productivity over the life cycle: Evidence for academic scientists', *Am. Econ. Rev.,* 81(1), pp. 114–132.

[106] Janger, J., Strauss, A. & Campbell, D. (2019). 'Attractiveness of jobs in academia: a cross-country perspective', *Higher Education* 78(6), p. 991-1010.

[107] This average perception does, of course, not exclude that there are researchers who view intersectoral mobility as positive, or that for some HEI positions, intersectoral mobility may be a requirement.

lead to the concentration of the most talented researchers in the most attractive research institutions. Measures to support weaker research systems to catch up to the better performing ones are hence of continuing importance.

In terms of **recruitment and career progression**, the new ERA Communication signals a strong commitment to providing an impetus at European level to further improve research careers, including training to acquire the skills necessary for a career in research. More specifically, with regard to individual instruments, by November 2020, 569 organisations had received the HR Excellence in Research Award[108] (up from 264 in 2017), as part of the HRS4R (The Human Resources Strategy for Researchers); the Charter & Code principles had been endorsed by more than 1,250 research organisations, and up from 910 in 2017. EURAXESS is a major initiative providing information on jobs and career perspectives. Awareness of its existence among researchers working abroad has increased considerably, ranging between 48% (among EU researchers working abroad) and 52% (among non-EU researchers who have been mobile to the EU) – a considerable increase over MORE3 (40% and 29% respectively). Variation exists between countries with respect to awareness and use of the EURAXESS portal. In some countries (e.g. Austria) public and international advertisement of new positions on EURAXESS is compulsory. The European Commission intends to further strengthen EURAXESS by turning it into the ERA4you portal.

In terms of **gender**, a continuation and intensification of further efforts also appears to be necessary. Section 14 provides further detail on this.

With regard to fostering **dual careers, or intersectoral mobility** during careers, more research seems to be necessary to show potential ways to increase intersectoral mobility, as it is currently neither perceived to be valuable for career progression, nor widely practiced. The European Commission intends to further foster such mobility, as a way of both providing alternative career paths and improving the valorisation of research results (see the new ERA Communication). However, academic researchers in both the EU and US appear, on average, to be more interested in traditional academic careers, though there is substantial variation between countries. A wider diversity of positions and careers in research, dedicated to the engagement with business and society (similar to the case of specific PhD programmes), could be investigated. For example, 'before and after' comparisons could be made of respondents' perceptions of a broader range of careers, once they have received information on what different careers in different sectors entail in practice.[109] Examples could be a senior lecturer who has industry experience (or still works in industry), has a higher level of teaching responsibility and less pressure to publish in top journals; or so-called "professors of practice", who would also be important in terms of making students aware of outside opportunities.

It is evident from the findings of the ERA progress report of 2018 and the accompanying national reports that over recent years, a number of measures have been implemented at

[108] These institutions have signed the Code of Conduct and provided the Commission with a gap analysis and a solid action plan on how to concretely implement the elements of the Code of Conduct. This indicates the strong commitment of these institutions.
[109] Such information need not always be based on new surveys; at national level there may be researcher surveys asking about different career paths or roles for academic researchers, e.g. in Germany, the Wissenschaftsbarometer asks about perception of purely teaching oriented professorships, https://www.wb.dzhw.eu/downloads/wibef_barometer2020.pdf

national level that aim to address the recruitment, career progression and career paths of researchers:

- In Portugal, the main progress of the NAP under priority 3 relates to a higher investment in scientific employment, with 250 new post-doctoral contracts (replacing grants) in 2018, and an increase in the number of scholarships financed for advanced training.
- In Austria, one of the key developments in the area of career progression has been the development and implementation of a career model at non-university research institutions, namely the Austrian Academy of Sciences (OeAW) and Institute of Science and Technology Austria (IST-Austria).
- In the Czech Republic, the Action Plan for Human Resources Development and Gender Equality in R&D was drafted by the Ministry of Education, Youth and Sports and approved by the government in January 2018. The Action Plan addresses a number of the most pressing topics in relation to the development of human resources in R&D, including gender equality and mainstreaming, as well as support and promotion for PhD students and early stage researchers, international mobility and the quality of institutional environment.
- In Germany, the federal government and the Länder have created a programme to improve the predictability and transparency of career paths from 2016 to 2032. The programme establishes tenure-track professorships at German universities and provides additional funding for tenure-track professorships. In addition, more RPOs in Germany have been awarded the 'HRS4R' logo since 2016. In particular, the institutes of the Leibniz Association, one of the major German RPOs, have steadily increased the percentage of their job offers published on EURAXESS Jobs portal (from 31.5% in 2014 to nearly 40% in 2017).
- In October 2016, the Foundation for Research and Innovation (ELIDEK) was established by Law 4429/2016 in Greece. ELIDEK, which is funded by the European Investment Bank (EUR 180 million) and the Greek Public Investment Program (EUR 60 million), aims to further enhance research and human capital development, to retain highly-qualified researchers in Greece and to address the problem of brain-drain. ELIDEK has already begun its activities and awarded 582 scholarships to selected PhD candidates (worth EUR 13.5m) in June 2017. It has also launched two calls for proposals in 2017 supporting post-doctoral research (a budget of EUR 34 million) and the 'Research Programmes of ELIDEK' (a budget of EUR 53 million).
- Spain saw an increase the number of RPOs awarded the 'HRS4R' logo for taking up the Charter and Code in their policies and practices. This process is expected to positively influence the publication of job offers and researcher satisfaction of the academic hiring processes in the immediate future.
- In Croatia, positive changes were largely influenced by the 2013 amendments to the Act on Science and Higher Education. This legislation integrated the main principles of the Charter and Code. In addition, the recruitment of researchers to public research organisations has also been redefined. It is compulsory to publish open vacancies in the Official Gazette of the Republic of Croatia, EURAXESS jobs portal and the website of the organisation. In addition, in 2017, Croatia introduced new regulations on the conditions for promotion to higher scientific grades. These regulations introduced more rigorous minimum criteria for the promotion of scientists to higher scientific/teaching grades.
- In Italy, progress mainly relates to the uptake of the principles set out in the European Charter for Researchers on open, transparent and merit-based recruitment procedures. Progress observed under priority 3 relates to the higher

percentage of universities and public research organisations awarded the 'HRS4R' logo, rising from 10.6% in 2016 to 15.3% in 2018.

- Similarly, in Poland since 2014 a large number of research and higher education institutions have endorsed the European Charter and Code for Researchers, and the number of institutions receiving the HR excellence in Research label has increased around tenfold. This has been a direct consequence of systemic efforts by national authorities in this area, with the Polish Ministry of Science and Higher Education encouraging the country's research and higher education institutions to adopt the principles of the Charter and Code.
- The Swedish Foundation for Strategic Research (SSF) has established Individual Grants for Future Research Leaders, to support young scientists of the highest standing from Sweden who have the potential to become future leaders of academic and/or industrial research. Each grant amounts to approximately EUR 1.2 million and covers a period of five years.

7. WORKING CONDITIONS

Working conditions

Satisfaction with different types of working conditions

	Knowledge Production	Mobility Perspectives	Financial Security	Individual Satisfaction	Social Environment
2016 (n=9,303)	74%	70%	76%	88%	89%
2019 (n=7,603)	**77%**	**75%**	**80%**	**91%**	**91%**

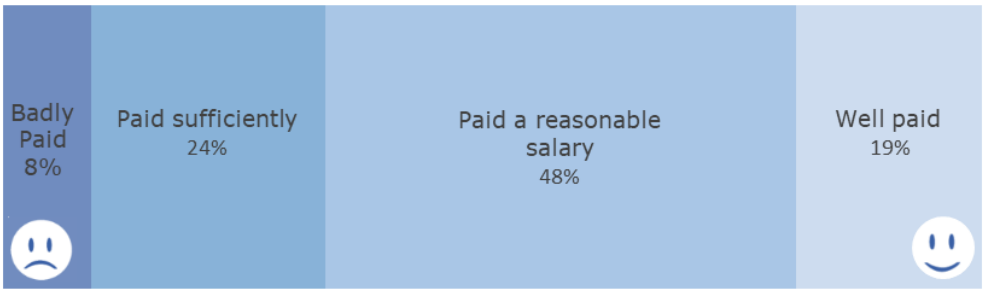
Working conditions with lowest satisfaction

- Satisfaction with research funding (52%)
- Satisfaction with the balance between teaching and research (70%)
- Satisfaction with career perspectives (75%)

Working conditions with highest satisfaction

- Satisfaction with intellectual challenge (95%)
- Satisfaction with level of responsibility (93%)
- Satisfaction with contribution to society (92%)

Perception of remuneration 2019



Source: Based on MORE4 EU HE report (Section 6) and MORE4 Indicators report on researchers (based on Eurostat data).

Once researchers have begun a research career, the working conditions in their job are crucial to their scientific productivity, as well as to their decision to stay in research or take on another job. Researchers, particularly academic researchers, experience a highly competitive working environment. The "up-or-out" nature of research naturally results in a high proportion of researchers dropping out of research careers. While the specific "winner-takes-all" aspect of (academic) research might lead to the undesired dropping out of highly talented researchers, competition among researchers can enhance scientific

productivity and lead to new and pioneering insights. However, this holds only true if the selection criteria are largely merit-based and decisions to leave the academic labour market are not due to poor working conditions[110].

Research careers are not only terminated due to low levels of productivity. One study[111] shows that despite high labour demand, the number of young American physician-scientists was stagnating at the time investigated, due to more attractive working conditions and secure career paths outside academia. The availability of funding and research grants as a measure to ensure the continuation of career paths and reduce insecurity, is found not only to enhance productivity[112], but also to reduce the chances of researchers leaving the profession[113]. Aside from financial support, there a number of other factors (e.g. collaboration possibilities, teaching and social recognition) influence research quality, as well as scientific productivity and the transition and diffusion of knowledge, and the wellbeing and satisfaction of researchers with their job.

7.1. Key findings[114]

The infographic above shows the evolution of the perception of satisfaction with working conditions between 2016 and 2019, based on the systematisation of MORE3. It is clustered into aspects relating to individual satisfaction (intellectual challenge, dynamic work environment, level of responsibility and quality of life); social environment (social status, reputation of employer, contribution to society); financial security (job security, pension plan and social security); and knowledge production (research funding and autonomy, balance between teaching and research, access to research equipment, quality of education and training, working with leading scientists); as well as career and mobility perspectives, which affect both knowledge production and financial security. By comparison with MORE3, there is an upward trend, particularly in relation to mobility and career aspects.

This myriad of working conditions that are potentially relevant to researchers makes it difficult to single out those that make a particular contribution to perceptions of the attractiveness of a job in academia. MORE2 used a 'stated choice' approach to identify the working conditions most relevant to deciding between jobs (and hence also the attractiveness of research systems, if these conditions are similar within research

[110] Geuna, A. & Shibayama, S. (2015). "Moving Out Of Academic Research: Why Scientists Stop Doing Research?" In: Geuna, A. (ed.), Glob. Mobil. Res. Sci. Econ. Who Goes Why, Elsevier, pp. 271–303.
[111] Donowitz, M., Germino, G., Cominelli, F. & Anderson, J.M., (2007). "The attrition of young physician-scientists: problems and potential solutions", *Gastroenterology*, 132(2), pp. 477–480.
[112] Dasgupta, P. & David, P.A. (1994). Toward a new economics of science. *Research policy*, *23*(5), 487-521.
[113] Geuna, A. & Shibayama, S. (2015). "Moving Out of Academic Research: Why Scientists Stop Doing Research?" In: Geuna, A. (ed.), Glob. Mobil. Res. Sci. Econ. Who Goes Why, Elsevier, pp. 271–303.
[114] Due to the often unchanged nature of the results and the continuing policy relevance of the topics raised, also in light of the new ERA communication 2020, several parts of this text are unchanged with respect to the MORE3 study.

systems)[115]. Based on this analysis, MORE3 and 4 conceptualise the main relevant working conditions as falling into one of three categories, namely:

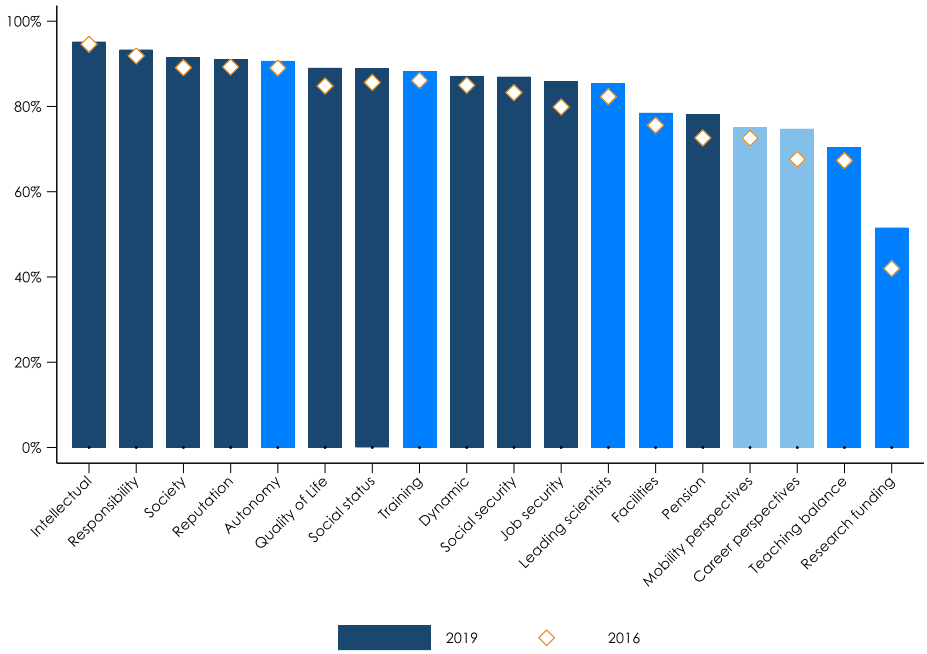
- **Working conditions not directly affecting scientific knowledge production**, such as conditions relevant to extrinsic pecuniary motivations to engage in a research career (e.g. salary and pension entitlements), and working conditions affecting social and content-specific motivations for a research career (dark blue bars in Figure 8).
- **Working conditions affecting scientific knowledge production**, such as research funding, working with stimulating peers or career-path determined time horizon available for implementing one's research agenda (medium blue coloured bars in Figure 8).
- **Working conditions relevant to both knowledge production and pecuniary motivations**, such as career and mobility perspectives (light blue coloured bar in Figure 8).

The working conditions that are crucial for deciding between jobs or for sustainably attracting early-stage researchers into research careers are mainly those that are relevant for knowledge production, for doing research, and relate much less to material working conditions or quality of life. All else being equal, while salaries are important, researchers are "willing to pay" – i.e. to sacrifice potential salary – for working conditions that enable them to implement their research agenda. The attractiveness of research jobs is hence a result of factors influencing how well researchers can do their jobs. These include, among others, the extent of research autonomy, the quality of their peers, their funding, the balance of time between teaching and research, as well as long-term career perspectives.

Figure 8 illustrates the difficult choices faced by students embarking on a career in research – a very high level of satisfaction with intellectual challenge and job-specific content runs up against uncertain career perspectives and less satisfactory funding of research. The same pattern is found in the survey concentrating on researchers currently working outside the EU (see the MORE4 Global survey report). This means that attracting more people into research careers – an EU policy goal to tackle the challenges of greater knowledge-based competition, and the role of knowledge in tackling climate change, among other issues – is clearly linked to funding and career perspectives. The job of a researcher is attractive in itself – researchers find great satisfaction in the content and intellectual challenges of their work, but the conditions have to foster the actual activity of research.

[115] IDEA Consult et al. (2013). MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final report. European Commission, DG Research and Innovation.
Janger, J. & Nowotny, K. (2016). "Job choice in academia", *Research Policy*, 45(8), pp. 1672–1683.

Figure 8: Satisfaction with working conditions (EU28)



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016) – Figure 50 in the MORE4 EU HE report.
Notes:
Based on question 32: "Please indicate your satisfaction with each factor as it relates to your current position"
(2019: n=7,603-8,414;2016: n=8,382-9,303)

Working conditions not directly affecting scientific knowledge production

Regarding **financial security**, roughly two out of three EU researchers feel either well paid (22%) or reasonably well paid (48%), while 20% feel they are only paid enough to make ends meet and the remaining 8% indicated that they struggle to make ends meet given their inadequate salary. The total share of researchers feeling well or reasonably well paid (70%) has increased slightly since 2016 (67%). The vast majority of those researchers currently working in the EU are content with social security (87%). Satisfaction with remuneration among part-time researchers working more than 50% of full-time is on a similar level to that of full-time researchers (around 70%); however, there is a clear gap in terms of satisfaction with job security (87% vs. 64%). On average, 56% of researchers in the EU feel less well paid than their counterparts outside academia, with female and later-stage researchers more likely to report being dissatisfied than early-stage researchers[116].

Among the EU Member States and Associated Countries, significant differences can be found, which generally align with the level of economic development in each country – particularly in the case of financial security. While in Luxembourg or Germany, high shares of researchers perceive their salaries as reasonable (92%), researchers in some Eastern and South European countries perceive things differently: in Greece, for example, only 23% of the researchers agree that they receive reasonable remuneration (Figure 9). Similarly, in all Western (and, in particular, Nordic) EU Member States, at least three out

[116] This is based on the perceptions of mostly academic researchers.

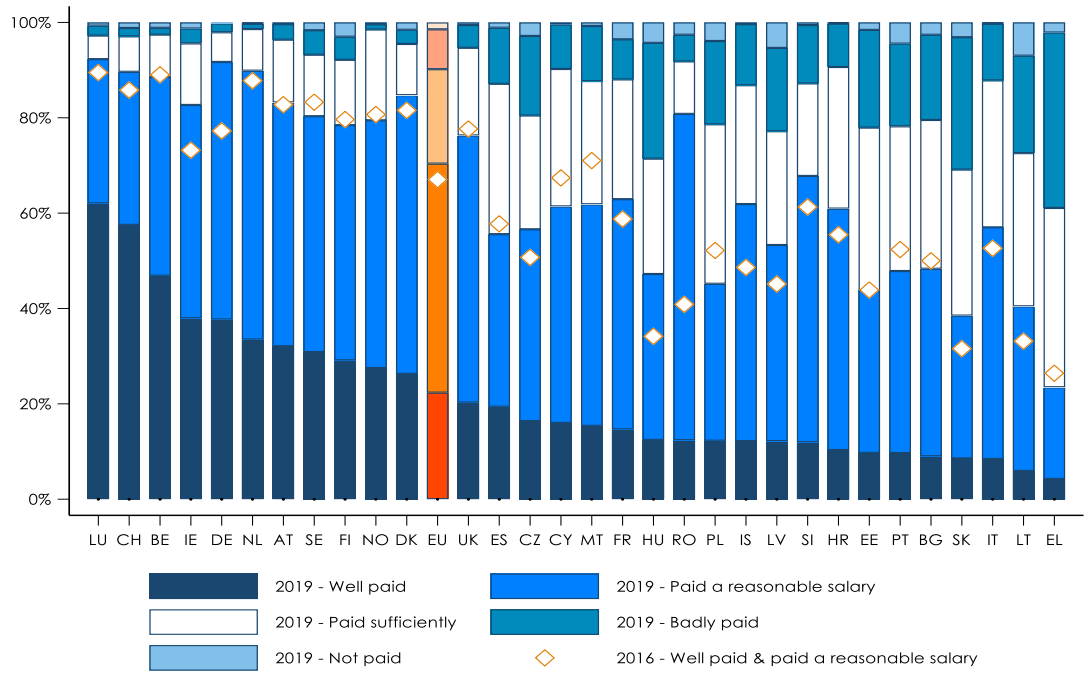
of four researchers are satisfied with their pension plan, while in Southern and Eastern countries report these shares are around 50% (in Greece, the share is just 39%). In terms of financial security, the gap between part-time and full-time workers is particularly high in Southern European countries (satisfaction with pension plans: 48% vs. 66%), while there is much less difference between part- and full-time employees in Northern European countries.

Of those researchers currently working outside the EU in non-EU OECD countries, a lower share feel well or reasonably well paid (57%). In addition, the share of researchers satisfied with social security is lower (67%) than in the EU. This contrasts with 2016, but can be explained by the higher share of respondents from economically less advanced countries in the MORE4 Global Survey (section 5.2). Similarly, 53% of researchers outside the EU feel less well paid than their counterparts outside academia, however; researchers are less likely to feel worse paid in later career stages, in contrast to the results of the MORE4 EU HE survey[117] (see the MORE4 Global survey[118]). While dissatisfaction with salary can affect researchers' mobility decisions, the literature and our results suggest that the key motivators for international mobility are a good research environment and promising career perspectives (see our discussion in Section 9); salary ranks very low as a motive for moving.

Within the EU, the shares of researchers satisfied at work and with their **social environment and recognition** are high in terms of every individual aspect included (86%-95%). While these shares are all slightly higher than the corresponding shares of researchers currently working outside Europe (68%-86%), the ranking of individual issues remains the same. Approval rates are highest for intellectual challenge and level of responsibility in researchers' working positions, and are a little lower for quality of life and dynamic work environment (see MORE4 Global survey). High levels of satisfaction with social security and content-specific aspects of jobs (intellectual challenge etc.) may compensate for dissatisfaction with pay when compared with working outside academia and, and contribute to making research careers attractive.

[117] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[118] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.

Figure 9: Perceptions of remuneration by country



Source: MORE4 EU HE Survey (2019) and MORE3 EU HE Survey (2016) – Figure 52 in MORE4 EU HE report.

Notes:

Based on question 33: "How do you feel about your remuneration package (if you do not take into account a second income or, if applicable, the income of your partner)?
(2019: n=9,299; 2016: n=10,394)

Working conditions for scientific knowledge production

A country's capabilities to contribute to the frontiers of scientific knowledge are driven by the capabilities of individual researchers. Working conditions that influence the scientific productivity of individual researchers are crucial to attracting excellent foreign researchers, increasing the performance of the existing scientific staff, and helping to build the number of promising junior scientists, i.e. drawing more people into research careers. Among these conditions are the financial support (research funding and access to research infrastructure) and intellectual support provided to researchers (quality of peers), the balance in the amount of time spent between teaching and research, as well as research autonomy. Finally, career path elements also influence scientific knowledge production, as career-determined time horizons for research agendas can change the content of research[119].

The majority of researchers in the EU28, particularly those in later career stages, are satisfied with the **intellectual support** they receive (opportunities to work with leading scientists: 85%; quality of education and training: 88%). In terms of **financial support**, the share of researchers satisfied with their access to research facilities and equipment (79%) is almost 30 percentage points higher than the share of researchers who are satisfied with the availability of research funding (52%), which is higher among later-stage researchers compared with those in early career stages. A high share of researchers is

[119] Petersen, A.M., Riccaboni, M., Stanley, H.E. & Pammolli, F. (2012). "Persistence and uncertainty in the academic career", *Proc. Natl. Acad. Sci.,* 109(14), pp. 5213–5218.

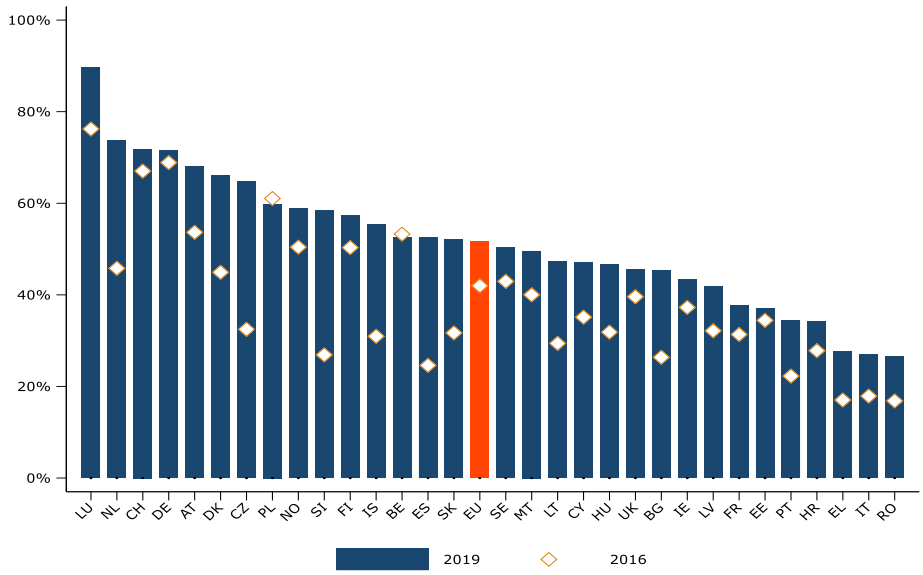
satisfied with **research autonomy** (91%; 2016: 89%), although this figure includes somewhat fewer early-stage researchers than leading R4 researchers. In contrast, the share of researchers satisfied with their balance **between teaching and research time** is considerably lower (70%), with a greater share of satisfied researchers among early stage R1 than among leading R4 researchers. Overall, the teaching workload has gone up slightly compared with MORE3 (based on a question in the EU HE survey on teaching activities).

Although the average share of researchers satisfied with research funding is higher within the EU than outside it (35%), the share of satisfied researchers working in the US and in Anglo-Saxon countries 45% and 49%) is considerably higher (than the EU average. Outside Europe, the shares of researchers satisfied with their balance between teaching and research time (58%), and the quality of training and education (69%) are lower in general (except in Anglo-Saxon countries including the US: 74%; see the MORE4 Global survey report).

Within the EU, the geographical pattern observed in terms of satisfaction with research funding shows that poorer Eastern European countries (with the exception of Poland), and in particular Southern European countries, are at the lower end of the spectrum (Figure 10). A similar pattern appears in terms of access to research facilities and equipment (Netherlands: 96%, Greece: 51%) as well as in terms of the balance between teaching and research activities (Luxembourg: 90%, Portugal: 46%), with higher shares of satisfied early-stage researchers especially in Northern and Western European countries (Table 2). Satisfaction with opportunities to work with leading scientists ranges between 53% and 95%, and corresponds roughly with countries' performance in terms of research excellence (as measured, for instance, by the EU's composite indicator of research excellence[120]). Researchers working in Anglo-Saxon and Nordic higher education systems such as Finland or the UK, are more satisfied on average with their opportunities to work with leading scientists (90%) than researchers working in Continental higher education systems (approximately 84%) or those in Southern Europe (83%).

[120] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/composite-indicators-research-excellence

Figure 10: Individual satisfaction with research funding, by country



Source: MORE4 EU HE survey (2019) and MORE3 EU HE Survey (2016) – Figure 66 in MORE4 EU HE report

Notes:

Share of researchers satisfied with the availability of research funding.
Based on question 32: "Please indicate your satisfaction with each factor as it relates to your current position"
(2019: n=9,019, 2016: n=10,075)

Table 2: Individual satisfaction with access to research facilities and the balance between teaching and research, by career stage

	RESEARCH FACILITIES				BALANCE TEACHING RESEARCH			
	R1	R2	R3	R4	R1	R2	R3	R4
North	92,2%	87,4%	87,4%	88,0%	80,7%	74,5%	67,6%	78,4%
South	78,3%	62,8%	64,5%	63,8%	70,6%	57,3%	62,6%	64,9%
West	88,2%	91,2%	81,1%	84,0%	82,7%	90,9%	65,4%	76,6%
East	70,2%	62,8%	67,4%	81,3%	69,2%	61,6%	58,8%	75,1%
EU28	**84,7%**	**81,9%**	**75,4%**	**79,5%**	**78,8%**	**80,2%**	**63,2%**	**74,3%**

Source: MORE4 EU HE survey (2019) – Table 15 and Table 19 in MORE4 EU HE report

Notes:

Share of researchers satisfied with their balance between teaching and research time.
Average shares of the following country groups are shown: East (CZ, EE, HU, LV, LT, PL, SI, SK, BG, RO, HR); North (NO, SE, FI, DK, IS); South (PT, ES, IT, EL, MT, CY); West (BE, FR, DE, NL, LU, AT, UK, IE, CH) and EU28.
Green = high compared to the average; Red = low compared to the average.
Based on question 32: "Please indicate your satisfaction with each factor as it relates to your current position"
(n=8,105-9,019)

Career and mobility perspectives

As outlined previously, career perspectives (the prospect of a tenured position) matter both for scientific knowledge production and for job and financial security. We therefore treat this aspect as a cross-cutting issue relevant for both remuneration and scientific knowledge production. Mobility perspectives shape collaboration patterns, so that they also influence scientific knowledge production. Team size and average number of co-authors is on the rise, so that mobility perspectives become more important overall for scientific productivity and career success.[121]

In terms of both career and mobility perspectives, three out of four researchers in the EU28 are satisfied with their current position (75% each; 2016: 68 and 73% respectively). However, the share of researchers satisfied with their career perspectives in Southern European countries (62%) contrasts somewhat with the rest of Europe (79-82%). Overall, the average share of researchers satisfied with their career perspectives outside the EU is lower (57%, with the exception US and Anglo-Saxon countries in general: 74%). A similar pattern is observed with regard to perceptions of mobility perspectives (Southern Europe: 64%; Continental Europe: 84%; EU28: 75%, 2016: 64%). Outside Europe (in the US) the average share of researchers satisfied with mobility perspectives is 25 percentage points lower than the EU28 average (13pp in 2016) (see the MORE4 Global survey report).

The lowest shares of researchers satisfied with their career perspectives are found among those in early career stages, particularly in career stage R2 (followed by R1); the highest are located in the group of leading R4 researchers. To some extent, this might reflect the higher shares of early-stage researchers who have fixed-term contracts, compared with leading researchers. This is plausible, as R4 researchers have made it to the top of the career path and hence enjoy their current position; uncertainty about the feasibility of a research career is highest at the R2 stage, when career progression often depends on the assessment of research performance by others. In terms of satisfaction with mobility perspectives, no large differences can be observed between career stages (these range between 73% for R3 and 77% for R4; see the MORE4 HE EU survey report).

Overall, comparing all aspects of working conditions irrespective of specific career stage, researchers' satisfaction is lowest in relation to funding, the balance between teaching and research, and career perspectives.

7.2. EU policy aims and implications of MORE4 findings

The policy context regarding the working conditions of researchers in the EU is characterised by a variety of policy aims emanating from, for example, the Council Conclusions on young researchers, the Communications on creating and deepening the ERA, and the agenda for the modernisation of higher education in the EU. Similar to the case of PhD training and recruitment/career paths, a number of general performance goals follows from these policies:

- **Quantity of researchers**: as with PhD training and career paths, working conditions need to be attractive to keep researchers in research careers. Among

[121] Pavlidis, I., Petersen, A.M. & Semendeferi, I. (2014). Together we stand. *Nature Physics*, *10*(10), 700-702; Walsh, J.P. & Lee, Y.N. (2015). The bureaucratization of science. *Research Policy*, *44*(8), 1584-1600.

the various working conditions, those affecting scientific productivity are particularly important.

- **Quantity of research**: the EU aims for R&D expenditures of 3% of GDP by 2020.
- **Quality of research**: attractive working conditions are crucial to ensuring researchers can fulfil their potential and contribute to EU research excellence.
- **International competitiveness of research jobs in the EU**: worldwide competition for the most talented researchers means that working conditions in the EU must be attractive enough to entice the best, ensuring brain circulation rather than brain drain.
- **Reducing intra-EU variation in research performance**: reducing both brain drain, notably from weaker regions, as well as wide regional variations in research and innovation performance, are key aims of the ERA.
- **Gender equality among researchers**: reducing gender-related differences in working conditions in order to increase the attractiveness to women of research careers, and to ensure full exploitation of female researchers' potential.

In addition to many initiatives at national level, the above goals are addressed from different angles at EU level:

- Recommendations and guidelines for Member States, as in the European Charter for Researchers, stress the need for career development opportunities and mobility perspectives, which are important working conditions; Council Conclusions on young researchers, which call upon Member States to improve career perspectives, the research-teaching balance, national funding of research and mobility, and collaboration schemes.
- Providing funding for individual researchers, e.g. through ERC and MSCA schemes, which provide several key working conditions such as access to research infrastructure and research autonomy.
- Project-based research funding such as through Horizon 2020, helps researchers fund their research.
- The EU encourages Member States to implement policies that boost gender equality, in particular in decision-making positions, *inter alia* by providing monitoring of gender balance in research (e.g. the SHE figures; see Section 14 for more details).
- With the new ERA Communication, the European Commission intends to develop new tools and initiate policies that are relevant to improving the working conditions of researchers, e.g. through priority 1 on investments, Member States are called upon to increase research funding, which would have a clear positive impact on working conditions for researchers.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on working conditions?

First, the MORE4 findings indicate that **research jobs are attractive by their nature** – researchers are intrinsically motivated because they like what they are doing, in terms of intellectual challenge, responsibility, social recognition etc. This means that for research careers to be attractive, it is sufficient to provide good working conditions. It is not necessary to convince students that research might be an interesting job option for them. Moreover, research based on the MORE2 data shows that researchers are willing to trade-off material working conditions such as salary against working conditions for research, including research autonomy and funding, longer time horizons for their research agendas (in the form of long-term career perspectives), etc. Working conditions for research are hence drivers of attractiveness for jobs in research, more so than salaries, quality of life and other non-research related working conditions.[122]

Second, there has been an **upward trend in satisfaction** with working conditions across the board since 2012. Linking these findings to national policy developments would require an in depth country-level analysis, which is outside the scope of this study. Satisfaction is lowest with respect to research funding, career perspectives and the balance between time for teaching and time for research. The last two issues are of particular concern to early stage researchers, because they are most in need of stable career perspectives and because evaluation benchmarks are often geared towards excellence in research rather than teaching. At an international level, a similar pattern of lower satisfaction can be observed with respect to these aspects of working conditions, with the US usually showing much higher levels of satisfaction.

Third, as with career paths and recruitment, a picture of **heterogeneity** emerges with regard to satisfaction with working conditions across the EU, although this time the fault lines relate less to different higher education systems (as in Section 6 on career paths), but rather to economic development, public budgets for research and research performance. Here, very low satisfaction in with salaries, pension plans, the quality of peers and research funding can be seen in certain Southern and Eastern European countries. This heterogeneity may impact on the completion of the single knowledge market in the EU and on prospects for achieving symmetrical rather than asymmetrical mobility of talented researchers in the EU (i.e. it may contribute to brain drain rather than brain circulation).

EU-level and national policy instruments

Heterogeneity in perceptions of working conditions across the EU can be addressed through a variety of approaches.

- First, overall economic policy towards convergence, e.g. through the ESIF – structural funds – will also work indirectly to promote the convergence of research systems, as wages, researchers' pensions and research funding budgets can grow more quickly in 'catching-up' countries. The ESIF contribute to the implementation of smart specialisation strategies focused on matching the strengths of national research and innovation systems with business needs.

[122] Janger, J. & Nowotny, K. (2016). Job choice in academia. *Research Policy*, 45(8), 1672-1683.

- Second, EU research funding can play a role in counteracting low satisfaction with national research funding. However, low success rates in Horizon 2020 imply that only the very best will make it, and these are more likely to come from successful research systems in economically developed countries. Most of the basic and applied research funding of the EU (Horizon 2020, ERC) is distributed on the basis of excellence – with good reason – but this also means that to date, it primarily benefits countries with well-performing research systems or individually excellent researchers. EU institutions are considering how the research and innovation divide between EU Member States and regions can be reduced, and how the problem of brain drain from less developed regions can be mitigated. This is also an explicit widening objective in the new ERA Communication (priority 2, access to excellence). One way to combine efficiency with equity may be to increase research infrastructure funding to struggling countries, which would still be open to researchers from across the EU, so that they could serve as European platforms, while still generating positive local spillovers. This merits further research though – first, it has to some extent already been pursued by the structural funds; and second, simply funding infrastructure is seldom enough – there also need to be researchers who can put that infrastructure to use. Institutional co-funding of tertiary education was discussed in Section 5 on PhD training. The European Universities initiative[123] could also be relevant; for the moment, however, it is oriented more towards teaching. Certainly relevant will be the possibility under Horizon Europe to combine its funding with payments from the structural funds.
- Third, if national research funding is relatively low (as outlined above), then the allocation mode used for funding matters all the more: rather than indiscriminately funding research institutions through base funding, a variety of funding modes could concentrate funding on the most promising research projects or early-stage researchers. This could include *ex-ante* peer-review on a project-by-project basis, or *ex-post* funding mechanisms such as the REF (Research Excellence Framework) in England. Such mechanisms have both advantages and disadvantages, which will need to be screened in a country-specific context to reflect national idiosyncrasies that may impact upon the effectiveness of such allocation mechanisms.[124] The Policy Support Facility (PSF) can help countries to implement such mechanisms (see below). More or stronger financial incentives for higher education institutions, which include (i) funding for excellence initiatives; (ii) competitive/performance-based funding; and (iii) performance agreements, are also a focus of the new ERA Communication, which has an agenda of institutionally transforming of universities.
- Fourth, the sharing of best practice and mutual learning exercises (MLE), as organised by the EU within the PSF (see discussion in Section 6) can be very important. MLEs can focus on which working conditions to prioritise, given limited budgets. The MORE4 findings indicate a focus on research funding (the allocation of funding); career paths/perspectives (as mentioned in Section 6); and on the balance between teaching and research. This balance matters more to early stage researchers, as they are judged on research performance. In order to introduce flexibility into universities, as the scientific productivity of tenured

[123] https://ec.europa.eu/education/education-in-the-eu/european-education-area/european-universities-initiative_en

[124] For example, project funding with low success rates leads to risk aversion, and can entail significant time in writing proposals; *ex-post* research assessments can be cumbersome and cost a lot of money.

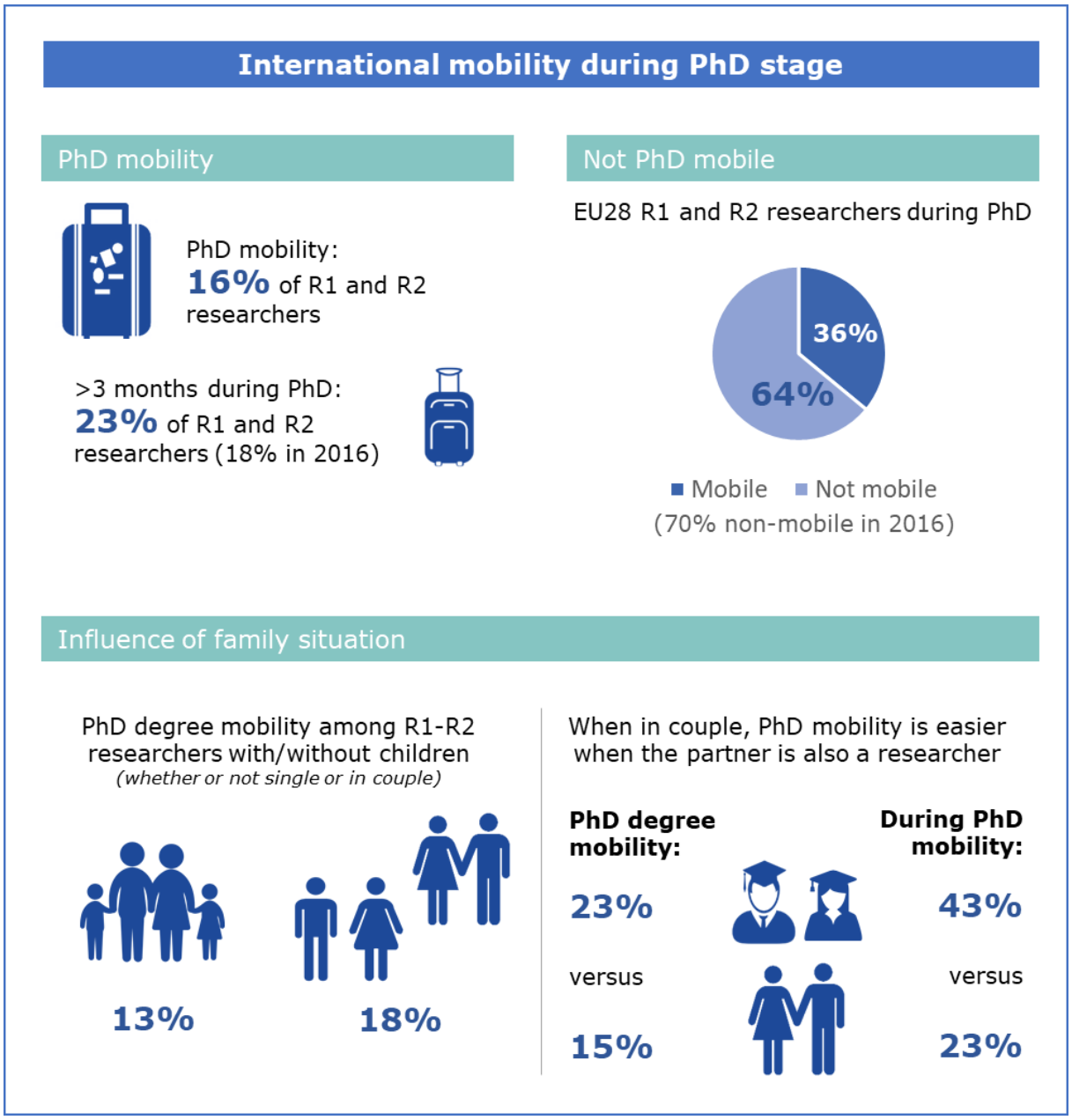
researchers declines, their teaching hours could be increased to free up resources for promising young researchers. Such adjustments may come at the explicit request of more established researchers, with the aim of imparting more of their knowledge and skills to students; it may also be the outcome of evaluations organised by universities themselves. National legal frameworks should in principle allow such flexibility. Given the known willingness of early stage researchers to sacrifice some potential salary in exchange for good research conditions, there is a chance that well-designed careers and positions in research can compensate for the economic disadvantages of 'catching-up' countries, such as lower salaries. To allow for the long-term planning of research agendas, in addition to career perspectives, long-term (national) funding commitments could increase budgeting reliability and planning security.

- Fifth, regularly monitoring the attractiveness of working conditions or jobs offered to researchers could also help to identify divergent trends at an early stage. The new ERA Communication signals that the European Commission intends to establish an observatory on brain circulation and research careers.

At the same time, the country snapshots in the ERA Progress Report 2018 also reveal that multiple initiatives and actions have been implemented **at national level** to address the working conditions of researchers:

- In 2016, Portugal adopted 'Fostering Scientific Employment' (Decree-Law 57/2016), with the aim of improving researchers' working conditions and career prospects and to promote the employment of PhD holders (EC, 2017c; OECD, 2016). The measure was taken to overcome challenges associated with a high emigration rate among graduates, as well as highly unstable research careers.
- In May 2016, the implementation of Greece's law on the National Strategy for Research, Technological Development and Innovation (ESETAK) was revised to enable improvements in the working conditions of researchers working in the public sector.
- The Academy of Finland supports early-career researchers by funding postdoctoral research posts and Academy Projects for early-career researchers. In 2017, the government dedicated additional funds to the Academy of Finland in order to support a larger number of high-quality projects submitted by early-career researchers and cover researchers' salaries.
- In Spain, initiatives have been implemented for the recruitment of highly reputed Spanish or overseas research professors into the national science and technology system. An alternative career path in public research organisations and universities through permanent contracts ('for distinguished researchers or scientists of great prestige') has been developed. A new call for the recruitment of highly reputed Spanish researchers using this type of contract is ongoing (the 'Beatriz Galindo' grants).

8. INTERNATIONAL MOBILITY DURING PHD STAGE



Source: Based on MORE4 EU HE report (Section 7.1.1)

8.1. Key findings

The MORE studies consider two types of mobility at PhD stage:

- **PhD degree mobility**: mobility with the purpose of obtaining a PhD in a country other than the country of citizenship AND the country of Master's degree.
- **During-PhD mobility**: mobility of three months or more during the PhD, while still obtaining the PhD in the country in which the researcher began their PhD (regardless of the citizenship of the researcher).

The following paragraphs discuss the key findings in MORE4 in terms of the profiles, motives and barriers involved in both types of PhD mobility.

8.1.1. Mobility profile (PhD)

SHARE OF RESEARCHERS WITH INTERNATIONAL 'PhD DEGREE MOBILITY' (of all R2 researchers, or R1 researchers that are enrolled in a doctoral programme)				
	EU28 total	**By career stage**	**By FOS**	**By gender**
2012 (n= 3,449)	15.3%	R1: 19.4% R2: 12.3%	MED: 16.4% NAT: 14.5% SOC: 15.5%	F:12.6% M:17.5%
2016 (n=2,469)	16.4%	R1: 20.0% R2: 14.6%	MED: 17.1% NAT: 16.7% SOC: 15.7%	F:15.9% M:16.9%
2019 (n=1,776)	15.5%	R1: 17.5 % R2: 14.1%	MED: 10.9% NAT: 14.6% SOC: 19.4%	F:15.1% M:16.0%
SHARE OF RESEARCHERS WITH INTERNATIONAL 'DURING-PhD MOBILITY' (of all R2 researchers, or R1 researchers that are enrolled in a doctoral programme)				
	EU28 total	**By career stage**	**By FOS**	**By gender**
2012 (n=3,449)	18.3%	R1: 13.9% R2: 21.5%	MED: 16.6% NAT: 16.2% SOC: 21.9%	F: 17.6% M: 18.9%
2016 (n=2,469)	18.2%	R1: 12.9% R2: 21.0%	MED: 17.1% NAT: 16.5% SOC: 21.0%	F: 18.8% M: 17.7%
2019 (n=1,776)	23.5%	R1: 18.0% R2: 26.7%	MED: 15.4% NAT: 21.1% SOC: 31.8%	F: 23.0% M: 24.0 %

The MORE4 EU HE survey[125] shows that **16% of EU PhD candidates obtain their PhD in a country other than that of which they are citizens,** and **23% experiences a move of more than three months to another country during their PhD**. 64% of R1-R2 researchers have never been mobile for or during the PhD phase (70% in MORE3). Eurostat data on the number of mobile PhD candidates (ISCED8) from another EU28

[125] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.

country as a share of total PhD candidates in the country[126] were analysed in the MORE4 Indicators report on researchers[127]. This indicator corresponds most closely to PhD degree mobility (those who are enrolled in that country to obtain their PhD), but represents only half the value in MORE4[128]: about 8% of PhD candidates were mobile from other EU28 countries in 2017. This share is also fairly stable over time.

Compared to the 2012 and 2016 data, PhD degree mobility seems to have further converged for male and female researchers. The difference is also very small for during-PhD mobility. R1-R2 researchers with children engage/have engaged less in PhD degree mobility (13%) than those without children (18%). This difference is smaller for during-PhD mobility (26% with children and 24% without children). Of the researchers who are in couple, PhD degree mobility is substantially higher for the ones who have a partner who is also a researcher (23% versus 15%). This is even more outspoken in during-PhD mobility (43% with partner working in research versus 23% of those living in a couple but whose partner does not work in research).

PhD mobility: country of origin

Seen from the perspective of the 'origin' of those researchers engaged in PhD mobility, it is important to note that PhD degree mobility can in some cases be a (negative) indicator of the attractiveness of PhD training in the country of which they are citizens. It can, however, also be a (positive) indicator of the personal willingness of citizens from a specific country to move abroad for their PhD (thus not necessarily implying a negative view on their country of origin). During-PhD mobility does not reflect citizenship, but instead reflects the PhD training in a specific country: it shows the extent to which PhD training in a specific country supports/allows/requires international experiences during a PhD.

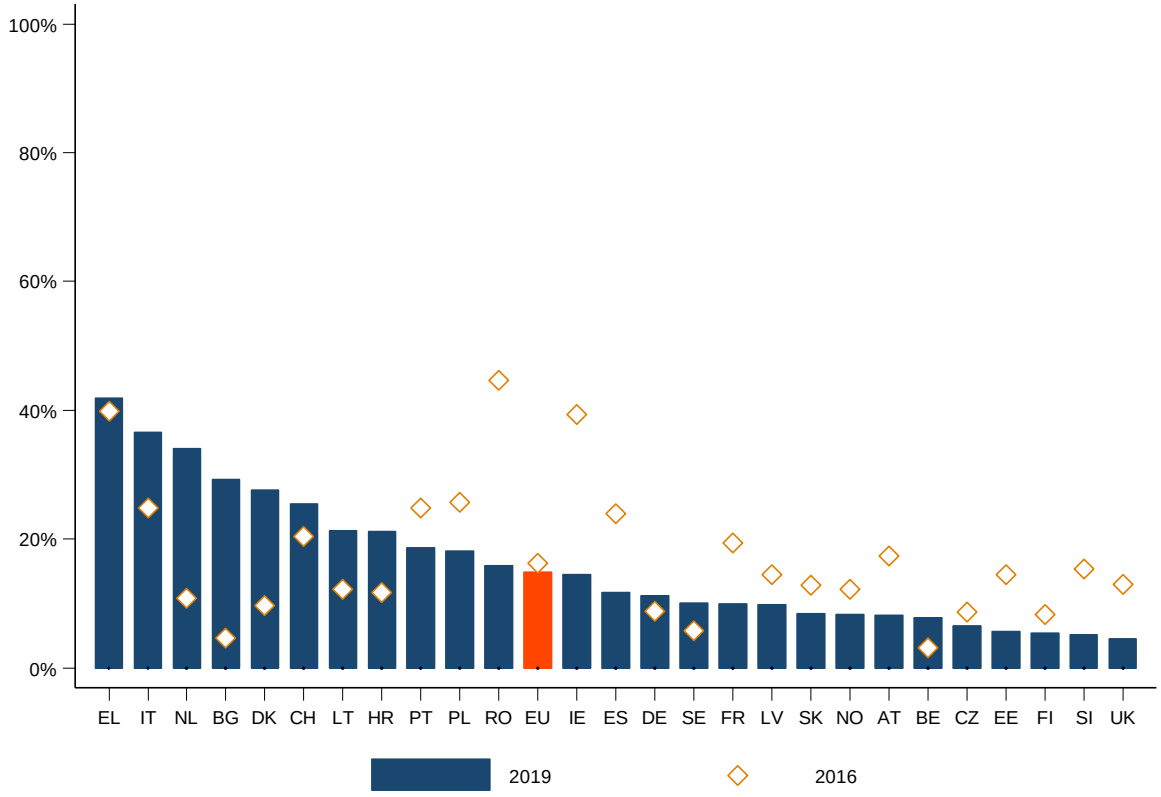
The largest shares of **PhD degree mobility** are found among researchers who are citizens of Greece, Italy, Bulgaria, the Netherlands and Denmark (each 25% or more; see Figure 11). This means, for example, that more than 40% of all researchers with Greek citizenship are mobile to obtain their PhD in a country other than Greece. This share is high when the number of mobile researchers represents a higher proportion of researchers from that country; it may also be high when the total number of researchers with this citizenship is lower (i.e. smaller countries). Finnish, Slovenian and UK citizens are the least mobile for PhD degrees (less than 6%). This means that the vast majority of Finnish researchers, for example, obtain their PhD in Finland. Comparing figures from MORE2, MORE3 and MORE4 reveals that while the EU average has remained relatively stable, there is a great deal of volatility in these figures at country level.

For **moves during PhD**, the patterns between countries are somewhat more consistent over time (see Figure 12). Researchers who will/did obtain their PhD in Spain, Italy and Denmark are considerably more mobile during their PhD to another country than the EU average (between 48% and 59%, compared with the EU average of 23%). This means

[126] Based on Eurostat: mobile PhD students from abroad as a share of total PhD students in the country (educ_uoe_mobs02, ISCED8/educ_uoe_enrt01, ISCED8). Cf. indicator 7.1 in the MORE4 Indicators report on researchers.
[127] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Researcher Indicators report. European Commission, DG Research and Innovation.
[128] The values of both indicators can not be directly compared because they are not based on the same definition.

that most of the researchers – of any citizenship – working on a PhD in Spain, experience a >3 months mobility experience outside Spain during their PhD. Hungary also had a during-PhD mobility share of 46% in 2019, compared with 17% in 2016. For Slovenia, on the other hand, this share decreased from 31% in 2016 to 13% in 2019. Researchers who obtain(ed) their PhD in Luxembourg, Romania or Switzerland (8% or below) or in Ireland, the UK and the Netherlands (12-14%) engaged less frequently in during-PhD mobility. In some of these countries, this could be in part due to other types of mobility being more prevalent, such as PhD degree mobility or Master's mobility.

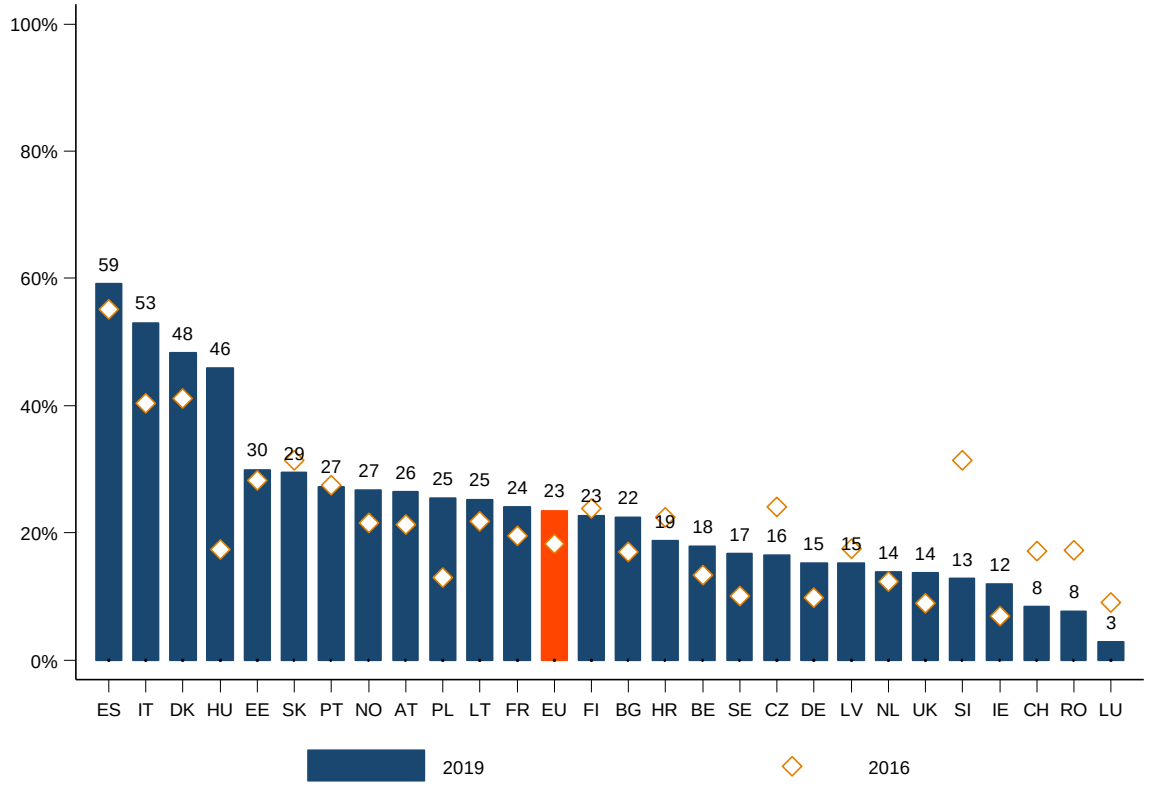
Figure 11: International PhD degree mobility, by country of citizenship (departure)



Source: MORE4 EU HE survey (2019) and MORE3 EU HE Survey (2016)
Notes:

Share of R1 PhD candidates and R2 PhD holders that were PhD degree mobile, by country of citizenship. With 'PhD degree mobility' defined as obtaining or having obtained a PhD in a county other than the one in which he/she obtained his/her previous degree.
Countries with fewer than 30 observations are omitted: Cyprus, Iceland, Hungary, Luxembourg, Malta.
Based on question 57: "Did/will you obtain your PhD in a country other than the one where you obtained your previous degree (the degree that gave access to the PhD)?" and question 5: "What is your country of citizenship?"
(2019: n=1,781; 2016: 2,587)

Figure 12: >3 month international mobility during PhD, by country of PhD (departure)



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Notes:

Share of R1 PhD candidates and R2 PhD holders that were >3 month mobile during their PhD, by country of PhD.
With '>3 month mobility during PhD' defined as moving for 3 months or more to a country than the one in which they obtained or will obtain their PhD.
Countries with fewer than 30 observations are omitted: Cyprus, Greece, Iceland, Malta.
Based on question 57: "During your PhD, did you move for 3 months or more to a country other than the country where you did/will obtain your PhD?"
(2019: n= 1,917; 2016: 2,764)

PhD mobility: destination country

Seen from the perspective of the 'destination' of researchers engaged in PhD mobility, PhD degree mobility is a (positive) indicator of the attractiveness of PhD training in the country of destination. The more researchers of foreign citizenship work on their PhD in a specific country, the higher we can assume the attractiveness of that country to be, in terms of PhD training or other factors encouraging mobility at this career stage such as dedicated funding programmes. During-PhD mobility, seen from the perspective of the destination, reflects – among other things – the attractiveness of PhD training in a country for a shorter stay (>3 months exchange, without the goal of obtaining a PhD in that country). Aside from the attractiveness of the research system, other framework factors will also play a role, such as language patterns and selection procedures.

As with country of 'origin', the figures for **PhD degree mobility** at country level vary considerably over time. In MORE4, we see high shares of PhD degree mobility towards Hungary, Luxemburg and Ireland, but also towards Scandinavian countries such as Norway, Denmark and Sweden. This is shown in Figure 13 below. Share may be high either due to a higher number of foreign researchers in a country, or due to the lower total number of researchers in these countries.

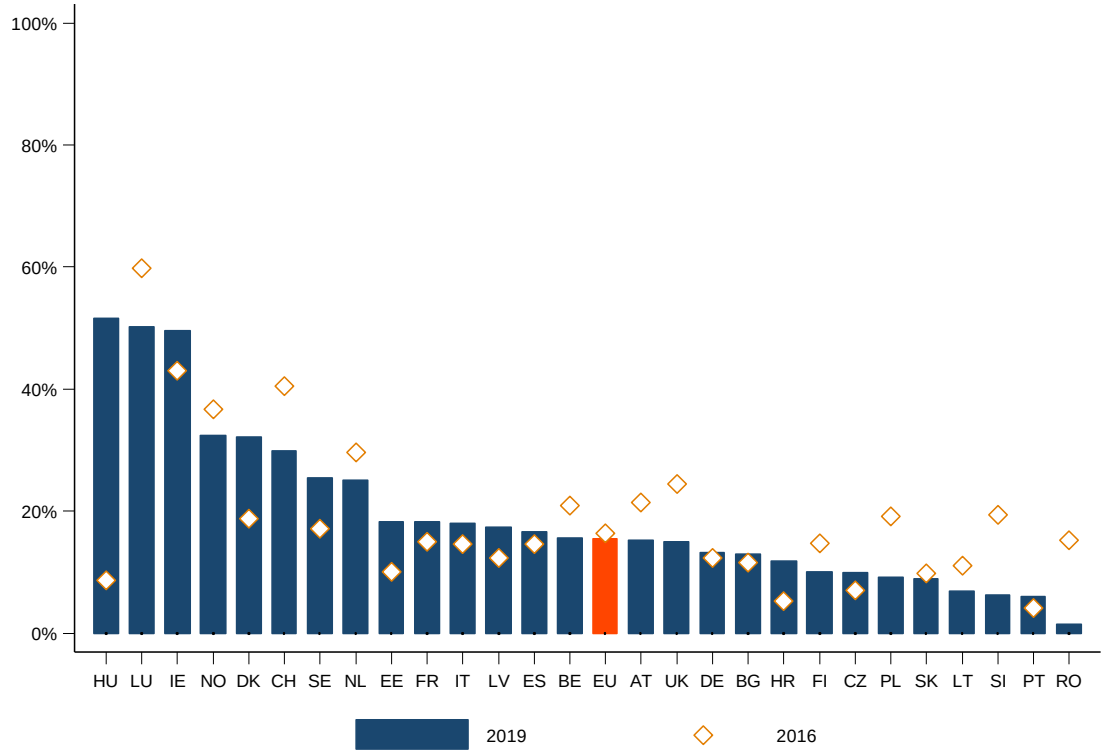
Eurostat also provides information about the destination of PhD mobility in its monitoring of mobile PhD candidates (ISCED8) from abroad, as a share of total PhD candidates in the country[129]. The countries with the most PhD candidates from abroad relative to their total number of PhD candidates are Luxembourg (54%), Austria (19%), Denmark (18%) and the Netherlands (17%). Corresponding shares for this indicator in Croatia, Lithuania, Poland, Romania and Slovenia range between 0% and 1%.

For **during-PhD mobility**, the main destination countries are the United States (13%), Germany (12%) and the United Kingdom (10%), as shown in Table 3. In MORE3 and MORE2, these countries were also among the top 3, but in a different order (Germany surpassed the United Kingdom in the most recent MORE survey). The top 10 destination countries for during-PhD mobility are often visited by R1 and R2 researchers from the largest mainland EU-countries (Germany, Italy, and Spain). In MORE3, this list was dominated by Southern European countries (Italy, Spain, Greece, Portugal).

The geographical patterns of >3 month during-PhD mobility are very similar to those for post-PhD mobility, and appear to be stable over time when compared with the figures for 2012 and 2016 (i.e. MORE2 and MORE3): the United States, United Kingdom and Germany are the most frequently mentioned destinations for researchers before and after their PhD. In addition, the MORE surveys also collect information on Master's mobility: in MORE3, the rate of during-PhD mobility observed was considerably higher among researchers who were not mobile for their PhD degree, because they already moved during their Master's degree (37% versus 18% in total). In MORE4, however, these percentages are no longer significantly different from each other (23% versus 24% in total).

[129] Based on Eurostat: Mobile PhD students from abroad as a share of total PhD students in the country (educ_uoe_mobs02, ISCED8; /educ_uoe_enrt0, ISCED8). Cf. indicator 7.1 in the MORE3 Indicators report on researchers.

Figure 13: International PhD degree mobility, by country of PhD (destination)



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Notes:
Share of R1 PhD candidates and R2 PhD holders that were PhD degree mobile, by country of PhD.
With 'PhD degree mobility' defined as obtaining or having obtained a PhD in county other than the one in which he/she obtained his/her previous degree.
Countries with fewer than 30 observation are omitted: Cyprus, Iceland, Greece, Malta
Based on question 55: "Did/will you obtain your PhD in a country other than the one where you obtained your previous degree (the degree that gave access to the PhD)?"
(2019: n=1,881; 2016: 2,716)

Table 3: Main destination countries for >3 month mobility during PhD (EU28 departing countries)

DESTINATION	SHARE (%)	CUMULATIVE SHARE (%)	ORIGIN 1 (CITIZENSHIP)	ORIGIN 2 (CITIZENSHIP)	ORIGIN 3 (CITIZENSHIP)
United States	12.7%	12.7%	Italy (11.6%)	Denmark (11.6%)	Germany (11.6%)
Germany	12.2%	24.9%	Spain (9.4%)	Slovenia (9.4%)	Austria/Bulgaria (6.3%)
United Kingdom	10.2%	35.1%	Spain (11.5%)	Italy (9.6%)	Denmark (9.6%)
France	7.3%	42.4%	Spain (16.2%)	Italy (13.5%)	Romania/Portugal (10.8%)
Spain	4.5%	46.9%	Portugal (16%)	Bulgaria (12%)	Slovenia (12%)
Italy	3.9%	50.8%	Germany (13.6%)	Lithuania (13.6%)	France (9.1%)
Sweden	3.5%	54.3%	Germany (16.7%)	Italy (16.7%)	Denmark, Lithuania, Sweden (11.1%)
Belgium	3.5%	57.8%	Germany (11.1%)	France (11.1%)	Denmark (11.1%)
Austria	3.3%	61.2%	Slovenia (17.6%)	Belgium, Slovakia (11.8%)	

DESTINATION	SHARE (%)	CUMULATIVE SHARE (%)	ORIGIN 1 (CITIZENSHIP)	ORIGIN 2 (CITIZENSHIP)	ORIGIN 3 (CITIZENSHIP)
Denmark	2.7%	63.9%	Spain (14.3%)	Finland, Portugal, Slovenia, and others (7.1%)	

Source: MORE4 EU HE survey (2019)

Reading note: Of the total number of researchers currently working in the EU but who were mobile for more than three months during their PhD to the United States, equal shares of 11.6% were Italian, Danish and Spanish.

Notes:

Share of R1 PhD candidates and R2 PhD holders currently working in the EU which were mobile for more than three months during their PhD to a specific destination country.
Destination countries with fewer than 14 observations are not included in the table (Denmark has 14 observations).
Based on question 58: "To which country(ies) was this?"
(n=510)

8.1.2. Motives and barriers (PhD)

Why move? Motives for PhD mobility

Both for PhD degree mobility and during-PhD mobility, we find a relatively stable ranking of motives over time. The ranking is also similar for both types of PhD mobility: both rank **international networking and working with leading scientists** very highly. **Quality of education and training and research autonomy** are also important for both. Unsurprisingly, the availability of research funding and suitable positions is more important for PhD degree mobility, while career progression and access to research facilities and equipment are more important reasons for during-PhD mobility.

The least important motives with regard to both types of PhD mobility are ameliorating one's pension plan, social security and other benefits, as well as personal or family reasons and improved remuneration and job security. Motives for moving are hence related to improving one's conditions for research, rather than improving 'material' conditions. This is in line with the findings on career paths and working conditions in Sections 6 and 7.

Overall, the motives for PhD mobility tend to focus more on the availability of research funding and positions, while those for post-PhD mobility tend to focus more on research autonomy and aspects relating to international networking (cf. Section 9).

Table 4: Importance of motives for international PhD degree mobility (EU28)

SHARE OF RESPONDENTS INDICATING THIS MOTIVE AS ONE OF THEIR MOTIVES FOR INTERNATIONAL PhD DEGREE MOBILITY (Of all R2 researchers, or R1 researchers who are enrolled in a doctoral programme and were PhD degree mobile)	2012 (n=653)	2016 (n=491)	2019 (n=305)
Availability of research funding	72.6%	79.2%	80.2%
Availability of suitable PhD positions	83.9%	84.5%	78.3%
International networking	/	81.8%	74.8%
Working with leading scientists	73.2%	87.8%	74.3%
Research autonomy	64.6%	77.9%	73.3%
Quality of training and education	76.4%	86.9%	71.1%
Career progression	74.5%	84.5%	68.0%
Access to research facilities and equipment	69.5%	79.0%	65.7%

Remuneration	50.8%	70.9%	57.1%
Balance between teaching and research time	/	64.7%	55.5%
Social security and other benefits	35.3%	63.6%	51.1%
Culture and/or language	58.9%	62.5%	50.1%
Job security	44.5%	62.1%	48.4%
Personal/family reasons	31.5%	60.3%	48.3%
Pension plan	(together with social security benefits in 2012 survey)	49.2%	38.5%
Working conditions	62.6%	/	/

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)

Notes:

With 'PhD degree mobility' defined as obtaining or having obtained a PhD in another county than the one where one obtained his/her previous degree.
Only includes researchers who will obtain or have obtained a PhD in an EU country.
Based on question 56:" Which of the following factors were important in your decision to obtain your PhD in another country?" The answer options between MORE2 and MORE3 differ slightly.

Table 5: Importance of motives for >3 month mobility during PhD (EU28)

SHARE OF RESPONDENTS WHO INDICATE THIS MOTIVE AS ONE OF THEIR MOTIVES FOR INTERNATIONAL DURING-PhD MOBILITY (>3 MONTHS) **(Of all R2 researchers, or R1 researchers that are enrolled in a doctoral programme and experienced >3 month mobile during their PhD)**			
	2012 (n=552)	**2016 (n=420)**	**2019 (n=333)**
International networking	/	86.1%	92.0%
Working with leading scientists	82.1%	88.5%	89.5%
Career progression	83.3%	70.6%	86.4%
Quality of training and education	62.4%	71.0%	83.9%
Access to research facilities and equipment	78.3%	74.7%	80.7%
Research autonomy	75.0%	75.4%	79.8%
Culture and/or language	68.2%	68.2%	74.6%
Availability of research funding	63%	67.3%	72.8%
Availability of suitable PhD positions	41.6%	56.7%	58.6%
Balance between teaching and research time	/	47%	56.0%
Remuneration	26.2%	34.1%	53.7%
Personal/family reasons	52.3%	29.8%	52.1%
Job security	22.6%	22.7%	46.4%
Social security and other benefits	13.2%	19.7%	46.4%
Pension plan	(together with social security benefits in 2012 survey)	12.2%	40.3%

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012).

Notes:

With '>3 month mobility during PhD' defined as moving for 3 months or more to a country other than the country in which he/she did or will obtain their PhD.
Based on question 59: "Which of the following factors were important in your decision to move to another country?" The answer options between MORE2 and MORE3 differ slightly.

Why not move? Barriers to PhD mobility

The barriers to PhD mobility, as perceived by non-mobile researchers, are also stable over time and comparable to post-PhD mobility barriers. They emphasise personal or family-related reasons (78%); the ability to obtain funding for mobility (60%) or research (58%); logistics (54%); and finding a suitable position (53%). In 2016 and 2012, the ranking of the main barriers was very similar, but the shares have increased for all items since then – especially personal and family reasons, which have experienced an increase of 20pp over time, confirming the key role played by such factors in mobility decisions. In addition, the logistical aspects of moving have become a more important barrier for PhD mobility (54%), compared with 2016 (29%). Overall, dimensions such as culture or obtaining a visa or work permit, as well as the language of the PhD programme and of teaching are less important barriers for PhD mobility (from 16% up to 27%).

The ranking of the barriers to mobility that are mentioned more frequently by non-mobile researchers is the same among R1 and R2 researchers, and the differences between these two groups tend to be limited. Compared with R2 researchers, more R1 researchers indicate that they face the following barriers: the language of the PhD programme (a difference of 12pp); culture (10pp); and obtaining a visa or work permit (9pp). Conversely, more R2 researchers report other types of barriers, such as finding a suitable position (a difference of 12pp) or logistics (11pp).

In 2016, female researchers tended to indicate more barriers as reasons for not having been mobile. In 2019, we observe some convergence between genders, with some barriers being mentioned more often by men than women. Personal and family reasons and logistics are still more important barriers to female researchers (differences of 8pp and 13pp, respectively), while access to research facilities and equipment for research, transferring social security entitlements, and culture, are more important barriers for male researchers (differences of between 14pp and 17pp).

Table 6: Importance of barriers for PhD mobility among the non-mobile (EU28)

AVERAGE SHARE OF RESPONDENTS THAT INDICATE THIS BARRIER AS ONE OF THE FACTORS KEEPING THEM FROM INTERNATIONAL PhD MOBILITY (OF ALL NON-MOBILE R2 RESEARCHERS, OR NON-MOBILE R1 RESEARCHERS THAT ARE ENROLLED IN A DOCTORAL PROGRAMME)			
	2012 (n=825)	**2016 (n=595)**	**2019 (n=401)**
Other personal/family reason	54.0%	58.0%	77.6%
Obtaining funding for mobility	(together with funding for research in 2012 survey)	44.1%	60.4%
Obtaining funding for research	63.8%	43.5%	58.3%
Logistics	44.0%	28.8%	54.5%
Finding a suitable position	54.5%	41.9%	52.8%
Maintaining level of remuneration	NA	21.6%	46.5%
Transferring social security entitlements	NA	12.9%	35.0%
Transferring research funding to another country	34.0%	14.6%	34.7%
Loss of contact with professional network	25.8%	22.0%	34.0%
Quality of training and education	25.5%	10.1%	29.3%
Language of teaching	(together with culture and language for PhD programme in 2012 survey)	12.8%	27.2%

AVERAGE SHARE OF RESPONDENTS THAT INDICATE THIS BARRIER AS ONE OF THE FACTORS KEEPING THEM FROM INTERNATIONAL PhD MOBILITY (OF ALL NON-MOBILE R2 RESEARCHERS, OR NON-MOBILE R1 RESEARCHERS THAT ARE ENROLLED IN A DOCTORAL PROGRAMME)			
Access to research facilities and equipment for research	25.7%	15.4%	26.5%
Language for PhD programme	22.1%	10.3%	22.4%
Obtaining a visa or work permit	NA	6.0%	21.1%
Culture	(together with language for teaching and language for PhD programme in 2012 survey)	4.1%	15.8%

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016), and MORE2 EU HE survey (2012)
Notes:
Share of non-mobile R1 PhD candidates and R2 PhD holders with some consideration of PhD mobility, who indicate the barrier as important for non-PhD mobility.
With 'non-PhD mobile' defined as never having been PhD degree mobile, nor mobile during their PhD.
With 'some consideration of PhD mobility' defined as not having indicated that they have never considered mobility (thus having considered it but made no effort; having considered it and searched; and having turned down a concrete offer).
Based on question 61: "Which of the following factors prevented you from taking part or all of your PhD in another country"? The answer options in MORE2 where slightly different compared to MORE3 and MORE4.

8.2. EU policy aims and implications of MORE4 findings

A strong ERA will be built on strong researchers. In this context, it is important to offer attractive career prospects to young researchers. One aspect of this is the internationalisation of PhD training, and thus mobility. To this end, open recruitment and mobility support measures are essential.

Mobility opportunities are not only a factor in the attractiveness of PhD training, but international mobility at PhD stage is also considered an important asset for a researcher's further career: Section 6 documents the positive role of international mobility in recruitment and career progression. International mobility also enables international collaboration, which is often a key ingredient of scientific productivity and research performance[130]. Several studies on the effects of mobility among students and staff show that experiences abroad enrich a person's professional and academic life while at the same time enhancing personal skills such as language learning, intercultural skills, self-reliance and self-awareness[131].

The Innovative Doctoral Training Principles[132] (see also Section 5 on PhD training) provide a coordinated framework to achieve excellent doctoral training. One important principle is

[130] Jonkers, K. & Tijssen, R. (2008). Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics*, *77*(2), 309-333.
[131] Among others: EURODATA Student Mobility in European Higher Education (Kelo, Teichler and Wächter 2006), the Erasmus statistics (European Commission 2012a), the Flash Eurobarometers (Gallup Organization 2010; Gallup Organization 2011) and the EU-funded study Mapping Mobility in European Higher Education (Teichler, Ferencz and Wächter 2011a; Teichler, Ferencz and Wächter 2011b), as cited in The Erasmus Impact Study, Effects of mobility on the skills and employability of students and the internationalisation of higher education institutions (2014). CHE Consult et al. ec.europa.eu/dgs/education_culture/repository/education/library/study/2014/erasmus-impact_en.pdf
[132] Report of Mapping Exercise on Doctoral Training in Europe "Towards a common approach" of 27 June 2011(final), adopted by the ERA Steering Group on Human Resources and Mobility.

that of international networking, according to which "mobility should be encouraged, be it through conferences, short research visits and secondments or longer stays abroad". The ERA Steering Group on Human Resources and Mobility[133] states that international networking, exposure to industry, interdisciplinary research options and transferable skills are seen as important principles influencing the success of doctoral training and the future career of doctoral candidates. Building on the Bratislava Declaration of Young Researchers, as well as the Council Conclusions on 'Measures to support early-stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development'[134], stress the importance of supporting international mobility for young researchers because it contributes to European added value in research excellence.

The main policy goals for PhD mobility can thus be identified as:

- **Quantity of researchers trained at PhD level**: PhD studies need to be attractive to draw in growing numbers of talented students, and options for international mobility represent one aspect of this.
- **Quality of PhD training**: PhD candidates will be drawn to the most attractive training and research environments. Mobility thus encourages increased levels and quality of training. In addition, it results in more international collaboration afterwards (see Section 10). These are two aspects with a direct positive influence on scientific productivity and future careers. This also relates to the point made in Section 5, that PhD training programmes in the EU must be attractive enough to entice the best within the context of worldwide competition for the most talented researchers[135], ensuring brain circulation rather than brain drain.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on PhD mobility?

The mobility patterns of early-stage researchers have remained stable over time (2012-2019), both in terms of numbers and flows (destinations and origins). At the same time, the figures for PhD mobility flows reflect differences between countries in terms of both mobility rates and the relative attractiveness of PhD training across Europe. Mobility rates are high in Southern European countries, and in a number of small and open countries. Comparing MORE2, MORE3 and MORE4 reveals that while the EU average has remained relatively stable, there has been a great deal of volatility in these figures at country level.

Young researchers are driven by factors relating to scientific knowledge production such as working with leading scientists, international networking, quality of training and education, and career progression. This corresponds with the general view that

[133] Report of the ERA Steering Group Human Resources and Mobility (ERA SGHRM): Using the Principles for Innovative Doctoral Training as a Tool for Guiding Reforms of Doctoral Education in Europe.
[134] Council of the European Union (2016). Draft Council conclusions on 'Measures to support early-stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development'. Retrieved from https://www.consilium.europa.eu/media/24214/st14301en16.pdf
[135] Hunter, R.S., Oswald, A.J. & Bruce. Charlton, B.G. (2009). 'The Elite Brain Drain*'. *The Economic Journal* 119, no. 538: F231–F251.

international PhD mobility is expected to have a positive impact on academic life and skills. Researchers are, however, held back by more practical issues such as personal or family reasons, or by a lack of funding or suitable positions. This is consistent with the previous literature, which sees motivations relating to boosting one's career as crucial for moving somewhere else, while personal or family reasons hold researchers back or lead to return mobility[136]. This implies that fostering international PhD mobility is related to two main dimensions: first, increasing the attractiveness or quality of PhD studies in general (i.e. working on the drivers of PhD mobility outlined in Section 5); and second, reducing barriers to mobility at PhD stage. There is an opportunity to work on these practical issues in order to broaden the group of researchers who are enabled or convinced to become mobile for or during their PhD.

EU-level and national policy instruments

It is clear that the positive factors identified as drivers for PhD mobility in the MORE studies are related to scientific productivity and training. Fostering international mobility will thus be facilitated by a consistent effort to **build high-quality research systems and PhD training across Europe**. In Section 5, we noted that the attractiveness of PhD training in general could be further improved by reforms aimed at more structured training. In this context, it is important that reforms should take into account differences between EU countries in order to achieve high-quality PhD training in all Member States – thus encouraging brain circulation, rather than brain drain. To enhance mobility, universities suggest increasing the opportunities for international tenure-track or tenured positions after graduating[137].

As we concluded in Section 5, an increase in the resources for MSCA co-funding and ESIF projects could further support the necessary reforms, particularly in those countries currently experiencing the highest outflow of PhD candidates.

Furthermore, existing HR frameworks and tools (e.g. the Innovative Doctoral Training principles [IDT], European Charter for Researchers and Code of Conduct for their Recruitment ['Charter and Code'], the European Framework for Research Careers [EFRC], and the Human Resource Strategy for Researchers [HRS4R]), are available to the Member States and research organisations as guidance for further reforms towards structured training. These tools will be revised and optimised under the impetus of the new ERA Communication (2020). The Communication emphasises the need for a more comprehensive approach: its aim is to build a toolbox by the end of 2024 to support the creation of a pipeline for talent by tackling the recognition of researchers' skills, enhanced mobility and exchanges between academia and industry, targeted training opportunities, and a 'one-stop shop' portal at which researchers can access a range of support services.

In addition to improving the quality and attractiveness of PhD studies in general, encouraging and **supporting international mobility** in itself is also important in stimulating the better circulation of ideas and beneficial effects for the individual careers

[136] Franzoni, C., Scellato, G. & Stephan, P. (2012). Foreign-born scientists: mobility patterns for 16 countries. *Nature Biotechnology*, 30(12), 1250-1253.
[137] CESAER, CLUSTER, EuroTech Universities Alliance, IDEA League and Nordic Five Tech (2015) Innovative doctoral training at universities of science and technology. Discussion Paper.

of the researchers. The latter are particularly important during the early career stages. To this end, two needs are identified: stronger funding opportunities for research and mobility, and the reduction of barriers – particularly those relating to the family situation of the researcher. Also, the Bratislava Declaration of Young Researchers (2016)[138] expressed the need (among others) to reorganise funding streams to place trust in and empower young researchers, and to implement better and more supportive childcare provision and parental care, as well as flexible working practices and dual-career opportunities.

In terms of funding for mobility, the MSCA generally plays a prominent role in stimulating mobility, and more generally in stimulating excellent and innovative research training (e.g. via the Innovative Training Networks [ITNs]). Furthermore, in the ERA process, open recruitment is stressed as an enabling factor for mobility. Access by non-nationals to national grants and the portability of grants are mentioned as facilitators of mobility. Advertising vacancies on the EURAXESS jobs portal and via the European Framework for Research Careers (EFRC)[139] is also encouraged, in order to reduce the barriers to non-national researchers in terms of finding suitable positions. EURAXESS services also play a key role in assisting researchers and their families with relocation issues. The EFRC further increases transparency and supports more comparable research career structures across sectors and countries. Due to a changing labour market and economy, the new ERA Communication[140] and Skills Agenda[141] both emphasise the need to update the EFRC and develop a taxonomy of researchers' skills. This will not only support the comparability of research careers, but also the modernisation of reward systems and the monitoring of trends in the research labour market, as well as careers, skills and talent. This common understanding on early-stage researchers thus further supports open recruitment and mobility options.

Most of these instruments, however, work on mobility and open recruitment in general, rather than to specifically benefit young researchers during their PhD research. While the drivers of mobility for this group are generally the same as those for post-PhD researchers, they are at the same time more focused on their training and on the availability of funding and positions. In this respect, actions could focus more specifically on the needs of this subgroup.

To support young researchers, Members States are also called upon to facilitate and promote the participation of early-stage researchers in bilateral and multilateral S&T cooperation schemes and projects, to support the voluntary return of early-stage researchers to pursue scientific careers in their countries of origin, thus facilitating inter-institutional networking throughout Europe and international scientific cooperation, while encouraging mobility throughout their careers. Member States are also encouraged to consider establishing measures such as a prize to recognise excellent early-stage

[138] Bratislava Declaration of Young Researchers (2020). Retrieved from http://declaration.mimuw.edu.pl/
[139] Towards a European Framework for Research Careers (2011), European Commission, Directorate General for Research and Innovation, Directorate B – European Research Area, Skills.
[140] European Commission (2020). *Communication. A new ERA for Research and Innovation*.
[141] European Commission (2020). *Communication. European Skills Agenda for sustainable competitiveness, social fairness and resilience.*

researchers, with the aim of supporting their independent research, mobility, networking, and entrepreneurial skills[142].

According to the Final Report on Monitoring ERA Priorities with ERA Roadmap National Actions Plans (NAPs) published by ERAC[143], 36% of actions included in NAPs for Priority 3 (Open labour market for researchers) are reported as completed (see Table 7), while another 46% of ongoing actions have made significant progress (degree of execution greater than or equal to 50%). Completed activities include the establishment of funding programmes (many aimed at integrating research staff into the private sector, either to do PhDs or through temporary schemes such as internships); the publication of policies/strategies/frameworks; as well as specific campaigns, mostly to promote EU initiatives such as the Charter and Code, HRS4R, EURAXESS Jobs, RESAVER, MSCA, etc.

Table 7: Distribution of actions by type and current status in Priority 3

TYPE OF ACTION	% OF TOTAL ACTIONS	STATUS				TOTAL
		COMPLETED	*(≥ 50%)*	*(< 50%)*	*CANCELLED*	
Remove legal and other barriers	53%	33%	53%	11%	3%	100%
Support EURAXESS	12%	47%	47%	6%	0%	100%
Support innovative doctoral training	24%	42%	30%	27%	0%	100%
Adopt the Charter and Code principles and implement the HRS4R	9%	17%	50%	33%	0%	100%
Other types of action	3%	50%	25%	25%	0%	100%
TOTAL	100%	36%	46%	17%	1%	100%

Source: https://data.consilium.europa.eu/doc/document/ST-1209-2020-INIT/en/pdf

Some examples of new instruments and developments at national level that contribute to international mobility at PhD stage can be drawn from the country snapshots in the ERA Progress Report 2018. As part of their NAPs, ERA countries are reforming their R&I systems; updating legal and administrative frameworks at national, regional and organisational levels; implementing organisational reforms; introducing new schemes and/or enhancing their existing programmes to support international PhD mobility. Without aiming to be exhaustive, and without any further information on the effectiveness of these

[142] Council conclusions on 'Measures to support early stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development' (2016).
[143] European Research Area and Innovation Committee (2020). *Final Report on Monitoring ERA Priorities with ERA Roadmap National Action Plans.* Retrieved from https://data.consilium.europa.eu/doc/document/ST-1209-2020-INIT/en/pdf

measures, we list below some examples of such new initiatives and developments across different Member States with varying levels of international PhD mobility:

- In 2016, Ireland launched its National Skills Strategy 2025[144]. This emphasises the implementation of the National Framework for Doctoral Education[145] adopted in 2015, and links it to Ireland's strategy for research and development, science and technology – Innovation 2020[146] – and the International Education Strategy for Ireland 2016-2020[147]. The strategy notes the need for a solid pipeline of research skills development that supports early-stage researchers, researcher mobility into industry and internationally, as well as the development, retention and attraction of advanced researchers.[148]
- In 2017, the Finnish Research and Innovation Council adopted its vision and roadmap for 2030, with the aim of making Finland the most attractive and competent environment for experimentation and innovation. Among other things, according to this roadmap, a period of international mobility is to be included in all higher education degrees.[149]
- The Swedish government also plans to redefine the way in which internationalisation is described in the Higher Education Act, and to prepare a new strategy to be implemented between 2020 and 2030.[150] The development will be inspired by a new Strategic Agenda for the Internationalisation of Swedish Higher Education and Research, developed in 2018.[151]
- In Slovenia, the internationalisation of higher education has been guided by the Strategy for the Internationalisation of Slovenian Higher Education 2016–2020[152], and two respective Action Plans adopted by the government of the

[144] Department of Education and Skills (n.d.). *Ireland's National Skills Strategy 2025.* Retrieved from https://www.education.ie/en/Publications/Policy-Reports/pub_national_skills_strategy_2025.pdf
[145] Higher Education Authority (n.d.). *National Framework for Doctoral Education.* Retrieved from https://hea.ie/assets/uploads/2017/04/national_framework_for_doctoral_education_0.pdf
[146] Irish Government (2019). *Innovation 2020. Excellence Talent Impact.* Retrieved from https://enterprise.gov.ie/en/Publications/Publication-files/Innovation-2020.pdf
[147] Irish Government (2016). *Irish Educated Globally Connected. An International Education Strategy for Ireland.* Retrieved from https://www.education.ie/en/Publications/Policy-Reports/International-Education-Strategy-For-Ireland-2016-2020.pdf
[148] European Commission (2018). *European Research Area. Progress Report 2018. Country Profile Ireland*. Retrieved from https://ec.europa.eu/info/sites/info/files/research_and_innovation/era/era-2018_country_profile_ie.pdf
[149] Finish Ministry of Education (2020). *Solutions for a sustainable and developing society.* Retrieved from https://minedu.fi/documents/1410845/22508665/The+National+Roadmap+for+Research%2C+Development+and+Innovation/e9566011-2acc-35b2-7b45-279387991430/The+National+Roadmap+for+Research%2C+Development+and+Innovation.pdf
[150] European Commission (2020). *National Reforms in Higher Education.* Retrieved from https://eacea.ec.europa.eu/national-policies/eurydice/content/national-reforms-higher-education-71_en
[151] Swedish Government (2018). *Internationalisation of Swedish Higher Education and Research – A Strategic Agenda.* Retrieved from https://www.government.se/48fc30/contentassets/4df6aeabd2bd4f5dbbf69210f786e133/internationalisationagenda.pdf
[152] Centre of the Republic of Slovenia for Mobility and European Educational and Training Programmes and the Ministry of the Republic of Slovenia for Education, Science and Sport (2016).

Republic of Slovenia for the periods 2016-2018 and 2018-2020. The strategy regards international mobility as a means to open up the Slovenian higher education community and ensure the quality of scientific research and development.[153]

- Similarly, the Czech Republic has adopted a Strategy for the Internationalisation of Higher Education for the Period from 2021. The priorities of this strategy are as follows: i) developing competences directly relevant to life and practice in the 21st century among HE students and staff; ii) the internationalisation of HE study programmes; iii) Simplifying the process for recognising education from abroad; iv) creating an international environment at HEIs and promotion abroad; v) strengthening the strategic management of internationalisation; and vi) Internationalisation activities of the national accreditation bureau.[154]
- In 2017, Poland established a National Agency for Academic Exchange (NAWA). The agency offers both broader and narrow (sectoral) opportunities for international mobility at PhD stage:
    - The Iwanowska Programme[155] allows visits whose aim is to implement part of a doctoral degree programme (including part of an 'industrial PhD' programme); to conduct research or obtain material related for the preparation of a doctoral thesis; to carry out teaching activities at the host centre as a complement to the aforementioned objectives, etc. Mobilities under the programme may last between three and 12 months. The programme provides funding for the scholarships, which covers the scholarship holder's expenses related to his/her stay in a foreign hosting institution and the mobility allowance;
    - The Walczak Programme[156], meanwhile, supports international mobility of researchers in the fields of cardiology, oncology, allergology and infectious diseases. Doctoral students and persons working on their doctoral dissertation are offered visits lasting between three and 6 months, with destinations being the best medical institutions located in the United States. The programme provides funding for the scholarships, which covers the scholarship holder's living allowance for the scientist's stay in a foreign host institution, and a one-off mobility allowance.

Strategy for the internationalisation of Slovenian Higher Education 2016-2020. Retrieved from https://eng.cmepius.si/wp-content/uploads/2015/08/Strategija-internacionalizacije-slovenskega-visokega-solstva_ENG_2016%E2%80%932020_WEB.pdf

[153] Centre of the Republic of Slovenia for Mobility and European Educational and Training Programmes and the Ministry of the Republic of Slovenia for Education, Science and Sport (2016). *Action plan strategy for the internationalisation of Slovenian Higher Education 2016-2018. Collected objectives, measures, indicators, responsibilities with a time plan.* Retrieved from https://eng.cmepius.si/wp-content/uploads/2015/08/Akcijski-nacrt-2016-2018_ANG-WEB.pdf

[154] European Commission. *Czech Republic. National Reforms in Higher Education*. Retrieved from https://eacea.ec.europa.eu/national-policies/eurydice/content/national-reforms-higher-education-17_en

[155] Polish National Agency for Academic Exchange (2020). *The Iwanowska Programme.* Retrieved from https://nawa.gov.pl/en/scientists/the-iwanowska-programme

[156] Polish National Agency for Academic Exchange (2019). *Call for proposals.* Retrieved from https://nawa.gov.pl/en/scientists/the-walczak-programme/call-for-proposals

- The Research Council of Norway offers Overseas Research Grants[157;158] enabling researchers, including doctoral and post-doctoral research fellows, to conduct a research stay in another country. Funding for research stays abroad can be allocated as part of a larger Research Council-funded project, such as a Researcher Project, or in connection with specific funding schemes for research stays in other countries. Funding is ordinarily only provided for research stays abroad that last between three and 12 months.
- The Dutch Research Council (NWO) is implementing the Rubicon scheme[159] as part of its broader Talent Programme. The latter consists of three funding instruments (Veni, Vidi, Vici) tailored to various phases in researchers' scientific careers. Rubicon is open to postgraduates who are currently engaged in doctoral research, or who have been awarded a doctorate during the 12 months preceding the relevant deadline for applications. The scheme is open to all scientific disciplines for a research project at an excellent research institution outside the Netherlands for a period of 12-24 months.

All of these developments – especially those national policies aimed at tackling funding for internationalisation issues and the activities of national agencies, as identified by the EAIE Barometer[160] (see Figure 14) – are of utmost importance to the further internationalisation of higher education. It is safe to conclude that they also have a strong positive impact on international mobility at PhD stage, as the ability to obtain funding is among the key barriers to such mobility identified in our research.

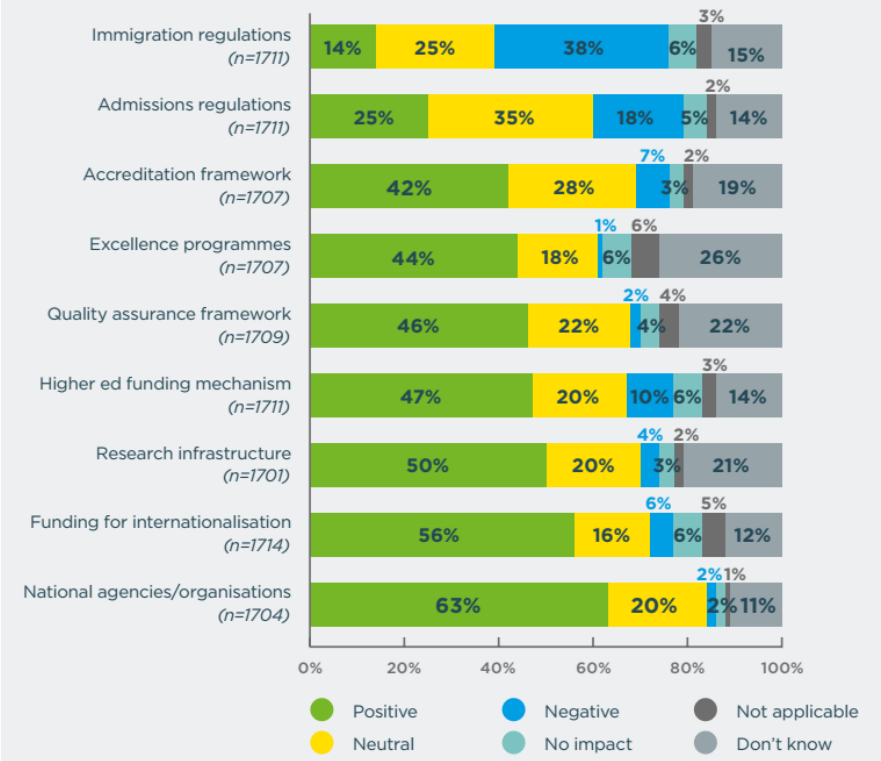
[157] The Research Council of Norway (2020). *Research Stays Abroad.* Retrieved from https://www.forskningsradet.no/en/apply-for-funding/funding-from-the-research-council/Personal-Overseas-Research-Grants/

[158] The Research Council of Norway (2019). *Funding for Research Stays Abroad for Doctoral and Postdoctoral Fellows.* Retrieved from https://www.forskningsradet.no/en/call-for-proposals/2019/personal-overseas-research-grant-for-doctoral-and-post-doctoral-fellows/

[159] Dutch Research Council (2020). *Rubicon*. Retrieved from https://www.nwo.nl/en/calls/rubicon-enw-2020-2-enw

[160] The data in this survey are based on a 2017 survey completed by 2,317 respondents from 1,292 unique institutions in 45 countries across the European Higher Education Area.

Figure 14: Impact of national policies on internationalisation at higher education institutions



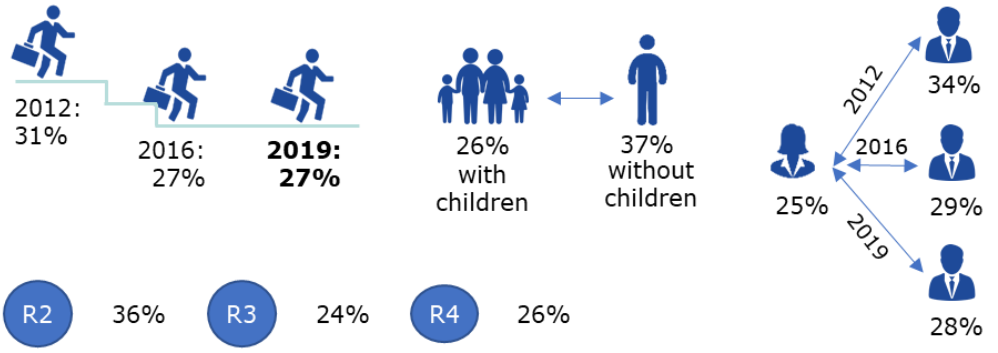
Source: EAIE Barometer (second edition).
https://www.eaie.org/our-resources/library/publication/Research-and-trends/eaie-barometer-second-edition.html

9. INTERNATIONAL MOBILITY AFTER PHD STAGE

International long-term mobility of researchers in post-PhD stage

Who moves?

27% of researchers currently working in the EU has been mobile in the last 10 years for more than 3 months



Humanities	Natural sciences	Social sciences	Engineering & Technology	Medical sciences	Agricultural sciences
31.0%	28%	30%	23%	22%	21%

Destinations

Highest share of mobile researchers in

1. Luxembourg (63%)
2. Switzerland (49%)
3. Austria (41%)
4. Denmark (35%)
5. Norway (34%)

Main destinations for EU researchers currently in EU

1. United States (16%)
2. Germany (10%)
3. United Kingdom (9%)
4. France (6%)
5. Italy (6%)

Main EU destinations for non-EU researchers currently outside the EU

- ✓ Germany
- ✓ France
- ✓ United Kingdom
- ✓ Spain

Main global destinations for EU researchers currently outside the EU

- ✓ United States
- ✓ Canada
- ✓ Australia
- ✓ New Zealand

Source: Based on MORE3 EU HE report (Section 8.1.1.1).

9.1. Key findings

9.1.1. Mobility profile

SHARE OF RESEARCHERS WITH >3 MONTH INTERNATIONAL MOBILITY EXPERIENCE DURING THE LAST 10 YEARS
(Of all R2, R3 and R4 researchers)

	EU total	By career stage	By FOS	By gender
2012 (n=7,131)	31.0%	R2: 30.1% R3: 31.5% R4: 31.1%	MED: 26.3% NAT: 34.4% SOC: 30.5%	F: 25.2% M: 34.2%
2016 (n=8,073)	27.4%	R2: 30.2% R3: 27.5% R4: 25.5%	MED: 19.5% NAT: 28.2% SOC: 30.3%	F: 25.1% M: 28.7%
2019 (n=7,653)	26.5%	R2: 36.3% R3: 23.6% R4: 26.3%	MED: 21.6% NAT: 25.9% SOC: 30.3%	F: 24.8% M: 27.5%

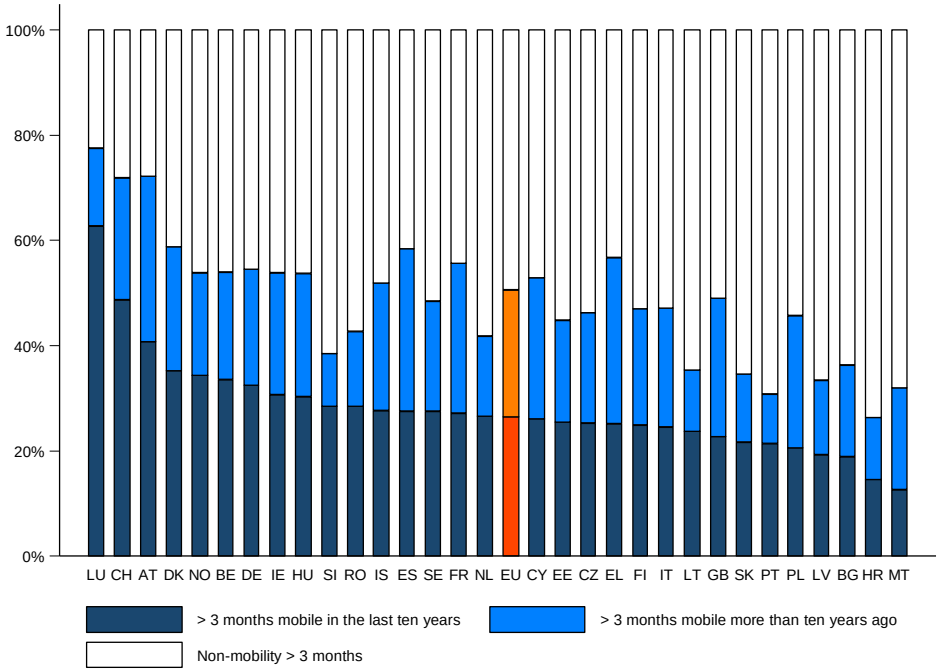
Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)

The results of the MORE4 EU HE Survey[161] indicate that the frequency and patterns (origin and destination) of international mobility during post-PhD career stages have remained stable.

A certain level of stability can also be observed across the three MORE studies at country level: over the last ten years, countries such as Luxembourg, Switzerland, Belgium and Austria have always had higher shares of mobile researchers than the EU-average. At the other end of the scale, a number of Eastern and Southern European countries show persistently low shares of mobile researchers, such as Poland, Malta, the Czech Republic, Latvia and Portugal. This is shown in detail in the figure below.

[161] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.

Figure 15: >3 month international mobility in post-PhD career stages, by country (2019)



Source: MORE4 EU HE survey (2019)

Note:

Only R2, R3 and R4 researchers.
Based on question 62: "After gaining your highest educational qualification (PhD or other), how would you typify your international mobility experience?"
(2019: n=8,300)

The results of the Global survey indicate that long-term international mobility is less common in 2020 than in 2017 (39% vs 50%), and hence converges towards the levels found in the EU survey.

SHARE OF RESEARCHERS CURRENTLY WORKING OUTSIDE EUROPE WITH >3 MONTH INTERNATIONAL MOBILITY EXPERIENCE (GLOBAL SURVEY)

	2017	2020
Less than 10 years ago	49.7%	39%
More than 10 years ago	12.2%	17.6%
Never	38.1%	43.4%

Source: MORE4 Global Survey (2020), MORE3 Global Survey (2017).

Comparison between the EU and Global surveys further indicates many similarities in terms of the attractiveness of the main destinations for researchers, both within and outside the EU. For the EU HE survey, the detailed results are given in Table 8. The top destinations are the United States and the larger European countries: Germany, United Kingdom, France and Italy. The same European countries are also often mentioned in the Global survey as popular destinations for non-EU researchers. Table 8 shows the main countries of origin of the researchers moving to the main destinations. This table shows that the larger European countries are not only important destinations; they also constitute the main countries of origin.

Table 8: Main destination countries for >3 month post-PhD mobility (EU28 citizens)

DESTINATION	2019 SHARE (%) (2016 SHARE)	MORE4 (2019) MAIN CITIZENSHIPS OF ORIGIN	MORE3 (2016) MAIN CITIZENSHIPS OF ORIGIN
United States	16% (16%)	Italy (11%) Germany (10%) Greece (9%)	Greece (9.6%) Germany (9.1%) Italy (8.9%)
Germany	10% (11%)	Italy (10%) Austria (8%) Croatia (6%) Slovakia (6%)	Spain (7.6%) Italy (7.3%) Poland (6.3%)
United Kingdom	9% (11%)	Italy (16%) Greece (10%) Spain (10%) Germany (6%)	Greece (14.8%) Germany (10.3%) Italy (6.1%)
France	6% (7%)	Italy (17%) Spain (11%) Romania (9%)	Italy (13.4%) Germany (7.5%)
Italy	6% (5%)	Romania (15%) Greece (12%) France (6%) Croatia (6%)	Spain (12.8%) Italy (11.3%) Greece (10.6%)
Sweden	3% (3%)	Italy (14%) Finland (11%) Germany (10%)	Finland (19.5%) Estonia (12.6%) Germany (10.3%)
Austria	3% (3%)	Germany (15%) Italy (15%) Slovenia (10%) Slovakia (7%)	Germany (21.5%) Italy (17.7%) Austria (7.6%) Hungary (7.6%)
Spain	3% (3%)	Italy (14%) Portugal (12%) Romania (11%)	Italy (16.7%) Portugal (11.1%) Greece (8.9%) Belgium (8.9%)

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016)
Reading note: of the total number of moves by researchers who currently work in the EU but who were mobile to the US for more than three months during post-doctoral career stages, 11% were made by Italian citizens, 10% by German citizens and 9% by Greek citizens. When the move is made to the same country as the country of citizenship (e.g. moves to France made by French citizens) it is not reflected in the table.
Notes:

Only R2, R3 and R4 researchers.
Based on question 64: "Please indicate the 3 most recent international steps/moves in the last ten years of your research career after your PhD up to (but excluding) your current position in which you are employed."
(2019: n=3,120) ((2016: n=3,249)

9.1.2. Motives and barriers

Motives: comparison over time and between MORE surveys indicates that the motives for and barriers to mobility are very stable. The general motives tend to be the same: international networking, career progression, research autonomy and working with leading scientists. These motives were found in the EU HE survey and in the Global survey using two different types of analysis. First, we analysed the motives indicated for each researcher's most recent mobility experience; second, we analysed the one main motive for each individual move by the researcher. The same patterns were found in the Global survey, where the main motive for each individual move was analysed. Table 9 shows an

overview of the main motives for mobility indicated by respondents to the EU HE and the Global surveys[162].

Table 9: Main motives for mobility (2019)

SURVEY	MOTIVES INDICATED FOR THE LAST MOBILITY EXPERIENCE OF THE RESEARCHERS (EU MOVE)	MAIN MOTIVE FOR EACH INDIVIDUAL MOVE
EU HE survey	International networking (87%) Research autonomy (85%) Working with leading scientists (83%) Career progression (81%)	Career progression (24%) Working with leading scientists (20%) Research autonomy (16%)
GLOBAL SURVEY	For EU researchers to move outside Europe: Availability of a suitable position (85%) Career progression (80%) For non-EU researchers to move to Europe: International networking (97%) Working with leading scientists (96%)	Working with leading scientists (23%) Career progression (12%) International networking (12%)

Source: MORE4 EU HE survey (2019), MORE4 Global survey (2020).

Barriers: while funding and positions are less important as motives for international mobility, a lack thereof constitutes the main barriers to international mobility. Table 10 presents the most frequently cited barriers to mobility indicated by researchers in the EU HE and Global surveys. Researchers currently working in Europe (the EU HE survey) are more likely to indicate a lack of funding for mobility and research, and a lack of available positions as the main barriers. These are also the main barriers indicated by EU researchers working outside Europe (the Global survey). Non-EU researchers working outside Europe appear to perceive barriers differently: other, more 'administrative' factors tend to play a larger role for this group, such as difficulties in obtaining a visa or work permit, the transfer of pensions, or access to social security entitlements.

Table 10: Main barriers to mobility (2019)

SURVEY	TARGET GROUP	MAIN BARRIERS
EU HE survey	For non-EU researchers moving to EU	Other personal/family reason (30%) Obtaining funding for research (29%) Finding adequate accommodation (26%)

[162] Respondents had the option to indicate other motives: access to research facilities and equipment; availability of research funding; quality of training and education; availability of suitable positions; culture and/or language; balance between teaching and research time; remuneration; personal/family reasons; social security and other benefits; pension plan; job security; and working conditions.

SURVEY	TARGET GROUP	MAIN BARRIERS
	EU and non-EU researchers (last EU move)	Obtaining funding for mobility (57%) Obtaining funding for research (55%) Finding a suitable position (53%)
	Non mobile researchers	Other personal/family reason (79%) Logistical problems (61%) Obtaining funding for research (61%)
Global survey	For EU researchers working outside Europe and wanting to return to Europe	Finding a suitable position (84%) Obtaining funding for research (77%) Obtaining funding for mobility (72%)
	For non-EU researchers having been Europe before and wanting to come back to Europe	Logistical problems (36%) Obtaining funding for mobility (35%) Obtaining a visa or work permit (34%)
	For mobile non-EU researchers working outside Europe and not having been in Europe before	Obtaining research funding (72%) Transfer of pensions (72%) Social security entitlements (70%)

Source: MORE4 EU HE survey (2019), MORE4 Global survey (2020).

Forced/escape mobility: the MORE3 and MORE4 surveys enquired about the degree of freedom researchers had in their decisions to be mobile. These surveys distinguish between escape (forced), expected (chosen) and exchange (chosen) mobility:

- **Escape mobility** occurs when a researcher is 'pushed' away from his or her environment due to a lack of funding, positions, for political reasons, etc. Escape mobility means that researchers are mobile because they need to be so if they wish to pursue a career as a researcher.
- The term **expected mobility** is used for those cases where mobility is perceived as a 'natural' step in a research career, but researchers do not feel obliged to move.
- Finally, **exchange mobility** refers to those situations in which a researcher chooses to move (positive motivation, self-chosen) with the aim of exchanging knowledge and work in an international network, or with the aim of using international experience as a way to boost his or her career.

Mobility is above all driven by the interest of researchers in strengthening their networks and engaging in knowledge exchange – both for researchers working in Europe and, to a lesser extent, those working outside Europe. It can be seen that those cases in which researchers indicate they were forced to be mobile due to a lack of alternatives in their home country are much higher among researchers currently working outside Europe.

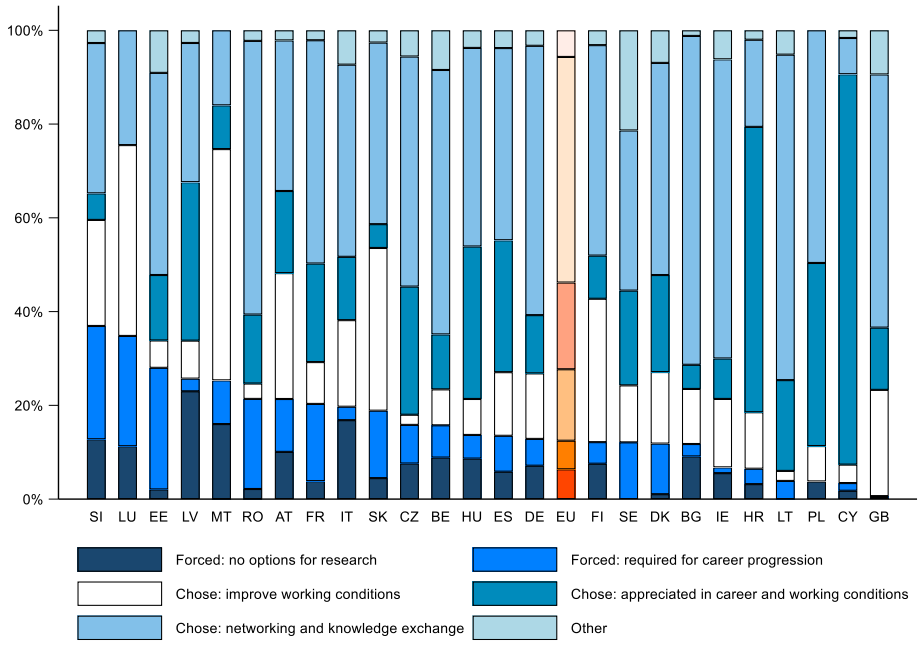
Figure 16 below provides an overview of escape mobility (versus expected and exchange mobility) by country of citizenship in the EU HE survey, considering all destinations (both EU and non-EU moves). Some changes have occurred since the MORE3 EU survey: in 2016, the highest shares of forced mobility among researchers who have been mobile for more than 3 months were found among citizens of Ireland and Bulgaria, with shares significantly above the EU average (48% and 37%, respectively). In 2019, the levels of forced mobility are higher in Slovenia, Luxembourg, Estonia and Latvia. Some aspects have changed less over time: Italy is still one of the countries with a higher level of forced mobility linked to the absence of other options to develop a career in academia. The level of forced mobility in the United Kingdom, on the other hand, remains negligible.

Table 11: Escape, expected and exchange mobility (EU28)

		EU SURVEY		GLOBAL SURVEY (DECISIONS TO MOVE/WORK OUTSIDE EUROPE)	
		2016	2019	2017	2020
Escape	*Forced: No options for research*	9.1%	6.0%	22.4%	18.0%
	Forced: Required for career progression	7.0%	6.4%	5.6%	5.0%
Expected	*Chosen: Improve working conditions*	15.3%	15.6%	12.6%	14.1%
	Chosen: Appreciated in career and working conditions	16.8%	17.8%	12.4%	13.1%
Exchange	*Chosen: Networking and knowledge exchange*	43.7%	46.8%	32.6%	35.7%
Other		8.0%	7.5%	14.5%	14.1%

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016), MORE4 Global Survey (2020), MORE3 Global Survey (2017).

Figure 16: Escape, expected and exchange mobility, by country of citizenship (EU28) (2019)



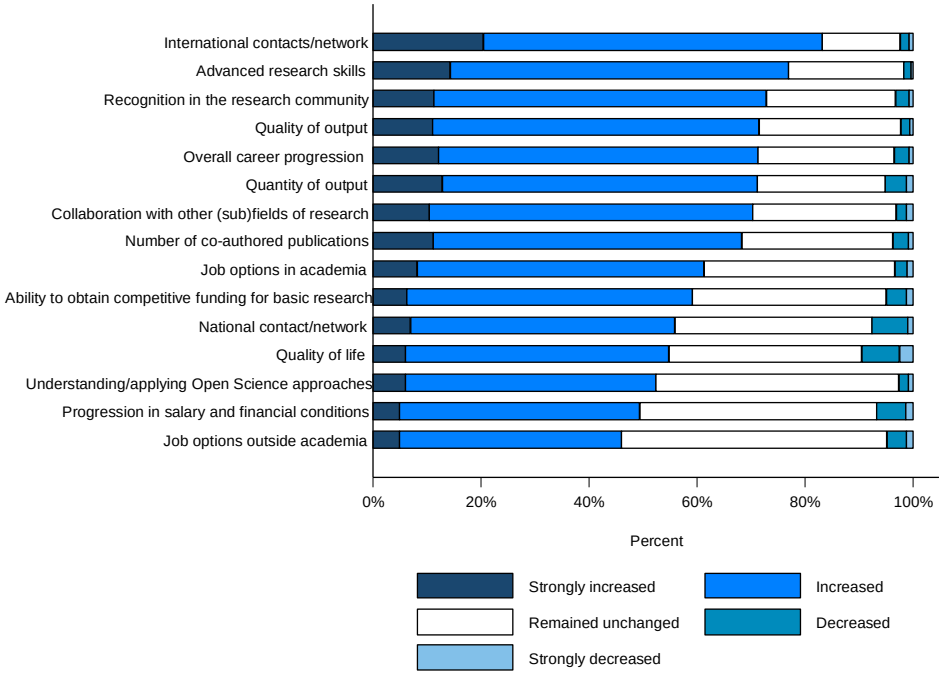
Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Notes: Only R2, R3 and R4 researchers who were >3 month mobile in the last 10 years. Share of researchers who have been >3 month mobile in post-PhD career and who experienced a specific degree of freedom in their decision to become mobile.

9.1.3. Effects of mobility

International mobility is perceived by researchers as having a positive effect on a wide range of dimensions. On the one hand, mobility is perceived as having a strong impact on researchers´ international contacts and networks, as well as on the acquisition of advanced research skills and researchers´ recognition within the research community. On the other hand, job options outside academia, salary and financial conditions, quality of life, and the degree to which researchers apply Open Science approaches receive lower scores. The MORE3 survey produced very similar results to those displayed here (except for the item on Open Science, which has been included for the first time in MORE4). The patterns are

also stable over time when we compare the effects of mobility experiences that took place 10 years ago, five years ago and at the current time. Comparison with the results of MORE2 and MORE3 confirms this finding.

Figure 17: Overall effects of mobility experience on research career (EU28)



Source: MORE4EU HE survey (2019)

Notes: Only R2, R3 and R4 researchers who were >3 month mobile in the last 10 years. Share of mobile researchers who indicated the effect of the entire mobility experience on a specific aspect of their career to be a (strong) increase, (strong) decrease or unchanged.

As with motives and barriers, we find strong agreement on the effects of mobility across different analyses. In all types of analysis, regardless of origin or destination, we find that international networking, collaboration and career progression are the main positive effects of international mobility. The main effects thus correspond to researchers' main motives for becoming mobile. Remuneration was not one of these main motives, and we similarly find that an increase in salary is not a common (immediate) effect of mobility. We find:

- EU HE survey (see Figure 17): mobility is perceived as having increased or strongly increased researchers´ international contacts and networks, as well as their advanced research skills and their recognition within the research community. On the other hand, researchers tend to have less positive views on the effects of mobility on access to job options outside academia, the progression of salary and financial conditions, or their understanding/application of Open Science approaches.
- Global survey, EU researchers working outside Europe: the largest positive effects of mobility are observed in terms of gaining an international network (72%), overall career progression (65%) and gaining recognition within the research community (62%). This is consistent with the findings on the motives for mobility.
- Global survey, non-EU researchers who have worked in the EU in the past: international mobility is considered to have a larger effect on: international network effects (92%), research skills (83%) and collaboration with other

sub(fields) of research (80%). These results are also consistent with those obtained in the 2017 Global Survey.

9.2. EU policy aims and implications of MORE4 findings

International mobility is generally considered a key dimension of international knowledge exchange and circulation. This type of mobility is considered to have positive effects both at system level and at the level of individual researchers. At system level, international mobility helps to create a sufficiently large pool of researchers to develop innovative research, while at individual level it has an impact on career progression, collaboration, and scientific productivity[163]. In parallel with the development of scientific works on the importance and effects of international mobility, there has been an increase in the policy attention paid to international mobility at regional and country level.

In relation to the system perspective in the literature, the ERA aims to create a critical mass of excellent researchers. The third ERA Priority[164] sets the goal of an open labour market for researchers (facilitating mobility, supporting training and ensuring attractive careers). A central aspect of this also relates to the fifth ERA priority: optimal exchange and circulation of knowledge, which aims to valorise collaboration and mobility, as well as optimising knowledge exchange without borders.

By strengthening the ERA through the 2020 Communication[165], the European Commission reinforces its commitment to fostering the international dimension in research. The main policy goals for the international mobility of researchers can thus be identified as:

- **Quantity of researchers**: research careers need to be attractive in order to draw in new talented researchers and retain them within the research profession at later career stages. Options for international mobility are one aspect of this.
- **Research excellence**: researchers will be drawn to the most attractive research environments. This relates to the second strategic objective of the 2020 ERA Communication: "Improve access to excellent facilities and infrastructures for researchers across the EU"; and the fourth objective: "Strengthen mobility of researchers and free flow of knowledge and technology"[166]. Mobility thus encourages the development of competitive research environments and international networks, which are positive for scientific productivity and excellence. This also relates to the point made in Sections 6 and 7 that career paths and working conditions in the EU must be attractive enough in the context of worldwide competition to entice the most talented researchers[167], ensuring brain circulation rather than brain drain.

[163] Fernández-Zubieta, A. & Guy, K. (2010). Developing the European Research Area: Improving knowledge flows via researcher mobility. JRC Scientific and Technical Report, JRC-IPTS, p.12.
[164] European Commission. *Open Labour Market for Researchers.* Retrieved from http://ec.europa.eu/research/era/open-labour-market-for-researchers_en.htm
[165] European Commission (2020). *Communication. A New ERA for Research and Innovation.*
[166] Ibid.
[167] Hunter, R.S., Oswald, A.J. & Charlton, B.G. 'The Elite Brain Drain*'. *The Economic Journal* 119, no. 538 (2009): F231–F251.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on mobility?

Analysis of the motives, barriers and effects relating to international mobility identified in MORE4 confirm the findings of previous MORE studies. This analysis clearly shows a distinction between those factors that drive researchers to engage in mobility, and those that remove barriers, thus enabling more researchers to engage in mobility. The former are factors mainly relating to scientific knowledge production (career progression, international networking, working with leading scientists) that point to the importance to researchers of research excellence. The latter factors – those removing barriers – are more practical in nature, relating strongly to the family situation of researchers and/or to preconditions for mobility such as research funding and the availability of a suitable position. These findings are in line with the literature: researchers move to improve their career, and stay or return for more personal reasons, or due to a lack of funding or position. I**mproving scientific knowledge production factors** hence creates motives or incentives to move countries in the first place – they are drivers of mobility and indicators of the attractiveness of a research system. Reducing barriers to mobility by increasing research funding and available positions, acts as an enabler of mobility[168].

In terms of mobility flows, the MORE4 EU HE and Global surveys show that the same countries continue to be the most popular destinations for researchers. This finding indicates **heterogeneity** among the countries of the EU in terms of research capacity and systems, leading to asymmetrical mobility flows. Policy actions will thus need to address both drivers and enablers, but with sufficient attention to the difference between countries.

Specific analysis from the Global survey on motives, barriers and effects in relation to the mobility of non-EU researchers who have worked in Europe and of European researchers working outside Europe, will be discussed in Section 13, to assess the attractiveness and policy implications for Europe as a research area. However, at this point the analysis of international mobility already emphasises the positive network effects of global exchanges: non-European researchers maintain a strong network in Europe and often continue their cooperation with European partners after their stay in Europe (see the MORE4 Global survey[169]). The most important effects of a current stay in Europe by non-EU researchers (as identified in the MORE4 EU HE survey) are indeed gaining an international network and recognition within the research community. Research funding and career progression are also indicated by researchers as positive effects of mobility to the EU. On a positive note, the ERA Progress Report 2018 already observed an increased number of co-publications with non-ERA partners.

It will thus be important to maximise the positive effects of international mobility and exchange, e.g. by addressing policy actions towards those factors that determine Europe's attractiveness to non-EU researchers or in relation to return mobility. The aim of this would be to make the ERA an attractive region for researchers from outside Europe, and to

[168] Note that research funding also affects scientific knowledge production; it is, however, not a main motive for becoming mobile.
[169] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.

encourage collaboration between EU and non-EU researchers (knowledge exchange) – in line with both the third and the sixth ERA priorities.

EU-level and national policy instruments

A central aspect of the ERA and its third priority is the optimal exchange and circulation of knowledge, with the aim of valorising collaboration and mobility and optimising knowledge exchange among the countries of the ERA. The Commission put forth a series of initiatives to achieve this goal by promoting transparent, open and merit-based recruitment as a way to remove barriers to international mobility. Examples of these actions are[170]:

- Strengthening the EURAXESS network so that it becomes an efficient provider of support for researchers, with EURAXESS services covering social security issues in different aspects of their functioning;
- Setting up a European Accreditation Mechanism for the development of human resources management in research institutions, in alignment with the European Charter of Researchers and the Code of Conduct;
- Supporting greater automatic recognition of comparable degrees within the ERA;
- Addressing social security barriers to researchers in the EU, and facilitating the entry and stay of third-country national researchers (pension portability, supplementary pension rights and funds).

The commitment in the 2012 ERA Communication to supporting employers in ensuring that pensions do not represent an obstacle to researchers' mobility was followed by the establishment of a Retirement Savings Vehicle for European Research Institutions (RESAVER). RESAVER incorporates a pan-European supplementary pension fund for researchers, ensuring the portability of this supplementary pension between countries and positions.

The 2020 ERA Communication[171] also announces several measures to support the international mobility of researchers, such as a toolbox of support for researchers' careers that will provide them with information on their skills, learning, careers and opportunities. Another supporting measure is the broadening of EURAXESS services, network and portals into an ERA Talent Platform. This platform will be an online 'one-stop shop' that will take advantage of links to Europass, the EU platform for people to manage their learning and careers, and the EURES network of European public employment services[172].

In addition, the dimension of international mobility is embedded into several funding schemes at EU level. These include the Marie Skłodowska Curie Actions (MSCA)[173]. These actions are rooted in the "Excellence" Pillar of the Horizon 2020 Programme, and provide funding opportunities for mobility, training and career development at all stages of a researcher's career. Funding is allocated with the objective of "permitting researchers to

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[170] European Commission. *Open Labour Market for Researchers*. Retrieved from http://ec.europa.eu/research/era/open-labour-market-for-researchers_en.html
[171] European Commission (2020). *Communication. A New ERA for Research and Innovation.*
[172] Ibid.
[173] European Commission. *Marie Sklodowska-Curie actions.* Retrieved from http://ec.europa.eu/programmes/horizon2020/en/h2020-section/marie-sk%C5%82odowska-curie-actions

cooperate freely across borders and at enabling undertakings to exploit the internal market potential to the full"[174]. Partial evidence of the success of the actions in this context is provided by the data from the MORE4 EU HE survey (see Section 15.4).

European Research Council (ERC) grants are also designed to promote the development of the ERA as an open labour market. These grants are allocated to individual researchers, who can then decide where they want to carry out their research – i.e. in which country and at which university (the "money follows researcher" principle). ERC grants do not require international mobility, but they aim to facilitate it from two angles: they allow individual mobility through portability of funding (i.e. they enable mobility); and they provide incentives for more attractive working conditions for researchers (i.e. they drive mobility). More information about ERC grants, based on the results of the MORE4 EU HE survey, can be found in Section 15.4.

A balance between removing barriers and improving the conditions that drive the mobility of researchers will be essential both to attract mobile researchers and to enable them to undertake this step to or within Europe. Given that some of the most important drivers of inward mobility are those relating to scientific excellence, policy attempts which focus on administrative factors (e.g. visa procedures), human resource practices (e.g. Charter and Code) or even social security and pension, will only address part of the problem. As stated by the Joint Research Centre in a report on international mobility[175], differences between countries will persist as long as excellence in research is fragmented and dispersed. By contributing to research excellence in the Member States and harmonising existing best practices, the EU will not only foster 'internal' international circulation, but also strengthen the attractiveness of the ERA outside Europe. Thus, the policy aim could be to optimise circulation and international mobility by reducing barriers (enabling mobility) and improving the factors driving mobility, thereby both encouraging knowledge circulation within Europe and attracting researchers from outside Europe.

In addition to removing barriers in order to enable mobility, and funding schemes that support and encourage mobility, a number of other measures can be considered to drive mobility and thus increase its effects. The effects of mobility can also be further optimised by encouraging instruments that allow researchers to return voluntarily to their home country, maintaining the network they have gained from their mobility experience and benefitting from the knowledge exchange this entails. The MORE4 Global survey indicated that interest in return mobility (during the next year) is low among later-stage researchers. This is probably explained by the fact that later-stage researchers are more settled and established in their current positions and therefore less inclined to look for a change in positions. In order to be effective, it is important that these types of actions run in parallel with actions to improve the attractiveness of research conditions in the home country.

[174] Journal of the European Union (2012). 2012. Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12012E%2FTXT

[175] Fernández-Zubieta, A. & Guy, K. (2010). Developing the European Research Area: Improving knowledge flows via researcher mobility. JRC Scientific and Technical Report, JRC-IPTS.

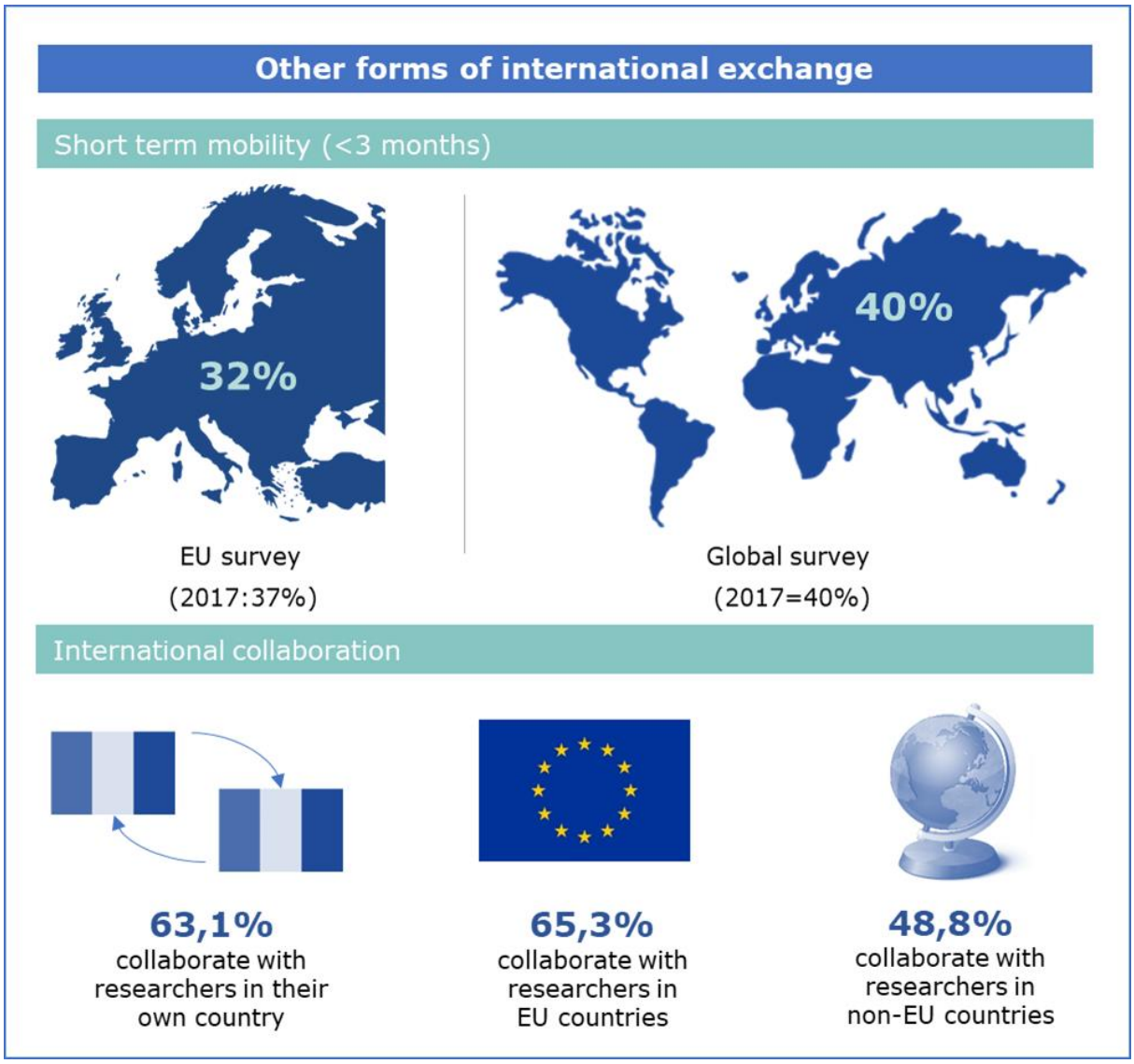
ERA progress 2018 has revealed that over recent years, multiple initiatives have been implemented **at national level** with the aim of supporting and improving the international mobility of researchers. Some of the key areas for action included the improvement and relaxation of migration rules for researchers, as well as additional funding opportunities for mobile researchers:

- According to the ERA progress report 2018, Austria's NAP under Priority 3 aimed to create a welcoming culture for researchers. Some progress was achieved by further developing the Red-White-Red card, which is expected to attract more top-level researchers.
- A number of actions were taken in Belgium concerning progress under the 4th priority (open labour market for researchers). In 2015, a guide for mobile researchers coming to Belgium was published on the Belgian EURAXESS portal, and dealt with more practical and administrative mobility issues. It contained information for mobile researchers on visas and residence permits, social security, taxes and bringing along family members. In addition, several events were organised in Belgium with the aim of fully informing newcomers (research institutions and funders) about the principles of the Charter and Code and their implementation in research institutions via the Human Resources Strategy for Researchers (HRS4R). Moreover, several publications and information events about EURAXESS were organised for researchers in Belgium. All of these measures, aimed opening up the Belgian labour market to foreign researchers, were planned in the Belgian national ERA roadmap.
- As part of international cooperation in education and foreign science policy, Switzerland has been awarding government excellence scholarships to foreign scholars and artists. These one-year scholarships are intended to promote international exchange and research cooperation between Switzerland and over 180 countries.
- According to the Denmark National Report under the ERA Progress report 2018, in recent years, universities have dedicated a great deal of attention to attracting foreign researchers by establishing special support services such as assistance with visas, residence and work permits, and free events that provide general information on moving to Denmark. Moreover, while Danish universities are obliged to publicly advertise all vacant positions, those at associate professor and professor levels must be advertised internationally. The National Report under the ERA 2018 progress report also indicates that RPOs in Denmark have increased their HR efforts to attract more researchers from abroad. Denmark has also been successful in Marie Skłodowska-Curie Actions, which strongly supports the recruitment of foreign researchers in Denmark while also stimulating outgoing mobility.
- In Estonia, the government has aimed to increase the mobility of (incoming) researchers by relaxing migration rules for innovative start-up companies, to ensure a smart and flexible talent management and migration policy. As a result, in 2017, the government created a list of 339 start-up companies that can hire foreign workers according to less stringent criteria. In addition, Estonia has bilateral cooperation agreements with some third countries, including China, Brazil, Canada, India, Indonesia, South Korea, Philippines, Mexico, Russia, the US and Thailand. In accordance with these agreements, Estonia offers scholarships and mobility grants to students and researchers from some of these countries.
- In France, the legal environment has been made more favourable. Recruitment procedures in French PROs have become more open to foreign researchers. Moreover, the Law of 7 March 2016 created a multiannual card called the

"passeport talent", for researchers and doctoral candidates. This four-year visa is proposed to scientists from their first year in France.

- Croatia also took action to encourage international cooperation by supporting researcher mobility. More specifically, Croatia adopted the Action Plan for Researchers' Mobility for the period 2017-2020. The main objective of the Plan is to strengthen human resources in science, encouraging mobility and international cooperation among Croatian scientists. It also seeks to improve working conditions for Croatian and foreign researchers. Since 2013, Croatia has also included international mobility as a criterion for evaluating the performance of public RPOs.
- According to the ERA progress report 2018, in Hungary, different programmes and initiatives have recently been implemented to overcome the issue of a deficit of high-skilled professionals in the field of Science and Technology (S&T). One of these initiatives was the Momentum programme, managed by the Hungarian Academy of Sciences, which aims to encourage outstanding Hungarian researchers working abroad to return to work in Hungary.
- In 2017, Poland established the National Agency for Academic Exchange (NAWA): this is the governmental agency that deals with academic exchanges. It manages various programmes and actions aimed at stimulating such exchanges. The new agency will offer inbound and outbound mobility scholarships, and introduce measures to stimulate international cooperation among Polish scientists.

10. OTHER FORMS OF INTERNATIONAL EXCHANGE



Source: Based on MORE4 EU HE report (Section 8.1.2 and 8.1.3), MORE4 Global Survey report (Section 6.1.2).

10.1. Key findings

First, the MORE4 findings show that three out of 10 researchers have engaged in short-term mobility during the last 10 years, confirming a declining trend since 2012. Second, conferences are the most frequent reason for this type of short-term mobility. Third, long-term mobile researchers are more likely to undertake short-term mobility. This suggests that some researchers are more "mobile" than others. Lastly, 'virtual mobility' is increasingly perceived as having had an impact on reducing short-term mobility.

10.1.1. Short-term mobility

SHARE OF RESEARCHERS WITH <3 MONTH INTERNATIONAL MOBILITY EXPERIENCE IN THE LAST 10 YEARS
(of all R2, R3 and R4 researchers)

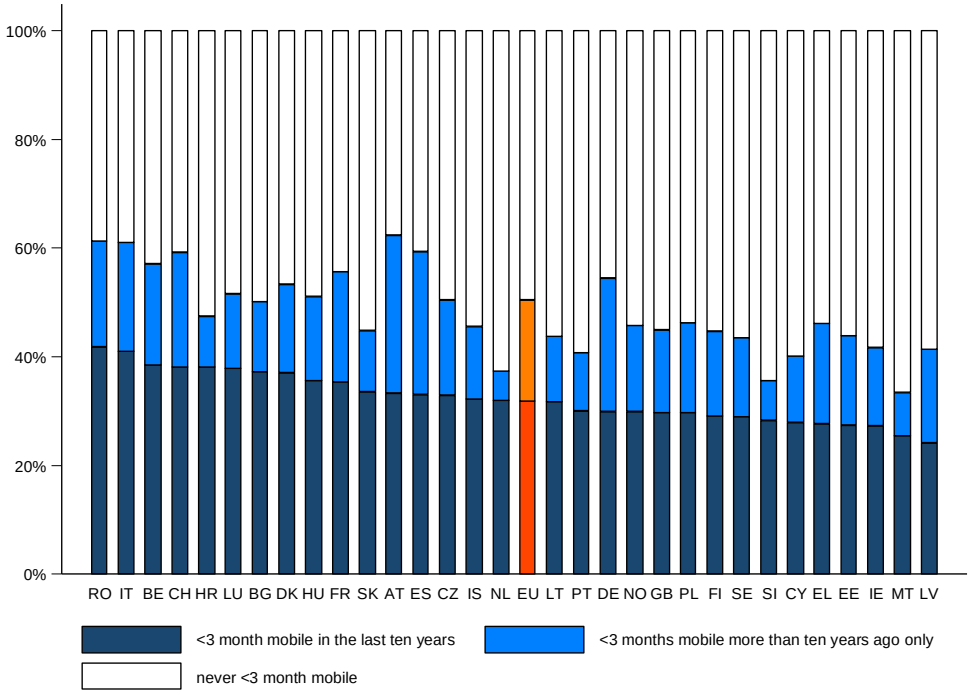
	EU TOTAL	BY CAREER STAGE	BY FOS	BY GENDER
2012 (n=7,131)	41.0%	R2: 35.8% R3: 41.0% R4: 45.1%	MED: 36.5% NAT: 42.3% SOC: 41.0%	F: 37.0% M: 43.3%
2016 (n=8,073)	37.2%	R2: 31.0% R3: 37.8% R4: 40.1%	MED: 34.9% NAT: 37.8 % SOC: 37.4%	F: 35.1% M: 38.4%
2019 (n=7,653)	31.8%	R2: 30.3% R3: 29.8% R4: 35.5%	MED: 25.4% NAT: 30.9% SOC: 37.1%	F: 31.9% M: 31.8%

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)
Note: Based on question 77: "Short term mobility (<3 months)"

The share of researchers who have had short-term mobility experiences in the last 10 years shows a downward trend since 2012, declining from 41% to 32% in 2019. Among researchers currently working outside Europe, this indicator shows greater stability. In both 2017 and 2020, 40% of researchers currently working outside the EU had worked abroad for less than three months at least once in the preceding 10 years. The MORE4 surveys confirm a finding also observed in MORE3: long- and short-term mobility are interrelated, and researchers fall into two main groups: mobile and non-mobile researchers. The former are more prone to engage in all types of international mobility, while the latter are less likely to move. However, the effects of long- and short-term mobility are not the same, and have changed over time. In MORE3, researchers who had been long-term mobile (i.e. for more than three months) during the preceding ten years, tended to attribute collaboration to mobility to a greater extent than those who had been short-term mobile (<3 months), or those who had never been mobile. In MORE4, however, the findings are reversed: on average, individuals who have been short-term mobile within the last three years tend to link collaboration to previous mobility experiences more strongly than those with a long-term mobility experience in the last ten years. This occurs for all types of collaboration: collaboration that takes place within the same country, with researchers located in the EU, and in non-EU countries.

It is important to note that the stability of this indicator over time at EU level conceals important variations at country level. As in MORE3, the analysis of short-term mobility by country shows that most countries are situated around the EU average of 32% (see Figure 18). In Latvia (24%), Malta (26%) and Ireland (27%), for instance, a smaller share of researchers have engaged in this type of mobility during the last 10 years, relative to the share seen in countries such as Romania (42%), Italy (41%), Belgium (39%), Switzerland (38%), Croatia (38%) and Luxembourg (38%). Compared with the MORE3 results, it can be seen that some countries have experienced a large variation over time: Romania and Luxembourg have gone from being among the countries with a lower level of short-term mobility in 2016 (22% and 29%, respectively) to being among the countries with the highest levels in 2019.

Figure 18: <3 month international mobility at post-PhD career stage in the last 10 years, by country (2019)

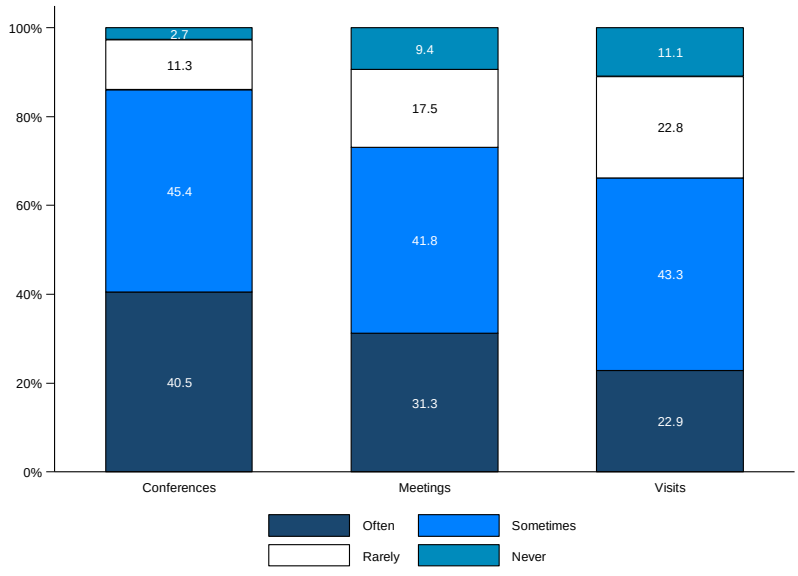


Source: MORE4 EU HE survey (2019)

10.1.2. Short travel for conferences, meetings and visits

A further finding, consistent with the results of previous MORE studies, is that conferences stand out as the most frequent type of short-term international travel reported in the MORE surveys. Conferences (97.3%) are followed by meetings with supervisors, partners or collaborators (90.6%) and study visits, research visits or fieldwork (88.9%) (see Figure 19).

Figure 19: Participation in conferences, visits and meetings, by frequency (EU28)



Source: MORE4 EU HE survey (2019)
Notes: Only R2, R3 and R4 researchers.

10.1.3. International collaboration

INTERNATIONAL COLLABORATION					
	Year	**EU28 total**	**By (current) career stage**	**By FOS**	**By gender**
Researchers in your country	**2016**	62.9%	R1: 51.2% R2: 54.4% R3: 63.1% R4: 73.7%	NAT: 67.0% ENG: 64.1% MED: 61.9% AGR: 61.3% SOC: 60.6% HUM: 60.4%	F: 62.2% M: 63.4%
	2019	63.1%	R1: 43.8 R2: 45.9 R3: 67.7 R4: 70.4	NAT: 64.5% ENG: 56.9% MED: 62.6% AGR: 65.7% SOC: 62.8% HUM: 69.3%	F: 62.4% M: 63.5%
Researchers in EU countries	**2016**	63.2%	R1: 39.5% R2: 48.3% R3: 67.7% R4: 78.2%	NAT: 70.0% ENG: 65.1% MED: 56.0% AGR: 60.0% SOC: 60.9% HUM: 65.3%	F: 60.1% M: 65.2%
	2019	65.3%	R1: 41.3 R2: 41.1 R3: 68.8 R4: 78.9	NAT: 69.0% ENG: 64.0% MED: 60.8% AGR: 65.6% SOC: 63.2% HUM: 70.8%	F: 63.1% M: 66.7%
Researchers in non-EU countries	**2016**	45.9%	R1: 22.9% R2: 31.0% R3: 47.1% R4: 64.8%	NAT: 56.6% ENG: 43.1% MED: 40.4% AGR: 47.2% SOC: 42.7% HUM: 44.4%	F: 40.5% M: 49.3%
	2019	48.8%	R1: 24.6 R2: 25.8 R3: 51.4 R4: 63.6	NAT: 53.2% ENG: 45.7% MED: 46.1% AGR: 46.4% SOC: 46.6% HUM: 54.5%	F: 43.9% M: 52.1%

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Notes: Multiple collaboration types per respondent are possible.

Patterns of international collaboration have also remained stable over time: 65% of EU HE researchers collaborated with other EU researchers in 2019 compared to 63% in 2016; in 2019, 49% collaborated with non-EU researchers (46% in 2016). Patterns observed in MORE3 at the level of individual researchers have also been confirmed in the MORE4 surveys: international collaboration is more frequent among researchers in later career stages, among those working in the Natural Sciences, and among male researchers.

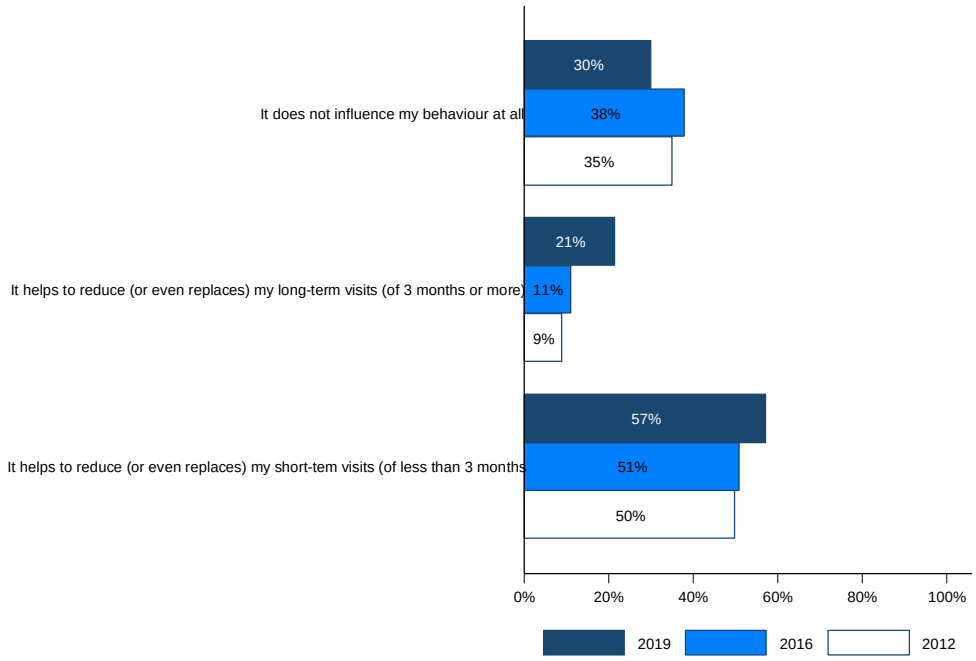
However, considerable heterogeneity exists between countries with regard to these types of collaboration: the shares of those engaging in national collaboration range from 22% in Luxembourg and Romania, to more than 80% in Italy or Iceland. In particular, the Nordic countries stand out as having higher levels of collaboration with researchers located in other EU countries. A completely different situation can be seen in Luxembourg (41%), Switzerland (43%) and in some large countries such as Germany (47%) or Spain (55%), where the shares are much lower. Collaboration with researchers located in non-EU countries is the least frequent option in general, and is even smaller in some Eastern European countries, such as Slovakia, Poland or Bulgaria (34%). Germany and Spain also stand out for having lower-then-average levels of this type of collaboration, at 29% and 39% respectively. The United Kingdom, Sweden and Iceland are the countries with a higher share of researchers collaborating with counterparts in non-EU countries: more than half

of researchers in these countries indicated that they have been involved in this type of collaboration.

10.1.4. International virtual mobility

The survey included questions on the effects of 'virtual mobility' on long- and short-term international mobility. The findings indicate that virtual mobility has had a great impact on reducing short-term mobility (57%) and that this share has increased over time since 2012 (50%). The same increasing trend is observed when looking at the effect virtual mobility has had on reducing long-term visits: the share of researchers indicating that virtual mobility has reduced long-term visits has increased from 9% in 2012 to 21% in 2019.

Figure 20: Influence of web-based or virtual technology on international behaviour and decisions (EU28)



Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)
Notes: Only respondents who collaborate with international partners.

10.2. EU policy aims and implications of MORE4 findings

The ERA has always paid strong attention to fostering knowledge circulation among the EU Member States. This can be achieved by promoting researchers´ international and intersectoral mobility (Sections 9 and 12). One of the main effects associated with these types of mobility is an increase in collaboration with other researchers and other sectors. This chapter has also focused on other forms of mobility – short-term and virtual – that can also have an impact on the degree to which researchers collaborate, and knowledge is exchanged. The MORE4 survey indicates that levels of collaboration have remained stable since 2016. Collaboration with researchers located in other EU countries is reported by the same share of researchers as collaboration with researchers in the same country (6 out of 10 researchers). Collaboration with researchers located outside the EU still lags behind: only 4 out 10 researchers reported collaborating with researchers outside the EU. This is related to the focus on international cooperation, the sixth of the ERA priorities, as a way

"(t)*o ensure that Europe as a whole is able to take maximum advantage of the best research and innovation opportunities in a global setting.*"[176]

What lessons can be drawn in relation to these policy aims from MORE4's key findings on international collaboration?

Data from the MORE4 surveys indicate that the EU is performing well in terms of international collaboration. Further support for initiatives to foster international mobility (see Section 9) could still play an important role as a key driver of international collaboration. The MORE4 EU HE survey[177], in line with previous MORE studies, confirms that international collaboration is often the result of previous mobility experiences, and that long-term mobility (i.e. more than three months) has a stronger effect on this than short-term mobility.

Other types of mobility can also play a role in fostering collaboration: this is the case with virtual mobility, which is one of the key means via which international collaboration can be pursued without the need to physically travel to other countries. Lower costs and ease of access mean that this type of collaboration is being increasingly used. The MORE4 EU HE survey was launched before the outbreak of the COVID pandemic, but it is likely that this has made this type of collaboration even more widespread.

The advantages of virtual mobility cannot, however, be equated with the benefits of long-term physical mobility. This was shown in MORE3 surveys and confirmed by the MORE4 results. In general terms, responses to these surveys over time indicate that virtual mobility is perceived as having an increasing impact on reducing short-term mobility rather than reducing long-term mobility. These results suggest that virtual mobility and long-term mobility do not fulfil the same needs: while virtual mobility can be useful during the development of research projects (e.g. reducing the need for short-term visits, enabling instantaneous communication, etc.), long-term international mobility can be considered key to the generation of new contacts and collaborations.

EU-level and national policy instruments

There are several EU programmes fostering short-term mobility and international collaboration. Some notable examples of these are Erasmus+, plus a number of MSCA sub-programmes such as RISE, and EU-ICI ECP activities. There are, however, no specific EU initiatives targeting regional or cross-country imbalances with respect to these forms of international exchange. The lower levels of international collaboration found in Eastern European countries are unlikely to converge with those in Western European countries unless specific measures are taken for this purpose. Because international collaboration is often driven by international mobility experiences, promoting mobility will also promote international collaboration. Fostering convergence between European countries in their levels of collaboration is also expected to have an important impact on individual researchers. In general, international collaboration with researchers from other countries tends to lead to higher citation rates than those received by publications by one author, or

[176] ERA Progress Report (2018).
[177] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.

by contributors from the same country[178]. Given that citation rates are key to researchers´ career prospects in many fields, and the increasingly globalised nature of the academic labour market[179], fostering access to international collaboration for researchers from Eastern Europe might mitigate the current imbalances identified in this regard.

According to the ERA Progress Report 2018, ERA countries are actively seeking to increase their collaboration with third countries. One of the most common practices for establishing long-term and sustainable international partnerships are bilateral agreements: ERA countries cooperate with a wide range of third countries, with the strongest concentration of bilateral agreements being with the US, China, Brazil, India, Russia, Japan, South Korea, and increasingly, South Africa. Importantly, smaller countries with less-developed national research systems are developing and maintaining cooperation with third countries using European instruments, as this is regarded as an effective approach. Furthermore, bilateral and multilateral cooperation activities are growing – not only between organisations performing research, but also between organisations that fund research, albeit at a slower pace.[180]

The following non-exhaustive list of initiatives implemented at national level over the last few years illustrates how ERA countries seek to establish and actively maintain their collaboration with third countries:

- In 2018, Finland established four Team Finland Knowledge nodes. The first ambassadors of Finnish education and research – known as 'Team Finland Knowledge experts' – have been appointed to Buenos Aires, Beijing, Singapore and Washington, with the objective of enhancing educational and research collaboration between Finland and these four regions.[181] Since 2018, the Team Finland Knowledge Network has expanded. The country's university and science specialists now also work in Abu Dhabi, Moscow, New Delhi and Pretoria.[182]

- Germany is one of several ERA countries (a few other examples are mentioned in Section 8.2) to have introduced a separate internationalisation strategy, and established innovation and research centres in third countries. In 2016, the German Federal Ministry of Education and Research redrafted and updated the Federal Government's Strategy on the 'Internationalisation of Education, Science and Research', and has increased its allocated budget for international cooperation. One of the key objectives of this strategy is working with emerging and developing countries, leading to an expansion of existing collaboration schemes and the creation of new partnerships with these countries.[183] In addition, Germany has expanded its collaboration with the EU13 Member States through the 'ERA Fellowships programme'[184]. This scheme was set up as part of the national strategy for the ERA to support capacity-building in the field of

[178] Schmoch, U. & Schubert, T. (2008). Are international co-publications an indicator for quality of scientific research? *Scientometrics*, 74(3), 361-377.
[179] There are however ongoing discussions on whether citation rates should be less important in recruitment processes and career progression.
[180] ERA Progress Report 2018. Technical Report.
[181] ERA Progress Report 2018. Country Snapshot: Finland.
[182] Ministry of Education and Culture of Finland. *Team Finland Knowledge network*. Retrieved from https://minedu.fi/en/team-finland-knowledge-network
[183] ERA Progress Report 2018. Country Snapshot: Germany.
[184] Federal Ministry of Education and Research of Germany (2020). *ERA Fellowships – Overview.* Retrieved from https://www.era-fellowships.de/en/era-fellowships-ueberblick.php

science management in the EU13, and to strengthen networking between EU13 countries and German non-university research institutes, research funding organisations and universities.

- In order to support the internationalisation of R&I, the Austrian Federal Ministry of Education, Science and Research (BMBWF) has signed agreements with selected target countries. Even though there is a strong focus on neighbouring countries and on Eastern and Southeastern Europe, bilateral agreements have also been concluded with countries outside of the ERA, such as Argentina, China, India, the Russian Federation and South Africa. Austria has two Offices of Science and Technology, located in the US and China. In addition, the Austrian Research Promotion Agency (FFG) is running a dedicated programme, 'Beyond Europe', to support the internationalisation of R&I projects. This programme is open to businesses, organisations performing research, and other organisations that seek to create and extend collaborations with partners outside Europe (FFG).[185]

- Hungary has S&T cooperation agreements with 36 countries at intergovernmental level, 10 countries at interinstitutional level, and 20 bilateral cooperation agreements with third countries. The body responsible for the implementation of intergovernmental S&T agreements is the NRDI Office, which is supported by a network of S&T attachés in the most important partner countries. Non-ERA countries in which these attachés are present include China, Russia, the United States, India, South Korea, Israel and Japan.[186]

- Portugal is among the stakeholder countries in Atlantic Interactions, a new intergovernmental initiative to unleash the potential of the Atlantic. The initiative fosters knowledge-driven solutions for Atlantic-related and Global Societal challenges that require interdisciplinary research and innovation in complex Earth systems, through cooperation targeting the Atlantic. It builds on the success of existing international framework agreements and supports the objectives of ongoing initiatives such as the Atlantic Ocean Research Alliance (AORA).[187]

- In 2017, the Swedish Foundation for International Cooperation in Research and Higher Education (STINT) decided to invest SEK 10 million in four projects within the Strategic Grants for Internationalisation programme for the time period 2017–2020: i) the South Africa–Sweden University Forum; ii) the Stockholm School of Economics strategic internationalisation program, 'From International to Global: Developing Teaching, Research and Business in Africa' with a built-in faculty and student exchange programme; iii) ASIAQ, The Arctic Science Integration Quest; and iv) the internationalisation of the curriculum.[188]

- One of the main targets of the Italian National Action Plan (NAP) regarding Priority 6 was to complete the process leading to the successful establishment of

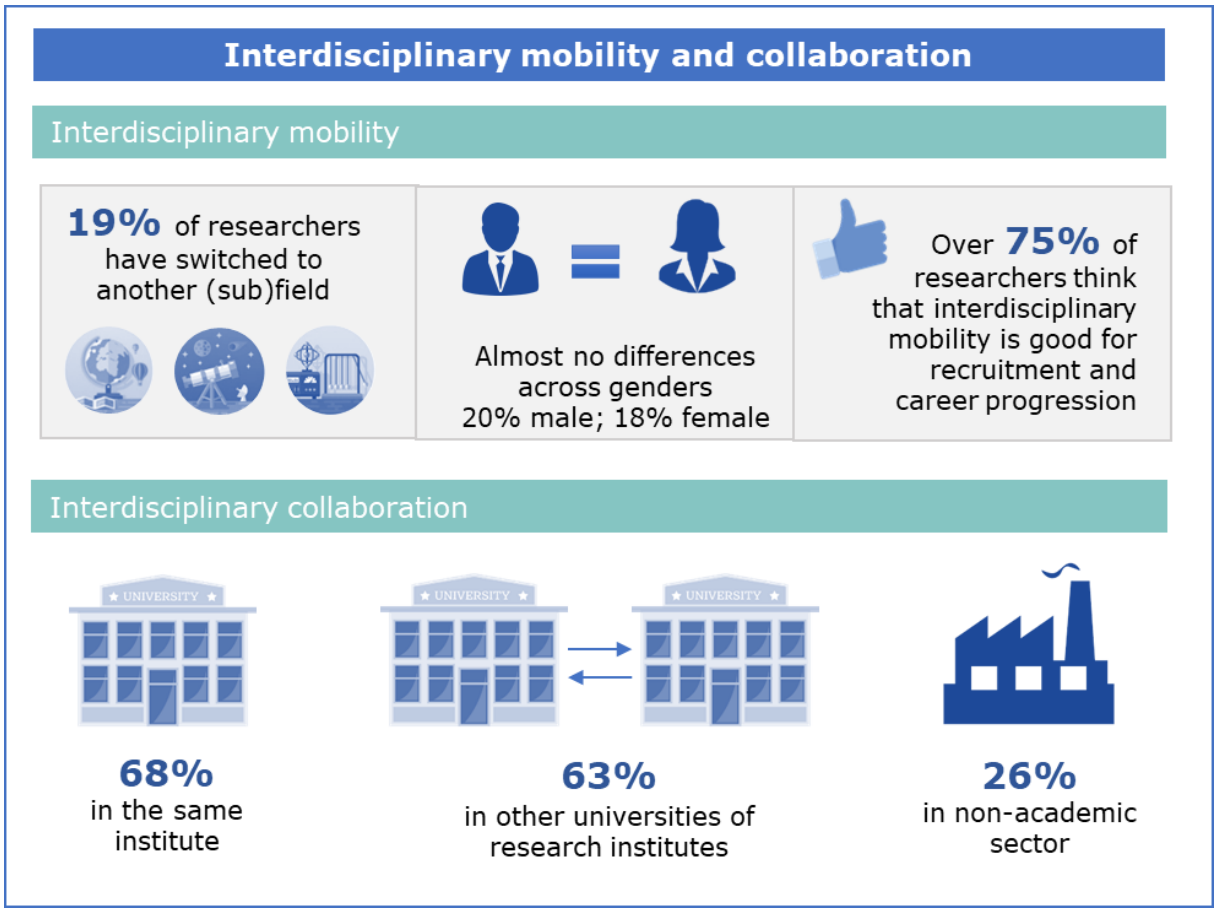
[185] ERA Progress Report 2018. Country Snapshot: Germany.
[186] ERA Progress Report 2018. Country Snapshot: Hungary.
[187] ERA Progress Report 2018. Country Snapshot: Portugal.
[188] ERA Progress Report 2018. Country Snapshot: Sweden.

the Partnership for Research and Innovation in the Mediterranean Area (PRIMA) programme. Italy has now achieved this target, as the programme has already received final approval.[189]

- Ireland has developed follow-up initiatives to the International Strategic Cooperation Award (ISCA) programme implemented by Science Foundation Ireland. Funding partnerships have been developed with international funders in Brazil, China and India. Irish research institutions are also active in cooperating internationally and publishing synchronised calls, although the most active cooperation takes place with Anglophone countries (e.g. the UK, USA etc.).[190]

[189] ERA Progress Report 2018. Country Snapshot: Italy.
[190] ERA Progress Report 2018. Country Snapshot: Ireland.

11. INTERDISCIPLINARY MOBILITY AND COLLABORATION



Source: Based on MORE4 EU HE report (Sections 8.2.1 and 8.2.2).

There is no common definition of interdisciplinarity. It can be understood as a way of doing research beyond the frontiers of traditional disciplines. In practical terms, this can entail a researcher crossing these frontiers in the elaboration of his/her own research agenda, or working with other researchers who specialise in other disciplines. Those who favour the promotion of interdisciplinarity argue that interdisciplinary mobility and collaboration are well suited to addressing complex societal challenges (including those relating to the Sustainable Development Goals), and that interdisciplinary approaches foster academic excellence and innovation. Interdisciplinarity not only fosters academic excellence, it can also "nurture cohesion at European level, innovative capacities of EU, and may play a key role in science diplomacy"[191]. Interdisciplinarity is therefore understood as a way to

[191] European Commission (2015) Minutes from the Workshop: Interdisciplinarity and Research Integrity in Open Science. Workshop of the Working Group 5 "Science in Transition" of the Research, Innovation, and Science Policy Expert High-Level Group (RISE). Retrieved from http://ec.europa.eu/research/openvision/pdf/rise/berlin_workshop_042015-freigabe-ja.pdf#view=fit&pagemode=none

stimulate disruptive innovation and to bridge the gap between research communities and the practical application of research results[192].

Other scholars are less convinced about the positive results of interdisciplinarity in terms of social impact or scientific outputs. First, and due to methodological limitations and the lack of a commonly-accepted definition for this type of research, little evidence exists of the positive economic and social impact of interdisciplinary research. Second, interdisciplinarity can jeopardise scientific rigour, since it involves evaluation by peers with different backgrounds and different scientific standards[193]. A lack of common standards and criteria, as well as a shortage of peer reviewers with experience in evaluating interdisciplinary research, poses problems for the evaluation of interdisciplinary research proposals[194]. In relation to this, some authors argue that interdisciplinarity can entail the development of unconventional claims and approaches that risk being penalised due to their unusual or innovative characteristics[195]. This can reduce the likelihood of being published in recognised scientific journals. Therefore, interdisciplinary research is often riskier than research in existing disciplines, and can lead to less efficiency (for instance, publishing fewer articles). The reverse of this argument was put forward by Leahey et al.[196] (2017), who showed that interdisciplinary works received more citations than disciplinary ones. Moreover, interdisciplinary knowledge is seen as enhancing the employability of individual researchers[197].

Hence, opinions are mixed with respect to the impact of interdisciplinary mobility on researchers´ career progression. In general, interdisciplinary research may remain a risky endeavour, but the MORE4 survey indicates that this factor is seen by researchers as having a positive effect on both recruitment and career progression.

11.1. Key findings

11.1.1. Interdisciplinary mobility

SHARE OF RESEARCHERS WHO HAVE SWITCHED TO ANOTHER (SUB)FIELD DURING THEIR ACADEMIC CAREER (of all EU28 researchers)				
	EU28 total	By career stage	By FOS	By gender
2016 (n=9,412)	34.3%	R1: 28.9%	NAT: 35.5%	F: 34.2%

[192] European Commission (2015). Quests for interdisciplinarity: A challenge for the ERA and HORIZON 2020. Policy Brief by the Research, Innovation, and Science Policy Experts (RISE). Retrieved from https://ec.europa.eu/research/openvision/pdf/rise/allmendinger-interdisciplinarity.pdf

[193] Carrillo, R. & Núñez, L. (2020). Interdisciplinarity. The interaction of different disciplines to understand common problems. In: Morin, J.F., Olsson, C. & Atikcan, E.O. (eds.), *Research Methods in the Social Sciences: An A-Z of key concepts*. Oxford University Press.

[194] Science Europe (2019). Symposium Report: Interdisciplinarity. Retrieved from https://www.scienceeurope.org/media/yv2huvp1/report-of-2018-science-europe-symposium-on-interdisciplinarity.pdf

[195] Frodeman, R. (2010). The Oxford handbook of interdisciplinarity. Oxford: Oxford University Press

[196] Leahey, E., Beckman, C.M. & Stanko, T.L. (2017). Prominent but less productive: The impact of interdisciplinarity on scientists' research. *Administrative Science Quarterly*, 62(1), 105-139.

[197] European Commission (2017) FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Retrieved from https://www.ffg.at/sites/default/files/msca_interim_eval_summary.pdf

SHARE OF RESEARCHERS WHO HAVE SWITCHED TO ANOTHER (SUB)FIELD DURING THEIR ACADEMIC CAREER (of all EU28 researchers)				
		R2: 29.5% R3: 33.6% R4: 40.9%	ENG: 36.8% MED: 32.5% AGR: 34.2% SOC: 37.2% HUM: 28.7%	M: 34.4%
2019 (n=8,540)	18.9%	R1: 15.2% R2: 20.1% R3: 17.4% R4: 21.7%	NAT: 17.8% ENG: 20.7% MED: 16.7% AGR: 16.6% SOC: 22.2% HUM: 17.1%	F: 19.7% M: 18.4%

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Note: Based on question 12: "Did you switch to another (sub)field of research during your academic career?"

Based on the question whether or not the researcher switched to another (sub)field of research during his or her academic career, 19% of all researchers indicate that they had. In 2016, this percentage was significantly higher (34%)[198].

The question is not limited to moves between the six main fields of science (Natural Sciences; Engineering and Technology; Medical and health sciences; Agricultural and veterinary sciences; Social Sciences; Humanities and the Arts), but also allows respondents to think about moves between subfields, and the extent to which such a move between subfields was an interdisciplinary move. Only small differences are apparent between genders and fields. Differences can, however, be observed between countries, with shares ranging from 13% to 32%.

Furthermore, interdisciplinary mobility is expected to have a positive effect on both recruitment and career progression, according to 75% and 76% of researchers, respectively. This opinion is not dependent on the respondent having been involved in interdisciplinary mobility him/herself.

The overall figure is similar in the Global survey: both in 2017 and 2020, 33% of researchers working outside the EU stated that they had switched to another (sub)field during their research careers.

[198] This difference may be (partly) related to a small change in the questionnaire for MORE4 compared with MORE3. In MORE3, researchers are first asked about their interdisciplinary collaboration, and are thus made aware of the reasoning in the framework of the FOS-classification before they are asked about interdisciplinary moves. This introductory question was removed from the MORE4 questionnaire for reasons of simplification. It is possible that this changed the perspective of the researchers with regard to this remaining question on interdisciplinary moves.

Table 12: Share of researchers who have switched to another (sub)field during their academic career, by country

COUNTRY	SHARE THAT SWITCHED TO ANOTHER FIELD	COUNTRY	SHARE THAT SWITCHED TO ANOTHER FIELD
Austria	22.8%	Latvia	30.0%
Belgium	14.1%	Lithuania	26.5%
Bulgaria	27.4%	Luxembourg	21.3%
Croatia	27.4%	Malta	26.1%
Cyprus	22.5%	Norway	21.4%
Czech Republic	20.2%	Poland	25.4%
Denmark	31.6%	Portugal	23.9%
Estonia	16.7%	Romania	18.7%
Finland	24.7%	Slovakia	21.2%
France	13.3%	Slovenia	18.3%
Germany	15.6%	Spain	15.9%
Greece	24.0%	Sweden	24.9%
Hungary	25.0%	Switzerland	14.8%
Iceland	24.4%	The Netherlands	20.9%
Ireland	25.8%	United Kingdom	18.4%
Italy	16.3%	**EU28**	**18.9%**

Source: MORE4 EU HE survey (2019)
Notes: Based on question 12: "Did you switch to another (sub)field of research during your academic career?" (n=9,321)

11.1.2. Interdisciplinary collaboration

SHARE OF RESEARCHERS WHO HAVE COLLABORATED WITH, OR WORKED IN, MORE THAN ONE FIELD IN THEIR CURRENT POSITION (of all researchers)				
	EU28 total	**By career stage**	**By FOS**	**By gender**
2016 (n=9,412)	73.5%	R1: 66.2% R2: 73.7% R3: 73.2% R4: 77.5%	NAT: 74.4% ENG: 75.5% MED: 76.2% AGR: 84.7% SOC: 67.7% HUM: 71.6%	F: 74.0% M: 73.2%
2019 (n=8,540)	79.5%	R1: 74.2% R2: 84.9% R3: 78.3% R4: 80.6%	NAT: 78.6% ENG: 80.6% MED: 83.4% AGR: 85.0% SOC: 76.9% HUM: 76.9%	F: 80.1% M: 79.1%

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Note: Based on question 82: "Please indicate with whom you collaborate in your research"

Almost 80% of researchers have collaborated with other fields (+6 percentage points compared with 2016). This type of collaboration was higher among those who report having worked in another (sub)field in MORE3 (interdisciplinary mobility), but this is no longer the case in MORE4.

The MORE3 Global survey investigated patterns of interdisciplinary collaboration among researchers working outside Europe. There are indications that European researchers working outside Europe have lower levels of interdisciplinary collaboration than those working in Europe (63% versus 80% respectively).

Table 13 shows the shares of researchers who engage in different types of interdisciplinary collaboration in each country: with researchers in the same institute, in other institutes, and in the non-academic sector.

- Generally speaking, collaboration with researchers working in academic institutions is much higher than that with researchers in the non-academic sector (68% in the same institute and 63% in other universities or research institutes, versus 26% in the non-academic sector). There has also been a small decrease in the level of interdisciplinary collaboration with the non-academic sector, which fell from 31% in 2016 to 26% in 2019.
- At country level, large differences can be observed between countries when comparing the shares of researchers engaging in interdisciplinary collaboration within academia (i.e. with researchers in the same institute or in other institutes): from 45% in Greece up to 84% in Romania for collaborations with researchers in another discipline within the same institute; and from 37% in Luxembourg up to 80% in Romania for collaborations with researchers in another discipline and from another institute.
- Differences are smaller between countries when it comes to interdisciplinary research with researchers working in the non-academic sector, ranging from 11% in Slovakia to 40% in Romania.

Differences can also be observed between research fields, with the highest shares of interdisciplinary collaboration occurring in Agricultural Sciences (85%) and the lowest in Social Sciences and Humanities (77%). This pattern is consistent with the observations made in MORE3.

Table 13: Types of interdisciplinary collaboration, by country

COUNTRY	RESEARCHERS IN ANOTHER DISCIPLINE BUT WITHIN THE SAME INSTITUTE	RESEARCHERS IN ANOTHER DISCIPLINE AND WORKING AT OTHER INSTITUTES	RESEARCHERS IN ANOTHER DISCIPLINE AND WORKING IN THE NON-ACADEMIC SECTOR
Austria	82.1%	72.4%	36.6%
Belgium	73.5%	54.7%	26.1%
Bulgaria	67.2%	60.0%	25.7%
Croatia	55.6%	58.8%	20.5%
Cyprus	57.7%	53.5%	26.3%
Czech Republic	64.6%	59.5%	22.7%
Denmark	51.5%	68.3%	30.6%
Estonia	68.4%	65.8%	16.9%
Finland	69.2%	65.6%	24.9%
France	63.4%	54.7%	26.0%
Germany	76.8%	64.1%	18.9%
Greece	45.0%	45.6%	19.3%
Hungary	60.3%	48.8%	20.0%
Iceland	61.8%	58.6%	34.9%
Ireland	64.2%	62.4%	33.9%
Italy	78.0%	72.8%	36.1%
Latvia	67.2%	72.7%	21.1%
Lithuania	65.3%	57.3%	16.6%
Luxembourg	69.6%	36.8%	11.7%
Malta	51.8%	49.1%	22.9%
Norway	56.5%	52.8%	17.8%
Poland	59.7%	67.3%	18.9%
Portugal	63.9%	58.1%	21.3%
Romania	84.1%	79.7%	39.8%
Slovakia	63.2%	51.2%	11.3%
Slovenia	69.7%	70.5%	17.2%
Spain	68.8%	61.1%	17.2%
Sweden	55.0%	56.1%	21.8%
Switzerland	77.7%	37.3%	17.9%
The Netherlands	56.6%	62.3%	16.3%
United Kingdom	66.5%	65.7%	34.7%
EU28	67.7%	62.9%	25.6%

Source: MORE4 EU HE survey (2019)

Notes:

- Multiple collaboration types per respondent are possible.
- Based on question 82 "Please indicate with whom you collaborate in your research" (n=9,321)

11.2. EU policy aims and implications of MORE4 findings

Although an interdisciplinary approach is considered to be an important mechanism for addressing complex societal challenges and fostering academic excellence and innovation (see above), interdisciplinary mobility and collaboration are mentioned less explicitly in the previous ERA priorities. However, in the Commission Staff Working Document to support the new ERA Communication of 30 September 2020, mention is made of the need to strengthen attention to the potential benefits of interdisciplinarity: "Although interdisciplinarity may be well suited to addressing complex ethical and societal challenges while fostering academic excellence and innovation, the development of policies pursuing

interdisciplinary careers is hampered by the absence of a clear-cut definition and promotion of greater awareness of interdisciplinarity and its benefits."[199]

Interdisciplinarity is also referred to – and positively regarded - in some of the most important EU research programmes funded within the Horizon 2020/Europe programmes, such as the ERC grants and MSCA grants (see below).

At doctoral level, the Principles of Innovative Doctoral Training also explicitly refer to 'Interdisciplinary Research Options'. According to this idea, doctoral training "must be embedded in an open research environment and culture to ensure that any appropriate opportunities for cross-fertilisation between disciplines can foster the necessary breadth and interdisciplinary approach".

Interdisciplinary mobility has been associated with the strengthening of certain skills that are becoming increasingly important. Examples of these skills are those that relate to a researcher's capacity to effectively communicate beyond the frontiers of their own field, as well as having an entrepreneurial mindset, and a greater capacity to adapt to changing environments[200]. The need to broaden researchers' skill base and provide them with interdisciplinary and transferable skills is, for example, confirmed in the MSCA Innovative Training Networks (ITN) and doctoral programmes in COFUND[201].

What lessons can be drawn in relation to these policy aims from MORE4's key findings on interdisciplinary mobility?

In MORE4 EU HE survey[202], 19% of researchers working in the EU report having switched to another field of science or discipline in the past. The share of researchers who have collaborated with researchers working in another disciplines is 80% (+6 percentage points compared with 2016). The survey also enables us to explore the differences between those researchers who have worked in projects funded by an MSCA or ERC grant[203] at some point during their research career, and the rest of the population of researchers.

Although these figures should be approached with caution, since the survey was not designed to offer representative data on these groups, some interesting patterns emerge. Those researchers who have worked in a project developed under an MSCA or ERC grant display higher shares of interdisciplinary mobility (27% and 31%) than the general population of researchers (19%). The MORE4 EU HE survey was not designed to produce representative figures for those researchers who have received these grants in the past,

[199] Brussels, 30.9.2020 SWD(2020) 214 final, COMMISSION STAFF WORKING DOCUMENT, A new ERA for Research and Innovation {COM(2020) 628 final}
[200] More information on skills and training is provided in Section 5.
[201] European Commission (2017) FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Retrieved from https://www.ffg.at/sites/default/files/msca_interim_eval_summary.pdf
[202] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[203] The survey did not include any questions on when these projects were carried out nor on whether the respondents were the principal investigators (in the case of ERC) or unique beneficiaries (in the case or MSCA) of the grants. On the basis of these data it is only possible to refer to those who have worked in a project funded by a MSCA or an ERC grant.

or have worked on projects funded by these schemes. However, the differences found in the analysis suggest that further research could shed light on the effects of these grants on interdisciplinary mobility.

Furthermore, interdisciplinary mobility is generally perceived as a positive factor for recruitment (75%) and for career progression (76%) – much more so than intersectoral mobility (see Section 12). These figures indicate that researchers tend to have a positive view of this type of mobility, in spite of the debates over the caveats applied to interdisciplinarity – e.g. the difficulties in getting articles based on interdisciplinary approaches accepted and published by leading academic journals; limitations in the peer-review process and scientific standards[204]. Researchers working outside Europe have a slightly less positive opinion on the effects of this type of mobility: only 67% and 70% of the researchers think that interdisciplinary mobility has a positive effect on recruitment and on career progression, respectively. However, researchers working outside the EU tend to attribute somewhat less positive effects to several types of factors (not just interdisciplinary mobility).

In contrast with the results of the MORE3 survey, the MORE4 survey findings do not show that the perceived effect of interdisciplinary mobility on recruitment and career progression depends on whether researchers have previously worked in other disciplines (i.e. whether they themselves had been interdisciplinary-mobile).

EU-level and national policy instruments

The overarching objectives defined in the Horizon 2020 Framework Programme explicitly address the need to foster interdisciplinary research. It will continue to be important in the mission-oriented policy approach of Horizon Europe. As such, some of the most well-known granting programmes of the European Commission for researchers support interdisciplinarity. For instance, ERC grants focus on an investigator-driven system designed to offer greater flexibility to researchers pursuing research in ground-breaking areas in which borders between disciplines have become increasingly blurred.

The MSCA encourage international, intersectoral and interdisciplinary mobility. The 2017 evaluation shows that interdisciplinary research is very important in the programme[205]:

- An estimated 30% of MSCA Individual Fellowship (IF) proposals include interdisciplinary research.
- One in four MSCA fellows moves to a new field of research as part of their first employment after their fellowship, and more than half of them believe that this is to a (very) great extent the result of participating in MSCA.
- The share of fellows who move to a new field of research after the end of their fellowship is particularly high in Innovative Training Networks (ITN; 27%) and

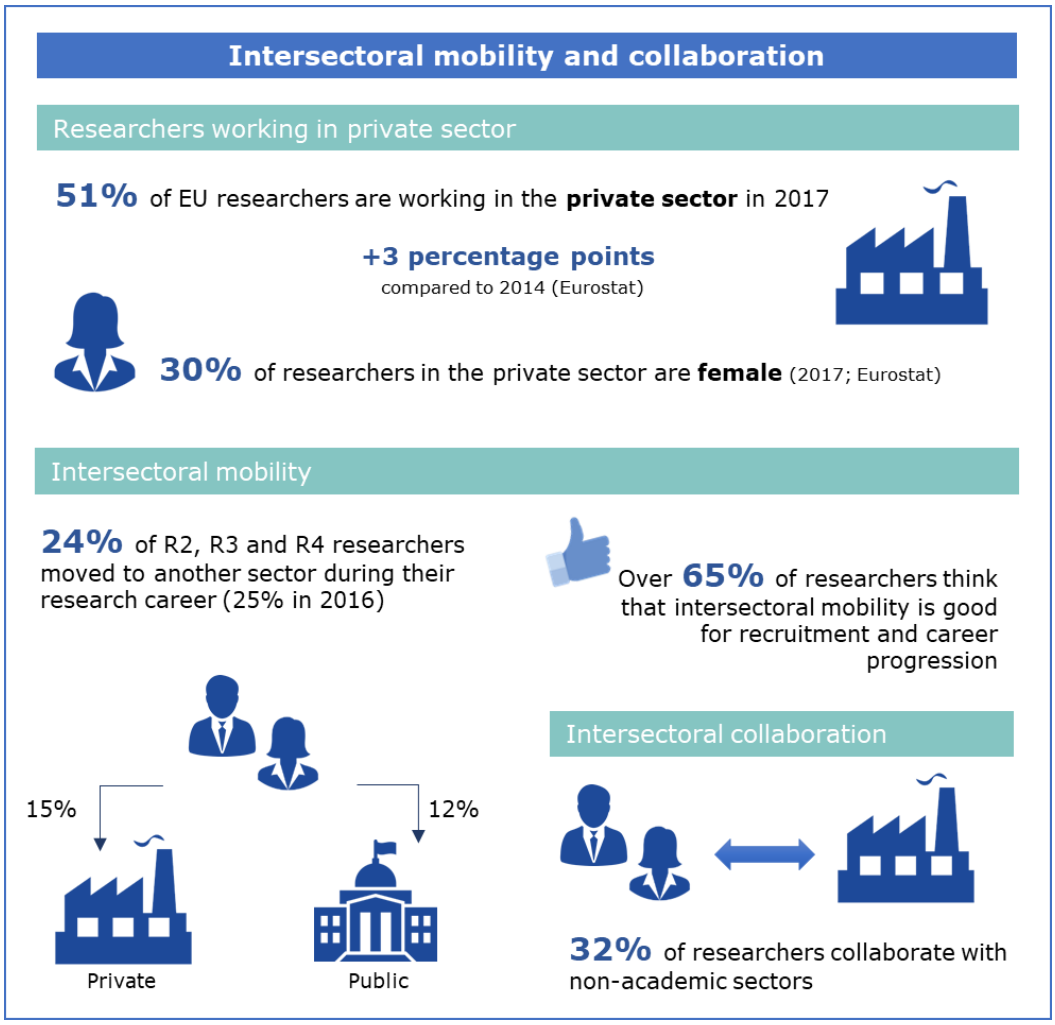
[204] Allmendinger, J. (2015). Quests for interdisciplinarity: A challenge for the ERA and HORIZON 2020. Policy Brief by the Research, Innovation, and Science Policy Experts (RISE). Directorate-General for Research and Innovation. Research, Innovation, and Science Policy Experts High Level Group.
[205] European Commission (2017) FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Retrieved from https://www.ffg.at/sites/default/files/msca_interim_eval_summary.pdf

the Research and Innovation Staff Exchange (RISE; 39% of those changing employers).

The 2017 evaluation also recommended that interdisciplinary research within the MSCA should be further encouraged, e.g. via the increased flexibility of calls and researcher positions as well as recognising that interdisciplinary researchers may have profiles that differ from the standard track record of other excellent researchers.

Moreover, the results of the MORE4 EU HE survey indicate that the share of researchers who have been interdisciplinary-mobile is higher among those who have worked on projects funded by an ERC (31%) or MSCA (27%) grant, compared with the general population of researchers (19%). Even though this type of mobility is not explicitly envisaged in the objectives of these grant schemes, these higher shares seem to point to the existence of relationships between the grants and mobility between disciplines that warrant further and more targeted research in future.

12. INTERSECTORAL MOBILITY



Source: Based on MORE3 EU HE report (Section 8.3)

Intersectoral mobility is strongly related to what has been called the "European Paradox"; that is, the difficulties faced in Europe "to sufficiently turn research results into globally competitive products"[206]. The insufficient number of researchers working in industry has been indicated as one of the reasons behind this paradox, and as a factor that may hinder European economic development and innovation[207]. Closing the gap between academia and the business sector is often perceived as a way to address societal challenges and accelerate transitions such as the green and digital transformation, while guaranteeing the

[206] European Commission (2006), Mobility of Researchers between Academia and Industry. 12 Practical Recommendations. Retrieved from http://ec.europa.eu/euraxess/pdf/research_policies/mobility_of_researchers_light.pdf
[207] Vandevelde, K. (2014). Intersectoral Mobility. Report from the 2014 ERAC mutual learning workshop on Human Resources and Mobility.

future competitiveness and growth of the European economy and strengthening its resilience, including in the context of the European Recovery Plan.

In this context, one of the objectives of the European Research Area (ERA) has always been the consolidation of a critical mass of researchers that would be sufficiently large to be able to develop the R&D that Europe needs to foster its competitiveness at a global level. Most researchers who are trained in HEIs will eventually pursue careers outside academia. Intersectoral mobility and exchanges are key to enhancing the employability of researchers in multiple settings. In line with this observation, the Council Conclusions on 'Measures to support early stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development'[208] stress the importance of early-stage researchers' skills and competences being suited to an evolving research environment, including industry, and to fuelling the knowledge-based economy.

The new ERA Communication[209] confirms the importance of translating R&I results into the economy to ensure the market uptake of research output and Europe's competitive leadership in technology. In doing so, it also seeks to further encourage and acknowledge intersectoral cooperation and multiple career paths for researchers.

12.1. Key findings

12.1.1. Intersectoral mobility

SHARE OF RESEARCHERS WITH INTERSECTORAL POST-PHD DEGREE MOBILITY (Of all R2, R3 and R4 researchers in the EU28)

	EU28 total	By (current) career stage	By FOS	By gender	By destination sector
2012 (n=7,131)	30.0%	R2: 27.3% R3: 28.9% R4: 33.3%	NAT: 28.6% ENG: 34.0% MED: 26.6% AGR: 44.9% SOC: 33.0% HUM: 26.3%	F: 28.1% M: 31.0%	Public sector:15.5% Private sector: 17.8%[210]
2016 (n=8,073)	24.8%	R2: 22.1% R3: 24.5% R4: 26.7%	NAT: 22.8% ENG: 29.9% MED: 18.5% AGR: 33.2% SOC: 29.6% HUM:19.4%	F: 23.5% M: 25.4%	Public sector:12.7% Private sector: 15.7%
2019 (n=7,653)	23.8%	R2: 17.4% R3: 23.4% R4: 27.4%	NAT: 21.4% ENG: 26.8% MED: 18.5% AGR: 27.0% SOC: 31.6% HUM:18.2%	F: 22.6% M: 24.5%	Public sector:12.4% Private sector: 14.7%

[208] Permanent Representatives Committee (2016). Draft Council conclusions on 'Measures to support early stage researchers, raise the attractiveness of scientific careers and foster investment in human potential in research and development' (2016) https://www.consilium.europa.eu/media/24214/st14301en16.pdf
[209] European Commission (2020). *Communication. A new ERA for Research and Innovation.*
[210] The share of private sector mobility includes the private not-for-profit sector.

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)
Note: Based on question 86: "Have you ever worked as a researcher (excluding PhD) in the non-university/higher education sector (e.g. companies, NGOs, charities, non-university research institutes, governmental bodies/agencies)?"

Stock of researchers working in the private sector

Based on Eurostat data[211], the MORE4 Indicators report on researchers[212] reveals that around half of EU researchers worked in the private sector in 2017 (not including not-for-profit organisations). This is a small increase compared with 2014 (+3pp). However, there is considerable variation between EU countries: at 72%, the share of private sector researchers is greatest in Sweden, while it is lowest in Latvia, at only 19%. Austria, Denmark, France, Germany, Hungary, the Netherlands and Slovenia also showed shares above 60% in 2017. Most countries with high shares of researchers in the private sector already had high shares in 2014, and in several cases as far back as 2009. The lowest overall numbers are to be found in Latvia (19%), Croatia (21%) and Romania (25%).

In the period 2014-2017, the largest increases in the shares of the total number of researchers who work in the private sector were in Bulgaria (+16pp), Poland (+15pp) and Greece (+14pp). The largest decreases were observed in Ireland (-11pp), Malta and Romania (-3pp each).

In terms of gender, around one-third (30%) of all female researchers work in the private sector. In 2017, the countries in which at least 50% of female researchers were employed in the private sector were Denmark (51%), Malta (52%) and Sweden (51%). Shares below 20% can be found in Slovakia (8%), Greece (11%), Latvia (15%), Lithuania (17%), Luxembourg (17%) and Cyprus (18%).

Stock of researchers currently working in the HE sector who have worked in other sectors

Of those researchers currently working in the HE sector, almost one in four have previously worked in non-academic sectors at some point during their career (24%). Similar to 2016, in 2019 12% of all R2 to R4 researchers indicated that they had been intersectorally-mobile to the public sector, while 15% went to the private sector. Of these, 6% had moved to large firms, 3% to SMEs or start-ups, and another 7% indicated that they had worked in private not-for-profit organisations.

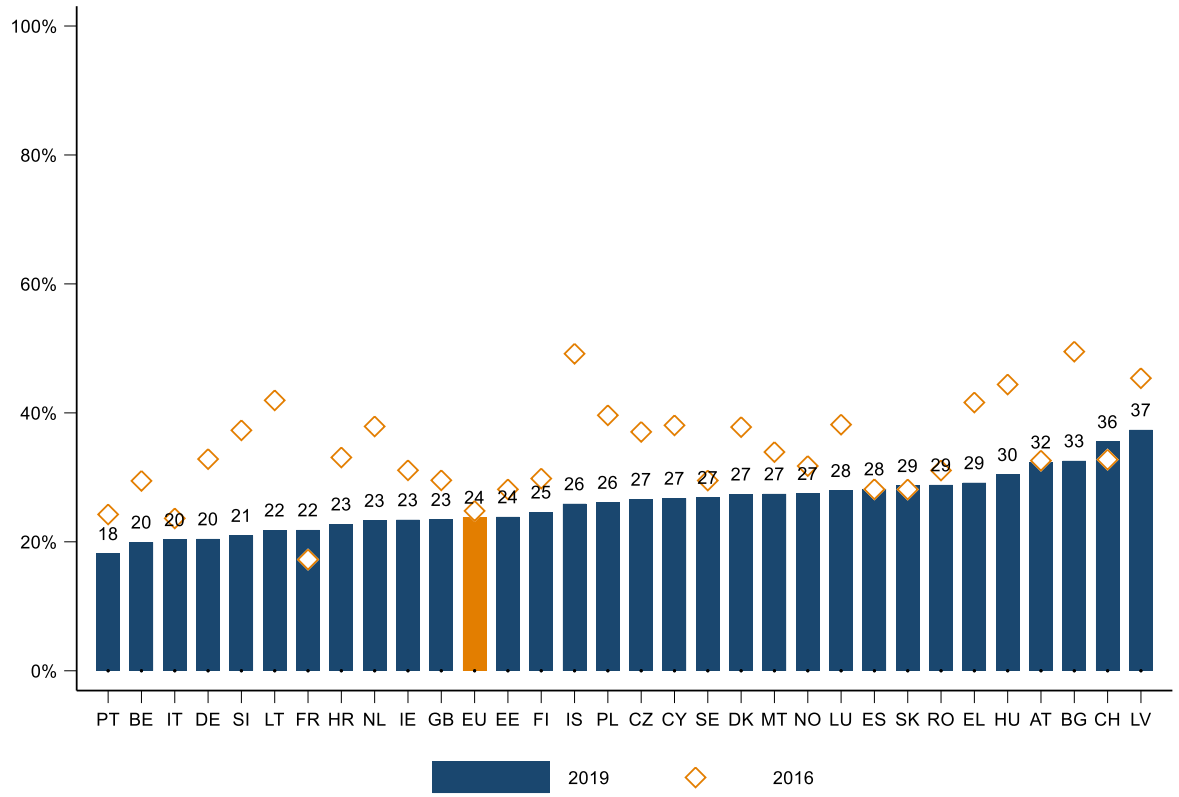
Figure 21 shows significant variation between countries. The least intersectorally-mobile countries are Portugal (18%), Belgium (20%) and Italy (20%), closely followed by Germany (20%). The most mobile countries are Latvia (37%), Switzerland (36%) and Bulgaria (33%). In most countries, the indicator has decreased in comparison to 2014.

Researchers are most inclined to engage in intersectoral mobility when they reach the established stage of their careers (R3). In 2016, later career stage researchers were more inclined to take a position in government organisations, whereas R2 researchers tended to

[211] Based on Eurostat, Total R&D personnel (researchers in FTE) by sectors of performance, occupation and sex (rd_p_persocc, 'Business enterprise sector'/ rd_p_persocc, 'All sectors'). See indicator 1.6 in the MORE4 Indicators report on researchers.
[212] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Researcher Indicators report. European Commission, DG Research and Innovation.

move to private industry (in particular to SMEs and start-ups), and R3 researchers were more likely to move to the not-for-profit sector. In 2019, the pattern has changed slightly, with both R2 and R3 researchers now moving more often to large firms and R4 researchers moving more often to SMEs or start-ups. These observations suggest that there is some volatility in these data on intersectoral mobility. Longer time series will be able to confirm if there are any trends in this indicator.

Figure 21: Evolution of intersectoral mobility, by country (2016-2019)



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Notes:

- Only for R2, R3 and R4 researchers.
- Based on question 86: "Have you ever worked as a researcher (excluding PhD) in the non-university/higher education sector (e.g. companies, NGOs, charities, non-university research institutes, governmental bodies/agencies)?" (2019: n=8,300; 2016: n=8,073)

As in 2017, the overall result in the 2020 MORE4 Global Survey for researchers currently working outside the EU – 20% – is similar to that found within the EU (24%), but the share is lower for EU researchers currently working outside the EU than for other groups (i.e. non-EU researchers). Differences also exist between countries (i.e. the country in which the researcher is currently employed), with shares ranging between 31% in Argentina to 14% in the US.

Motives

The most frequently mentioned motives for mobility to each destination sector differ little between 2016 and 2019, as can be seen in Table 14. Networking is still the most important motive for working outside academia, regardless of the destination sector. Other motives depend more on the destination sector, e.g. 'contribution to society' is more common as a motive for researchers moving from academia to the government and not-for-profit

sectors, whereas 'gaining first-hand experience of industry', 'improved remuneration', and 'bringing research to the market' are more common factors driving the mobility of researchers from academia to private industry.

Table 14: Three most frequently cited motives for intersectoral mobility, by destination sector (EU28)

2016 (N=1,333)	
Public sector or government organisation	Network (73.1%) Contribution to society (72.6%) Career progression (64.3%)
Private, not for profit sector	Contribution to society (71.9%) Network (71.7%) Research autonomy (69.9%)
Private sector: large companies	Gaining first-hand experience of industry (72%) Remuneration (66.3%) Career progression (64.5%)
Private sector: SMEs and start-ups	Gaining first-hand experience of industry (77.71%) Network (73%) Bringing research to the market (59.7%)
2019 (n=1,084)	
Public sector or government organisation	Contribution to society (86.0%) Network (84.3%) Research autonomy (74%)
Private, not for profit sector	Network (81.4%) Contribution to society (79.8%) Gaining first-hand experience of industry (72.3%)
Private sector: large companies	Gaining first-hand experience of industry (76.2%) Career progression (73.2%) Access to research facilities and equipment (72.8%)
Private sector: SMEs and start-ups	Renumeration (83.5%) Network (83.4%) Bringing research to the market (82.1%)

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Notes:

- Only R2, R3, R4 researchers who have undertaken an intersectoral move in the last ten years
- Based on question 92: "Which of the following factors were important in your decision to undertake this move?"

Effects on recruitment and career progression

65% of researchers consider that (1) mobility to the private sector, (2) mobility to the non-profit, public or government sector, or (3) both, are positive for recruitment. This positive perception is significantly higher among those with experience in a large private firm (76%), but lower among those with experience in an SME or startup (54%).

67% regarded intersectoral mobility as having had a positive effect on their career progression, again with a higher share among those who had experienced mobility to a large private firm (77%) and a lower share among those researchers who had experienced mobility to an SME or startup (55%), or to a private not-for-profit organisation (59%).

Working inside the HE sector is considered better (than outside the HE sector) in terms of opportunities to work with leading scientists, social security, Open Science approaches, job security, research autonomy and intellectual challenge. On the other hand, working outside

the HE sector is considered better (than inside the HE sector) for (among others) remuneration, contribution to society, the availability of research funding, a dynamic working environment, and future career perspectives.

Less positive results are found among researchers working outside Europe: 51% of researchers consider that intersectoral mobility is a positive factor for recruitment; 47% for career progression. Among those researchers who had been intersectorally mobile, results were very similar: 51% reported it as being positive for recruitment, 46% for career progression. The overall percentage of intersectorally mobile researchers working outside Europe who consider mobility a positive factor has increased since 2017, but remains lower than for researchers working in Europe.

12.1.2. Intersectoral collaboration

Table 15: Collaboration with academic researchers outside their own institution, or with non-academic researchers.

INTERSECTORAL COLLABORATION [213]				
2016 (n=9,412)	**EU28 total**	**By (current) career stage**	**By FOS**	**By gender**
Academic (Outside own institution)	80.2%	R1: 66.8% R2: 71.3% R3: 81.2% R4: 91.0%	NAT: 85.9% ENG: 80.8% MED: 73.9% AGR: 80.0% SOC: 79.5% HUM: 81.0%	F: 78.6% M: 81.2%
Non-academic (Intersectoral collaboration)	35.5%	R1: 24.6% R2: 25.6% R3: 35.3% R4: 47.3%	NAT: 41.0% ENG: 44.5% MED: 34.5% AGR: 43.0% SOC: 29.2% HUM: 26.4%	F: 30.5% M: 38.7%

[213] The MORE2 EU HE survey (2012) included a similar question on collaboration, but with fewer categories of collaboration partners. The data are not sufficiently comparable to include the MORE2 results as a basis for comparison here.

2019 (n=8,540)	EU28 total	By (current) career stage	By FOS	By gender
Academic (Outside own institute)	77.4%	R1: 57.7% R2: 56.3% R3: 82.5% R4: 86.0%	NAT: 80.7% ENG: 72.8% MED: 75.1% AGR: 75.6% SOC: 76.3% HUM: 83.5%	F: 76.9% M: 77.7%
Non-academic (Intersectoral collaboration)	32.2%	R1: 19.6% R2: 18.2% R3: 34.0% R4: 40.0%	NAT: 34.0% ENG: 35.5% MED: 32.6% AGR: 41.8% SOC: 29.9% HUM: 25.5%	F: 30.5% M: 33.2%

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)
Note: Based on question 82: "Please indicate with whom you collaborate in your research (e.g. joint projects, joint papers, etc.)"

32% of researchers working in HEIs collaborate with researchers in non-academic sectors. As in 2016, this is more common in 2019 among later career stages (40% and 34% in R4 and R3 versus less than 20% in R1 and R2) and less common in SSH fields (26% in Humanities and 30% in Social Sciences versus more than 40% in Agricultural Sciences).

In 2016, a gender difference of 8 percentage points was observed in relation to non-academic collaboration. This has decreased to 3pp in 2019, mainly due to a decrease in the share of male researchers engaging in this type of collaboration. For academic collaboration, no gender difference is observed (78% of male researchers versus 77% of female researchers).

In line with the 2016 results, we see that intersectoral mobility and intersectoral collaboration go hand in hand. The effect is larger for non-academic collaboration (30% among non-intersectorally mobile researchers versus 47% among intersectorally mobile researchers) than for academic collaboration (78% versus 84%). The survey also included an explicit question on the extent to which intersectoral collaboration was the result of a previous mobility experience. 32% of researchers in the group that collaborated with non-academic partners stated that collaboration with non-academic partners is the result of a previous mobility experience (versus 30% in 2016). For EU researchers working outside the EU, the effect is larger: more than 70% indicate that intersectoral collaboration results from a previous intersectoral mobility experience.

12.2. EU policy aims and implications of MORE4 findings

ERA Priority 5 – optimal circulation and transfer of scientific knowledge – explicitly recognised the mobility of researchers between the private and the public sectors as one of the most efficient ways to achieve this aim.

Together with the professionalisation of intellectual property management, the fostering of collaborative research between HEIs and private research organisations, and the training of students in entrepreneurship and in business and industry culture, intersectoral mobility has positive consequences for society, researchers and the institutions that employ them.

Under the heading of deepening the ERA, the new ERA Communication (2020) [214] confirms that "incentivising researchers to pursue a career outside academia through enhanced inter-sectoral circulation schemes involving industry can help improve researchers' employability and boost the permeability of talents across Europe's economy and society".

- First, this type of mobility is meant to foster the match between research results and market needs, hence increasing the **application potential** of (publicly) funded research.
- Second, it helps researchers acquire a **broader set of skills** – entrepreneurship, management of IPR, etc. - that can better equip them for the challenges of the current and future labour markets.
- Third, the companies and institutions that employ intersectoral researchers can benefit from **access to new collaborations and knowledge** that can help them be more efficient and innovative.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on intersectoral mobility?

Intersectoral mobility has received increased EU policy attention in recent years. Data collected in the framework of the MORE projects provide a good opportunity to shed light on the evolution of the situation across EU countries over time. Note that Section 5 on PhD training and Section 6 on careers have also looked at intersectoral mobility from their specific angles (integrating intersectoral mobility into PhD training, and diversifying research careers through intersectoral mobility).

One observation from the MORE4 Indicators report on researchers[215] is that, in comparative terms, the EU lags behind the US, China, Japan and South Korea with respect to the number of researchers employed in the private sector (based on Eurostat data[216]). As this type of indicator is not expected to fluctuate or evolve strongly, it needs to be monitored in the longer run to see the effect of policy actions. It is also important to note that large differences exist within the EU in relation to the economic structure and research intensity of different Member States. EU policy and funding initiatives to promote exchanges with, or attractive career paths in, industry research settings will thus need to take this diversity in national contexts into account, and allow for sufficiently flexible approaches.

The MORE EU HE data showed a decrease between 2012 and 2016 in the share of researchers who have had a previous intersectoral mobility experience, from 30% in 2012 to 25% in 2016. In 2019, the share remained at 24%. The drop between 2012 and 2016 was mainly due to a decrease in mobility towards the public sector, which can be partially explained in the context of budgetary cuts in the public sector that have affected several EU countries during that timeframe. Around one-third of researchers have been involved in intersectoral collaboration (similar to 2016).

[214] European Commission (2020). *Communication. A new ERA for Research and Innovation*.
[215] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Researcher Indicators report. European Commission, DG Research and Innovation.
[216] Based on Eurostat, Total R&D personnel (researchers) by sectors of performance, occupation and sex (rd_p_persocc). See indicator 1.6 in the MORE4 Indicators report on researchers.

The MORE data also provide interesting insights into the reasons why these figures remain relatively low. There is an apparent paradox: on the one hand, researchers working in the higher education sector tend to perceive that remuneration outside academia is better than inside academia. On the other hand, the share of researchers who have worked in another sector remains fairly low (this is expected though, given the fact that the survey only targets researchers who currently work in HEI). The analysis of the data point to several reasons behind this paradox:

- Incentives to work outside academia differ from incentives to work within academia. Intersectoral mobility is considered a positive factor for recruitment and for career progression by six out of 10 researchers currently working in HEIs, but those with this type of experience do not value it more highly than those without it. On average, researchers in HEIs hold much more positive views regarding the effects on their career progression of other types of mobility, such as international or interdisciplinary mobility (86% and 76%, respectively). The promotion of incentives to strengthen the recognition of intersectoral mobility moves in recruitment processes, and in terms of incentives and rewards for their career progression, would probably make this type of move more attractive for researchers. Along similar lines, it has been pointed out that the efforts made to facilitate a return to academia after an experience in the private sector have been limited in most EU countries[217].
- Training in skills that could be valorised most in an intersectoral move towards the private sector are still the exception rather than the norm. The percentage shares of R1 and R2 researchers who have received training in entrepreneurship, intellectual property rights (IPR) or negotiation skills during their PhD are smaller than those who have received training on typical research-based skills (research skills, critical thinking, and even communication skills) (see Section 5). Challenges also exist in relation to validating skills and competences gained through intersectoral researcher mobility.
- Aligning future policy developments which aim to fostering intersectoral mobility with researchers´ motivations, and providing incentives for this type of mobility to become more valued in academic career paths, might help to better reward researchers for undertaking an intersectoral mobility period and help bridge the gap between industry and academia through the greater incidence of bidirectional mobility. In this, it is important to take into account limitations related to differences in economic structures (cf. supra).

EU-level and national policy instruments

The Horizon 2020 Framework Programme contains several objectives related to intersectoral mobility and collaboration, such as promoting interdisciplinary and cross-sectoral research and innovation; promoting international networks for excellent researchers and innovators; and facilitating the cross-border and cross-sector mobility of researchers[218]. Horizon Europe is expected to "continue to facilitate cross-border

[217] Vandevelde, K. (2014) Intersectoral mobility. Report from the 2014 ERAC mutual learning workshop on Human Resources and Mobility.
[218] These are included in Article 14 of the Regulation No 1291/2013.

collaboration between top scientists and innovators, allowing for trans-national and cross-sector coordination between public and private R&I investment."[219]

Intersectoral collaboration – and, to a lesser extent, intersectoral mobility – are therefore present in many Horizon 2020 sub-programmes and grant schemes, together with excellent research and international and interdisciplinary research and mobility. This will be continued in Horizon Europe. Several EU funding instruments explicitly promote intersectoral mobility and collaboration. The Marie Skłodowska-Curie Actions (MSCA) stand out as one of the instruments that put a greater emphasis on this type of mobility. In the European Commission's words, it aims to provide "excellent and innovative research training as well as attractive career and knowledge-exchange opportunities through cross-border and cross-sector mobility of researchers to best prepare them to face current and future societal challenges."[220]

- The Innovative Training Networks (ITN) explicitly mentions the importance of the meaningful exposure of researchers to the non-academic sector as an important factor in increasing their employability[221]. ITNs include industrial doctorates (in which non-academic organisations play an equal role to universities, with regard to the researcher's time and supervision), and joint doctoral degrees delivered by several universities.
- Research and Innovation Staff Exchange (RISE) supports intersectoral mobility through the funding of short-term exchanges of R&I staff that can take place between academic, industrial and commercial organisations throughout the world[222]. It also emphasises the importance of developing their knowledge, skills and careers, as well as the importance of building links between organisations in different sectors.
- Also, in COFUND Fellowship programmes, applicants are encouraged to include elements of cross-sectoral mobility into their programmes[223].

There is evidence that the MSCA indeed contribute to intersectoral mobility during and after participation in the MSCA:

- Interviews carried out in the framework of a study on the impact of business participation in MSCA on researchers´ careers and job creation showed that the

[219] COM(2018) 435 final, based on an analysis in the impact assessment of the impacts Horizon Europe is expected to generate if the Programme is continued.
[220] European Commission. *Excellent Science*. Retrieved from https://ec.europa.eu/programmes/horizon2020/en/h2020-section/excellent-science
[221] European Commission (2020). *Funding tenders*. Retrieved from https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/msca-itn-2020 ITNS
[222] European Commission (n.d.). *Staff Exchange*. Retrieved from https://ec.europa.eu/research/mariecurieactions/actions/staff-exchange_en
[223] European Commission (2020). *Co-funding of regional, national and international programmes*. Retrieved from https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/msca-cofund-2020

programme had very positive effects on beneficiaries, through the acquisition of new knowledge and industry-relevant skills[224].

- The 2017 evaluation[225] showed that there were over 6,500 planned secondments from academia to non-academia and over 4,300 from non-academia to academia in RISE during the period 2014-2016. Moreover, around 12,000 of the approximately 27,000 fellows funded under the budget of the 2014-2016 MSCA calls are estimated to have experienced some form of cross-sectoral mobility out of or into an academic setting.
- In addition, based on a survey of MSCA fellows, this 2017 evaluation also found that the 11% of MSCA fellows who were mainly hosted in the academic sector during their fellowship, moved to the non-academic sector after the end of the fellowship. 38% attributed this move to a (very) large extent to MSCA participation. Cross-sectoral mobility after the end of the fellowship is particularly high under ITN (19% of fellows moved to the non-academic sector) and RISE (28% of those who leave their sending organisations move to the non-academic sector).
- ITN fellows also perform strongly in terms of cross-sectoral collaboration in research. Their share of academic-corporate cross-sector publications (4.3%) is significantly higher than the global average (2.6%), and also higher than the cross-sector publication shares of the comparison group of researchers similar to ITN (3.8%).

The MORE4 EU HE survey[226] does not allow us to establish causal links, but it sheds light on the extent to which researchers who have received an MSCA grant (or worked in a project funded by an MSCA) in the past show similar shares of intersectoral mobility compared with the overall population of researchers. While the MORE3 EU HE survey showed that those who had been given a grant by an MSCA were on average 5 percentage points more likely to have been intersectorally-mobile than the general population of researchers, the MORE4 survey shows that the level of intersectoral mobility does not differ between former and current MSCA grantees and the general population of researchers (26% and 24%, respectively).

The MORE4 EU HE survey offers different insights into the grants provided by the European Research Council (ERC). The ERC´s main objectives focus on fostering excellent research in Europe through a bottom-up approach. Intersectoral mobility is not an explicit objective of these grants. However, as in MORE3, the highest shares of this type of mobility are found in the ERC group (30% in MORE4; 36% in MORE3).

In addition to the confirmed role of the ERC and MSCA in the new policy framework for the new period (Horizon Europe and the policy goal of strengthening the ERA), the new ERA

[224] PPMI Group et al. (2017). Study of business participation and entrepreneurship in Marie Skłodowska-Curie actions (FP7 and Horizon 2020). Final report. Directorate-General for Education, Youth, Sport and Culture. European Commission.
[225] European Commission (2017) FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA)
https://www.ffg.at/sites/default/files/msca_interim_eval_summary.pdf
[226] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.

Communication (2020)[227] also aims to implement a new ERA4You initiative to reinforce intersectoral mobility and collaboration, and to involve the private sector more strongly in the training of researchers. Moreover, this initiative will include a dedicated pillar for 'widening countries', to support researchers from these countries to develop and access excellence, thus recognising the importance of addressing differing needs across the EU.

The importance of promoting intersectoral researcher mobility at EU level cannot be overestimated, and should not be downplayed, as research into **national instruments and policy developments** in this area concludes that attention to intersectoral mobility varies from country to country. According to one recent study[228], the supply of dedicated intersectoral mobility schemes across the EU Member States is uneven, particularly in Central and Eastern Europe. The focus in this region has instead been on "strengthening the framework conditions in which intersectoral mobility could be implemented in future i.e. through investment in strengthening the qualifications of young researchers, improving the R&I infrastructure, and measures to foster technology transfer and closer academic-industry cooperation".[229] A number of developments in this direction can be identified:

- In Finland[230], Finpro and Tekes were merged into Business Finland. Post-reorganisation, this body is expected to serve as a 'one-stop shop' for customers. The major goal of the organisation is to strengthen links between industry and academia by prioritising projects that show elements of cooperation.
- In 2019, the Łukasiewicz Research Network[231] was established in Poland. This network brings together 35 research institutes from all over Poland, many of which previously operated under the Ministry of Entrepreneurship and Technology. It operates in line with the 'Science is Business' model, and offers dedicated solutions for business in the areas of Health, Sustainable Economy and Energy, Smart Mobility and Digital Transformation.
- In Austria, the government programme for 2020-2024 includes the expansion of knowledge transfer centres by anchoring them within the performance agreements with universities 2022-2024.[232]
- In Spain[233], a new tool for the recognition of non-academic research activity ("sexenio de transferencia") has been developed and a new programme has been adopted, aimed at promoting applied research and public-private collaboration through technology centres ("Red Cervera").
- In 2018, Portugal adopted the legal framework for higher education degrees and diplomas. The Decree-law 39/2018 clarifies that research and development activities that are part of a study cycle leading to a doctorate can be carried out in any knowledge creation environment, including companies, technology interface centres and health care units with important R&D activity, among other scientific and technological institutions.

[227] European Commission (2020). Communication. A new ERA for Research and Innovation.
[228] European Commission (2018). *Study on Fostering Industrial Talents in Research at European Level. Final Report*. Retrieved from https://cdn5.euraxess.org/sites/default/files/policy_library/final_report_intersectoral_mobility.pdf
[229] Ibid.
[230] ERA Progress Report 2018, Country Snapshot: Finland.
[231] Lukasiewicz. Main Page. Retrieved from https://lukasiewicz.gov.pl/en/
[232] Austrian ERA Roadmap Final Report 2020.
[233] ERA Progress Report 2018, Country Snapshot: Spain.

- In 2020, Estonia redefined the status groups of PhD students. Under the new system[234], PhD students will be grouped into:
    - Junior researchers – PhD students at a university: the university pays the junior researcher a salary for the research. The workload at the university must be at least 50% or 20 hours per week. In addition, the doctoral student takes up employment elsewhere.
    - Industrial doctorates, which in turn can take two forms: (i) the PhD student works in a company or institution, but the studies and supervision are organised by the university. Doctoral studies make up at least 50% of the workload. State support is granted for industrial doctorates; (ii) the PhD student works at a university, but his / her studies are not financed by the state – the financing is agreed between the university and the institution.
    - PhD students studying on the basis of an individual plan, without a junior researcher employment contract. In this case, PhD students retain their student status and do not receive a salary or a scholarship from the state. The duration of PhD studies combining intersectoral researcher mobility should not exceed twice the nominal time intended for a PhD, i.e. 8 years.

The same study[235] indicates that, compared with countries in which such cooperation is still nascent, intersectoral mobility schemes are more prevalent in countries with a longstanding tradition of industry-academic collaboration, such as the UK, Ireland, Belgium, Luxembourg, Denmark, Sweden and Norway. This insight can be further corroborated by examples of instruments and schemes mentioned in NAPs and/or highlighted in the ERA Progress Report 2018 as contributing to the creation of an open labour market for researchers and improving access to, or the transfer of knowledge – they are indeed mainly implemented by countries experienced with similar schemes:

- The Austrian Research Promotion Agency (FFG) operates a couple of national intersectoral mobility schemes: the Industrial PhD Programme[236] targeting PhD students, and the Talents programme[237], offering internships for students (Young Talents scheme) and female researchers (FEMtech scheme).
- In Sweden, intersectoral mobility is supported by the Swedish Foundation for Strategic Research (SSF) via the Strategic Mobility, Industry Doctoral Student, and Research Institute Doctoral Student programmes.[238] The last of these programme was established in 2018 and instead of focusing on direct mobility between industry and academia, fosters mobility through funding PhD or licentiate candidates at research institutes. These institutes are by definition

[234] European Commission (2020). *Estonia. National Reforms in Higher Education.* Retrieved from https://eacea.ec.europa.eu/national-policies/eurydice/content/national-reforms-higher-education-20_en
[235] European Commission (2018). *Study on Fostering Industrial Talents in Research at European Level*. *Final Report*. Retrieved from https://cdn5.euraxess.org/sites/default/files/policy_library/final_report_intersectoral_mobility.pdf
[236] Austrian Research Promotion Agency. *Research partnerships – Industrial PhD*. Retrieved at https://www.ffg.at/en/programm/forschungspartnerschaften
[237] Austrian Research Promotion Agency. *Talents.* Retrieved from https://www.ffg.at/en/talents
[238] Technopolis (2019). *Analysis of Intersectoral Mobility.* Retrieved from https://strategiska.se/app/uploads/ssf_intersectoral-mobility_final-report-191002.pdf

promising environments for intersectoral networks, as a lot of the research being carried out there fill the gaps between academia and industry – or links the two sectors together.

- Industrial PhD schemes are also supported in several countries, such as Denmark[239], Norway[240], and the United Kingdom[241].
- The Volkswagen Foundation (VolkswagenStiftung), the largest private research funder in Germany, has recently completed its Humanities, Cultural Studies, Social Sciences and Professional Practice in Graduate Education scheme[242]. The main aim of this scheme was to provide a one-off concentrated and paradigmatic stimulus for stronger practical orientation in doctoral education at German universities, particularly in the fields of humanities and social sciences. The scheme offered support for the establishment of small graduate research programmes in the humanities and cultural studies (first funding line). In addition, in the second funding line, university graduate schools in the humanities, cultural studies and the social sciences could apply for support for their doctoral students to embark upon internships or other practice-based modules with a term of up to one year.

A selection of national initiatives promoting intersectoral mobility has also been published on the EURAXESS website, as part of the Academia-Business engagement tool[243]. These examples, again, mainly come from countries with multiple examples of similar instruments being implemented in the past or still being supported by both research funding and research implementing organisations, as well as by other national actors.

This overview corroborates and complements the findings of the MORE study, which concluded that systematic attention to key incentives, such as the recognition of intersectoral mobility as a valuable experience both in industry and academia, is lacking.[244] This stems from insufficient practical experience in the promotion of dedicated intersectoral mobility in research across ERA countries, as well as difficulties in learning from such practices in countries where intersectoral mobility represents only a very small component of a larger R&D&I priority (often supported and implemented with ESIF support), and the variety of approaches and prioritisation of measures included by countries in their national ERA Roadmaps.

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[239] Innovation Fund Denmark. *Industrial Researcher*. Retrieved from https://innovationsfonden.dk/en/programmes/industrial-researcher

[240] The Research Council of Norway (2019) *Industrial Ph.D. Scheme – Doctoral Projects in Industry*. Retrieved from https://www.forskningsradet.no/en/call-for-proposals/2019/industrial-ph.d.-scheme--doctoral-projects-in-industry/

[241] Engineering and Physical Sciences Research Council. *Industrial Doctorate Centres.* Retrieved from https://epsrc.ukri.org/skills/students/centres/pre2013/idd/

[242] VolkswagenStiftung (2020), Humanities, Cultural Studies, Social Sciences and Professional Practice in Graduate Education. Retrieved from https://www.volkswagenstiftung.de/en/funding/humanities-cultural-studies-social-sciences-and-professional-practice-in-graduate-education

[243] Euraxess. *Engagement activities.* Retrieved from https://euraxess.ec.europa.eu/career-development/organisations/resources-and-tools/engagement-tool/activities

[244] European Commission (2017). *MORE3 study.* Retrieved from https://cdn1.euraxess.org/sites/default/files/policy_library/final_report_2.pdf

13. ATTRACTIVENESS OF THE EUROPEAN RESEARCH AREA

When knowledge is the principal factor behind competitive advantage, leading to increased competition for talented knowledge workers, the attractiveness of research areas is crucial for sustainable and dynamic knowledge economies. Research based on MORE2 data[245] and the findings of MORE3 and MORE4 provides a clear picture of what drives attractiveness among researchers in academia, as illustrated in our conceptual framework in Section 3. Attractiveness is driven by research job characteristics that influence a researcher's scientific productivity, such as research autonomy, career perspectives and the opportunity to work with high-quality peers. All other factors being equal, 'material' working conditions that relate to remuneration, pensions and job security and other non-science related conditions influence job choice, but are not decisive factors for job or mobility decisions.

Career perspectives are cross-cutting working conditions, as they influence both financial conditions and scientific knowledge production, and have an impact on setting the time horizons for long-term research agendas. Long-term research agendas are more conducive to fundamental breakthroughs than research agendas limited by fixed-term contracts. Career perspectives are particularly important to early-stage researchers, for whom a performance-based model ('tenure-track' versus a seniority-based model) can make a substantial difference to their careers or career decisions.

As our conceptual framework in Section 3 makes clear, the attractiveness of postgraduate research jobs is hence a result of the structure of recruitment, career paths and the quality of working conditions (analysed in Sections 6 and 7). The attractiveness of research areas is also determined by the attractiveness of PhD studies. International or intersectoral mobility may be driven by perceptions of varying attractiveness. In turn, mobility indicators, such as which countries researchers choose for their international mobility experience, can also be interpreted as indicators of attractiveness, and mobility perspectives influence working conditions as they enable international collaboration, a driver of scientific productivity.

This section presents the results of MORE4 survey questions that asked EU and non-EU researchers to directly compare the EU with non-EU research systems in terms of a number of key determinants of attractiveness, such as working conditions for research, material working conditions, and cross-cutting working conditions. The systems were also compared in terms of a range of additional characteristics such as ease of industry collaboration.

[245] Janger, J., Strauss, A. & Campbell, D. (2019). 'Attractiveness of jobs in academia: a cross-country perspective.' *Higher Education*, 78(6), p. 991-1010; Janger, J. & Nowotny, K., "Job choice in academia". *Research Policy* 45, Nr. 8 (Oktober 2016): 1672–83. doi:10.1016/j.respol.2016.05.001.

13.1. Key findings[246]

Overall, whether researchers regard the non-EU research system as better or worse than the EU system in relation to various aspects, depends heavily on their experience – i.e. which system they know. Four groups of researchers who have knowledge of at least one EU and one non-EU system were asked to compare the systems. These groups were:

- EU researchers who have been mobile to a non-EU country in the past, differentiated by country of mobility – associated EU, non-EU OECD, BRICS and other emerging countries (MORE4 EU HE survey[247]; top right panel of Figure 22);
- EU researchers who currently work abroad, differentiated by country of employment – USA, non-EU OECD, BRICS and other emerging countries (MORE4 Global survey[248]; top left panel of Figure 22);
- Non-EU researchers who currently work in the EU, differentiated by citizenship – associated EU, non-EU OECD, BRICS and other emerging countries (MORE4 EU HE survey[249]; bottom left panel of Figure 22);
- Non-EU researchers who have been mobile to the EU in the past, differentiated by country of employment - non-EU OECD, BRICS and other emerging countries (MORE4 Global survey[250]; bottom right panel of Figure 22).

Figure 22 compares the share of respondents who assess the EU research system as more attractive with the share of researchers who assess it as less attractive. The graph contains net shares (i.e. share of "better in the EU" minus the share of "worse in the EU", in percentage points). Where 'better' and 'worse' are equally balanced, this line takes the value 0, and is shown explicitly as the line "EU = outside EU". Lines within or below the line at the value 0 therefore indicate "EU = worse" (taking negative values), while lines outside or above indicate "EU = better" (taking positive values). Note that these results include information from both the MORE3 Global survey (researchers currently outside the EU) and the MORE3 EU HE survey (researchers currently inside the EU). These surveys followed different sampling strategies, so the results should be interpreted with care (see Section 1.4). The panels summarise more detailed categories:

- **Remuneration and other material factors.** This category includes remuneration, social security and other benefits, quality of life, job security and pension plan;
- **Conditions for scientific knowledge production.** This includes the availability of research funding, access to research facilities and equipment,

[246] Due to the often unchanged nature of the results and the continuing policy relevance of the topics raised, and also in light of the new ERA Communication 2020, several parts of this text are unchanged with respect to the MORE3 study.
[247] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[248] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.
[249] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[250] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.

working with leading scientists, research autonomy, administrative burden, and the balance between teaching and research time;
- **Engagement with industry.** This includes the ease of commercialisation of research results, and ease of industry collaboration.

Non-summarised categories are:

- Mobility perspectives;
- Attractive career paths;
- Availability of suitable positions;
- Quality of education and training.
- Political situation.

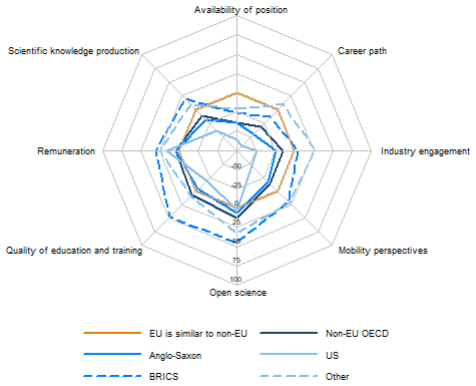
The main insights are as follows:

- If researchers come from a more advanced non-EU research system (i.e. an OECD member country), or if European researchers have worked in such a system during a mobility period, they are less likely to view the EU positively as a place to do research.
- The EU's strengths are perceived as including elements of the **remuneration** group, such as social security, job security, quality of life (vs. the US, but not overall) and pension plan (less so for salaries), and of the group **education and training**. The EU's weaknesses are perceived particularly with regard to **attractive career paths**, and to a certain extent also with regard to the **availability of suitable positions.** The other categories follow the pattern of the first insight, i.e. researchers from non-EU OECD countries, including the US, tend to find conditions for knowledge production worse in the EU compared with researchers from emerging countries.
- Non-EU researchers who have been mobile to the EU in the past (lower panel, right) generally see the EU as being better across the board than their current countries of employment. This group mainly came to the EU for chosen exchange mobility (see Section 9 on mobility). The other three groups rate conditions inside the EU on balance as worse than outside, with the exception of researchers from less developed research systems (BRICS and other emerging countries).
- Within the group of EU researchers currently abroad (left side of the upper panel), researchers in the US perceive the US as a much better place to do research, with the exception of social and job security, and quality of life. In terms of conditions for scientific knowledge production, very few researchers think that opportunities to work with leading scientists, research funding and career paths are better in the EU than in the US. The ease of commercialisation of research results or collaboration with industry are also perceived to be better in the US than in the EU, similar to the availability of research positions more generally.
- EU researchers currently working abroad in other OECD countries generally show the same pattern as EU researchers who have been mobile to these countries in the past (upper right panel), but are more positive, e.g. with respect to the quality of education and training.
- Within the group of non-EU researchers currently working in the EU (lower panel, left), researchers from associated EU-countries – Iceland, Norway and Switzerland – perceive the EU better with regard to career perspectives, remuneration and the availability of positions, but worse with regard to knowledge production and mobility perspectives.
- Within the EU, wide variation exists in perceptions of the attractiveness of different research systems. Researchers who have been mobile outside the EU

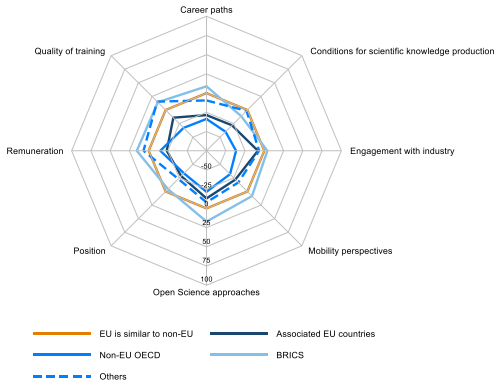
and who are now working in Central and Eastern or in Southern Europe find it relatively more attractive to work outside the EU than inside it, compared with researchers from Western and Northern Europe. This indirectly reflects on the attractiveness of their current countries of employment.

Figure 22: Comparison between working as a researcher outside and inside the EU (Task 1)

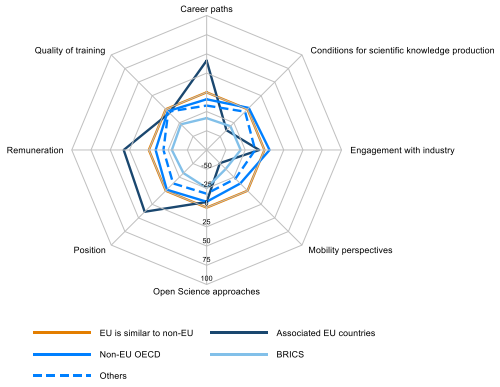
EU researchers currently outside EU



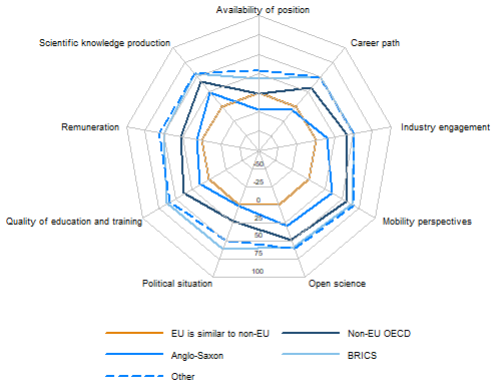
EU researchers currently in EU and in the past mobile to non-EU



Non-EU researchers currently in EU



Non-EU researchers currently outside EU and in the past mobile to EU



Source: MORE4 EU HE Survey (2019) – top right and bottom left panel

Notes:

Positive values indicate higher shares of researchers assessing working in the EU as better rather than worse.
Working conditions are bundled together; for a full picture, see Table 15.
Non-EU researchers working in the EU are grouped by country of citizenship; EU researchers with mobility experience by their mobility destination country.
Based on question 46: "How does working as a researcher outside the EU compare to inside the EU? Please indicate if something was worse, similar or better outside the EU than in the EU." and question 74: "How does working as a researcher outside the EU compare to inside the EU? Please indicate if something was worse, similar or better than in the EU."
(bottom left panel: n=227, top right panel: n=717)

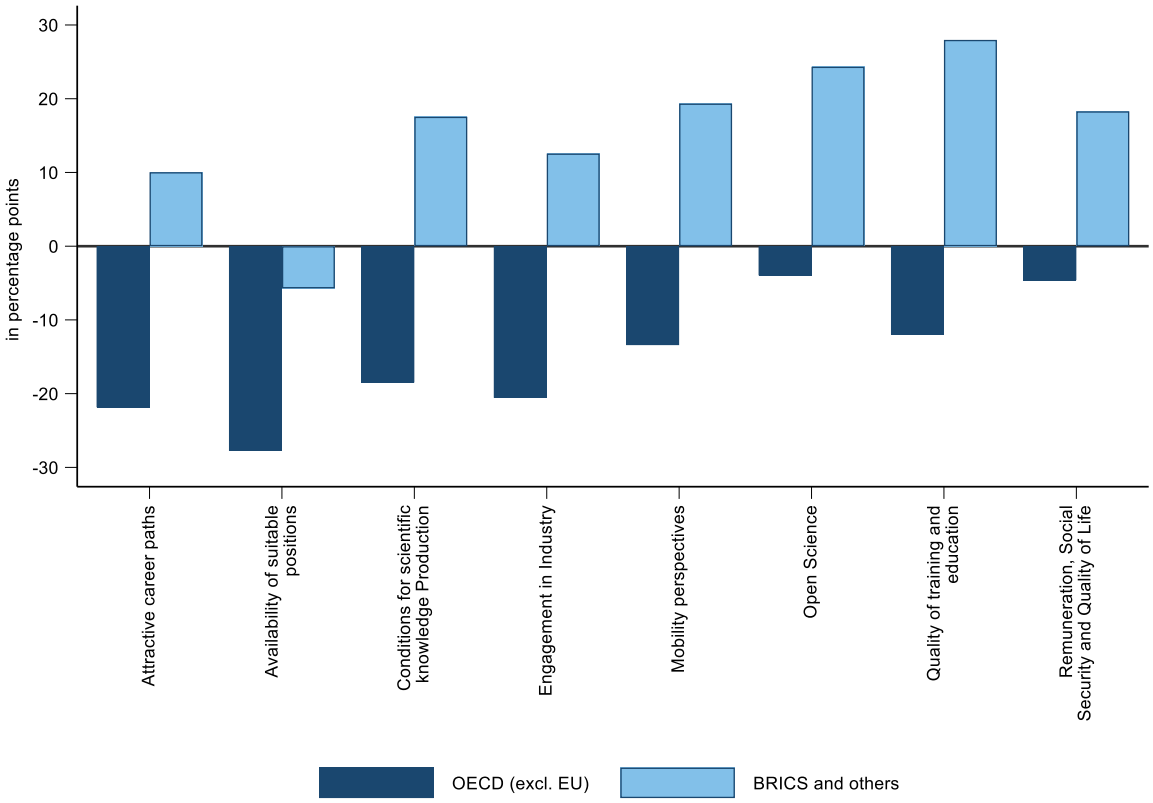
Source: MORE4 Global survey (2020) – top left and bottom right panel

Notes:

EU researchers who work abroad (TG1) and non-EU researchers who have worked in the EU in the past (TG2) are each grouped by their current country of employment.
Based on question 48: "How does working in … compare to working as a researcher in Europe? Please indicate if something is worse, similar or better in … than in Europe." and question 58: "How does working as a researcher in Europe compare to your current employment in …? Please indicate if something is worse, similar or better in Europe than in ..."
(top graph/left half of the table: n=245-318, bottom graph/right half of the table: n=307-402)

Figure 23 summarises Figure 22 by aggregating the four researcher groups based on the number of respondents, forming two groups – researchers working in, or with mobility experience in non-EU OECD countries; and researchers working in, or with mobility experience in the BRICS or other emerging countries. This figure should be interpreted with caution as it aggregates different groups of researchers from different surveys. However, the aggregate picture clearly illustrates the observed differences in perceptions of the attractiveness of the EU as a research destination between researchers with experience in stronger research systems and researchers with experience in the research systems of economically less-developed countries.

Figure 23: Balance of researchers perceiving the EU as better or worse than other research areas



Source: MORE4 EU HE Survey (2019) and MORE4 Global survey (2020)

Notes:

Positive (or negative) values indicate a higher share of researchers who perceive working in the EU as better (or worse) than outside.

Working conditions are bundled together; for a full picture, see Table 15.

Table 16: Comparison between working outside the EU and working inside the EU as a researcher: full set of data of the figures above

	EU researchers abroad					Non-EU researchers mobile to the EU			
	Anglo-Saxon	USA	Non-EU OECD	BRICS	Others	Anglo-Saxon	Non-EU OECD	BRICS	Others
Career path	-45.1	-65.5	-30.9	-13.7	9.8	-6.8	30.6	50.0	48.5
Conditions for scientific knowledge production	-18.5	-38.1	-11.6	19.7	9.9	23.1	42.1	55.2	55.2
Administrative burden	-9.6	-22.2	1.1	26.4	14.8	28.8	42.0	44.5	31.1
Autonomy	-32.1	-40.0	-26.0	-5.5	1.8	1.5	22.9	47.7	47.2
Research facilities	-21.4	-54.5	-10.6	29.7	27.8	16.2	45.5	62.8	69.7
Working with leading scientist	-10.5	-45.5	-1.6	39.7	27.8	35.7	53.3	71.5	68.2
Research funding	-9.2	-43.6	-12.9	31.0	7.7	26.6	48.8	53.3	61.5
Teaching balance	-23.3	-20.0	-19.6	-2.9	-25.0	22.2	42.1	47.1	52.1
Engagement with industry	-24.6	-48.8	-14.6	5.0	26.5	16.0	41.2	50.9	50.6

	EU researchers abroad					Non-EU researchers mobile to the EU			
	Anglo-Saxon	USA	Non-EU OECD	BRICS	Others	Anglo-Saxon	Non-EU OECD	BRICS	Others
Commercialisation of results	-33.3	-63.2	-21.5	4.3	18.6	14.3	44.3	49.4	47.5
Collaboration with industry	-16.2	-38.1	-8.3	6.9	31.4	15.9	39.1	52.3	51.2
Mobility perspectives	-17.8	-47.2	-13.9	19.4	21.8	34.9	57.1	64.7	68.0
Availability of position	-39.7	-61.8	-39.1	-26.4	-21.2	-21.8	-1.7	18.1	29.0
Remuneration	4.1	15.3	3.6	30.5	25.1	7.2	28.0	50.2	55.9
Remuneration	-34.3	-62.3	-34.1	-1.4	1.8	-24.5	17.9	56.3	58.9
Social security	36.4	58.2	34.8	54.9	44.4	34.9	44.4	40.6	54.2
Pension	26.5	33.3	30.6	61.9	63.3	13.2	32.6	27.2	50.3
Job security	7.1	21.8	3.4	24.6	15.4	-13.0	11.1	5.2	36.1
Quality of life	-11.8	21.4	-9.1	19.7	12.3	20.6	39.8	77.2	66.9
Open science	6.3	2.1	13.0	45.0	32.7	30.0	48.2	58.1	60.9
Quality of education and training	-3.8	-19.6	7.7	47.8	9.1	12.9	37.1	63.0	58.5
Political situation	-	-	-	-	-	1.6	22.1	61.2	50.0

Source: MORE4 Global survey (2020) - Table 34 in MORE4 EU Global report.

Notes:

Positive (or negative) values indicate a higher share of researchers who perceived working in the EU as better (or worse) than outside.
Based on questions 48 and 58 of the Global survey (see Figure 23 above).

13.2. EU policy aims and implications of MORE4 findings

As the preceding sections have shown, determinants of attractiveness are mostly linked to factors that influence the scientific productivity of researchers. Increasing the quality or excellence of research is hence tantamount to fostering attractiveness in general. Higher research quality encompasses many of the EU policy goals stated in the new ERA Communication, the Council Conclusions on young researchers, etc., and illustrated in the preceding sections:

- Improved doctoral training, e.g. as envisaged by the IDTP (Innovative Doctoral Training Principles);
- Improved recruitment procedures and career paths;
- Improved working conditions;
- Improved perspectives for international and interdisciplinary mobility;
- Work towards implementing the concept of European Universities, an Erasmus+ funded pilot initiative, which has enabled transnational networking and cooperation across borders between universities in different European and ERA participant countries.
- Reducing intra-EU variation in research performance: it is a key aim of ERA to reduce the wide regional variations in research and innovation performance through the convergence of weaker systems.

What lessons can be drawn in relation to these policy aims from MORE4's key findings on attractiveness?

In summary, key career-related job characteristics or characteristics that influence researchers' productivity are perceived on balance to be better in a number of economically advanced (OECD) countries with strong research systems, compared with the EU. The EU is seen as more attractive in terms of quality of life, as well as job security and social security arrangements. International evidence[251] and the MORE surveys show that career-related aspects are decisive factors in researchers' decisions to move away from their home country (e.g. independence, working with leading scientists and attractive career paths), while they commonly move back for personal or family reasons. Barriers to mobility are related to research and mobility funding, the availability of positions, and issues such as barriers to the cross-border portability of social security and pensions – recognised barriers to the mobility of researchers in an ERA context. This is further confirmed in the analysis of the factors driving mobility in the MORE4 surveys (see Section 9).

This general finding means that the current advantages of the EU in terms of quality of life and job characteristics relating to social and job security are less effective as drivers of attractiveness, or as attractors of researchers, than characteristics that influence the scientific productivity of researchers. Here, the advantages of the EU are less clear-cut. This again depends on the strength of the research system with which the EU is being compared. To put it differently: all other things being equal, quality of life and social security will play a role in attracting researchers, but the conditions for scientific knowledge production must be attractive in the first place. The survey results therefore show a clear opportunity for the EU to strengthen its attractiveness as a place to do research by improving the conditions for scientific knowledge production.

EU-level and national policy instruments

Attractiveness is a cross-cutting area in which the policy implications of the preceding sections come together. Improving the attractiveness of the EU as a destination for researchers hinges on many factors. The analyses in the previous sections provide a general picture of how attractive the EU and various other research areas globally are as research areas. In addition, they highlight which factors are decisive in determining this attractiveness, and which are enablers rather than drivers. Working conditions for research, or for scientific knowledge production, are drivers of attractiveness and international mobility. When such conditions are seen as attractive, they contribute to researchers choosing the EU as a location for their research because doing so will foster their career and advance their research agenda. Among these are attractive career paths (a tenure track model), career perspectives, and working with leading scientists. Important enabling framework conditions – or barriers to coming to the EU – include immigration options (rules relating to non-EU nationals working in the EU), and the general availability of jobs as well as funding for research. The last of these is a working condition relevant for scientific productivity, but generally is not the main motive for mobility (as outlined in Section 9). Measures boosting research by firms, such as those relating to access to finance, R&D subsidies and entrepreneurship, as well as broader regulatory and framework

[251] Franzoni, C., Scellato, G. & Stephan, P. (2012). Foreign-born scientists: mobility patterns for 16 countries. *Nature Biotechnology*, 30(12), 1250-1253.

conditions to promote innovation, will also create positive feedback loops, together with national higher education reforms.

Many policies at EU, national and regional levels address factors that are potentially relevant in influencing the attractiveness of the ERA relative to other research areas. A cross-cutting discussion in this regard is provided in Section 15. In this section, we focus more specifically on two EU-level policy instruments, EURAXESS and EU research funding instruments, with regard to their appropriateness and awareness of them among researchers outside the EU. This can shed light on ways to strengthen and increase the attractiveness of the EU to researchers who are currently outside it[252].

We therefore present below the MORE4 findings on the role played by EU funding and the availability of researcher positions (the EURAXESS jobs portal) on attractiveness.

The two most important barriers to mobility are the availability of a suitable position and the availability of research funding (see Sections 8 and 9). EURAXESS and EU research funding can, as a result, potentially play a very important role as **enablers** of mobility or attractiveness, alongside similar instruments at national level, as they directly address the availability of positions and research funding. The results regarding the levels of awareness about (and use of) these instruments among our sample of researchers currently working outside the EU, shows that awareness is higher among those researchers who single out the availability of positions or funding as the main barriers to mobility – particularly with regard to the EURAXESS portal. Interestingly, awareness has increased considerably since 2017 (see Figure 24). This suggests that EU instruments succeed in reaching their intended target group. As a consequence, EU funding and EURAXESS can, in principle, contribute to a foundation of attractiveness in terms of enabling mobility to the EU – or preventing the forced outward mobility of talents - if researchers wish to come to the EU in the first place.

Awareness of EURAXESS has increased among EU and non-EU researchers working abroad , accompanied by an increase in actual usage. There is, however, still room for improvement.[253] General interest among non-EU researchers is high, in terms of finding out more about EU research funding (see Figure 25), but a frequently indicated barrier – indeed, the main one – to using it is the lack of knowledge on the part of researchers about specific EU research programmes. The results of the MORE4 Global survey (like other studies) also reveal that policies aimed at promoting the return mobility of senior researchers may be limited in their effectiveness, as interest in return mobility is highest among early-stage researchers.

Funding and the availability of researcher positions are, however, not the main motives driving self-chosen mobility to attractive research systems. The factors that drive such mobility relate much more to the career perspectives available, such as a clear-cut tenure-track model in which a permanent position depends solely on performance, opportunities

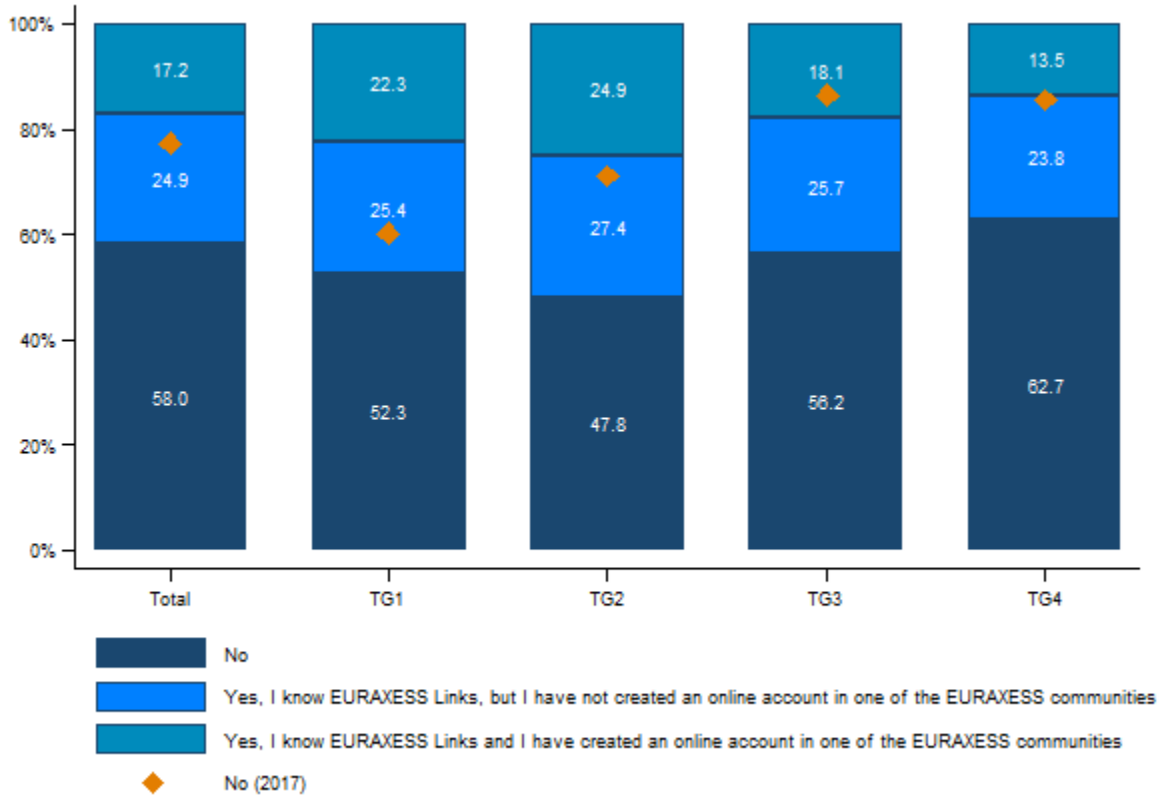
[252] The MORE4 EU HE survey includes an analysis of the awareness and use of EURAXESS and EU research funding. EURAXESS is only known by 19% of researchers in the EU, and used by 34% of those. 25% of EU researchers have benefitted from EU funding.
[253] The MORE4 Global survey contains a detailed analysis of awareness and usage patterns for EURAXESS and EU research funding.

to work with leading scientists, and other factors influencing scientific productivity (e.g. early independence in research).[254]

In parallel with addressing the enablers of attractiveness, any effort to improving the attractiveness of the ERA therefore also needs to improve the **drivers** of scientific productivity. These drivers relate to conditions for scientific knowledge production in Europe: e.g. attractive career paths, innovative funding models that allocate funding to the most promising research (i.e. more than simply the availability of funding), procedures for the selection of talented young scientists, high-quality structured PhD training etc. In general, these elements can be more effectively dealt with at national level through reforms to HEIs, universities and research institutions. But the EU also has an important role to play here, as outlined in the previous sections, e.g. by facilitating the diffusion of best practices and monitoring progress in deepening the ERA, as well as funding high quality training, (e.g. through the MSCA doctoral training subsidies). Note that funding schemes such as the ERC indirectly affect public research systems, because universities and higher education policy makers adjust their research and innovation policies and programmes to make improvements in a way that enables them to obtain more funding for excellent research in the future. Steps that can be taken at EU level to increase the portability of pensions and social security will reduce barriers to mobility, and hence enable greater mobility – but this needs to be combined with measures to strengthen the drivers of attractiveness/mobility.

[254] Note that forced mobility involving a change of employer is associated with the availability of positions as a main motive. However, the EU or ERA certainly wants to be attractive even to researchers from well-functioning systems who are not forced to move because of a dire situation in their home country.

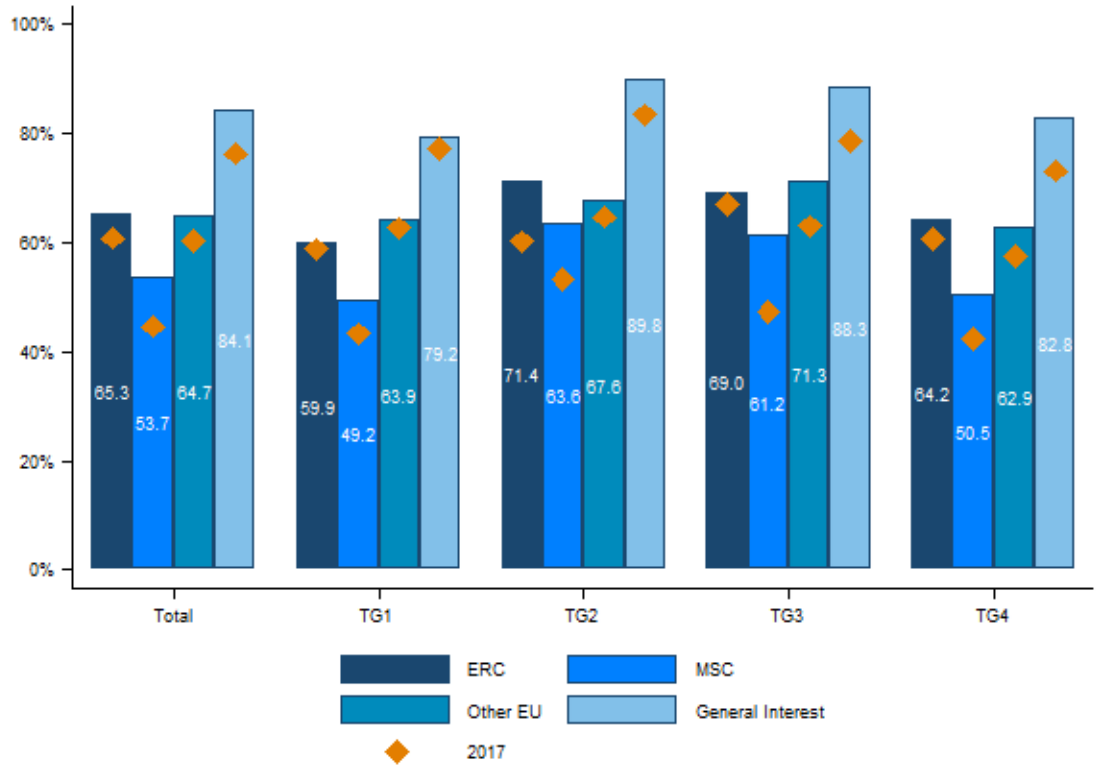
Figure 24: Awareness of EURAXESS across researcher groups



Source: MORE4 Global Survey (2020), MORE3 Global Survey (2017) - Figure 101 in MORE4 Global survey.
Notes:

Total: Researchers currently working outside the EU (2020: n=2,369; 2017: n=1,727)
TG1: EU researchers currently working outside the EU (n=327)
TG2: Non-EU researchers who have worked in the EU in the past (n=407)
TG3: Non-EU researchers who have worked abroad but not in the EU (n=254)
TG4: Non-EU researchers who have never worked abroad (n=1,380)
Based on question 79: "Do you know EURAXESS Links?"

Figure 25: Interest in applying for EU funding across researcher groups



Source: MORE4 Global Survey (2020), MORE3 Global Survey (2017) – Figure 103 in MORE4 Global survey.
Notes:

Total: Researchers currently working outside the EU (n= 2,369)
TG1: EU researchers currently working outside the EU (n= 327)
TG2: Non-EU researchers who have worked in the EU in the past (n=407)
TG3: Non-EU researchers who have worked abroad but not in the EU (n=254)
TG4: Non-EU researchers who have never worked abroad (n=1,380)
Based on question 81: "Are you interested in applying for (other) EU funding in the future?

14. GENDER

14.1. Key findings

Equality between women and men is a fundamental right which also plays a key role in achieving sustainable economic growth, and has many benefits for society. Women represent half of the world's population; however, their talents are still not fully incorporated in all aspects of social and economic life. The result is an inefficient situation in which a considerable quantity of female resources lies idle. Therefore, enhancing gender equality can lead to huge economic and business benefits that support the objectives of Europe 2020: namely, smart, sustainable and inclusive growth – thereby justifying the fourth ERA priority of "Gender equality and gender mainstreaming in research".

This section focuses on gender difference among researchers on the basis of the data collected within the framework of the MORE4 EU HE survey[255], Global survey[256] and the Indicators report on researchers[257]. The main insights are:

- Equal distribution of women and men in PhD studies or holding a PhD, but training contents differ slightly;
- Stagnation in female researcher participation in the European labour market
- Less heterogeneity across age groups in Eastern Europe;
- Large variations in gender balance between EU countries;
- Significant under-representation of female researchers in the highest career stages, particularly in Health Sciences;
- Improvements in terms of female researchers' perceptions of recruitment and career progression;
- Conversely, women report lower confidence in their future career prospects;
- Fewer female researchers are satisfied with working conditions relating to scientific productivity;
- Reasons for and against mobility are not independent of gender;
- More men than women working in research have children;
- The share of researchers with permanent contracts has increased, but the gender gap still prevails;
- An increasing share of part-time workers are in the higher stages of their careers;
- Fewer female researchers regard themselves as 'reasonably well' or 'well' paid at every career stage career; and
- Fewer female researchers are satisfied with social security, pension arrangements and job security.

[255] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[256] PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.
[257] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Researcher Indicators report. European Commission, DG Research and Innovation.

14.1.1. Links with gender-equality goals and limitations

Like its predecessors, the MORE4 EU HE (Higher Education) survey was designed to analyse the patterns of mobility and working conditions of researchers currently working in Europe, and to map their changes over time. As such, the questionnaire is not designed to evaluate gender policy; however, the sampling strategy was set up to include gender as one of the main dimensions for analysis.

The MORE4 and MORE3 Global surveys were used to identify gender differences in non-EU countries. The sample of the Global surveys is generally not representative in terms of observation numbers. Thus, any interpretation and comparison of these data over time should be approached with caution.

Finally, the survey data only allow for an analysis of gender differences in terms of perceived researcher satisfaction. The individual impressions of researchers may not be congruent with the actual differences between female and male researchers in terms of non-science related working conditions (e.g. remuneration) or working conditions related to scientific knowledge production (e.g. intellectual support).

As such, not all aspects of gender-equality in the ERA can be analysed comprehensively. However, gender differences among researchers with regard to the main aspects of mobility and working conditions can be analysed with a high degree of accuracy. The following indicators, based on MORE4 survey questionnaires, can be used to gather information about aspects of gender equality during the course of a research career in the EU:

Table 17: Topics and indicators used for the analysis

Category	MORE4 survey indicators
PhD studies	Share of female researchers currently enrolled in a PhD programme or already holding a PhD, Characteristics of PhD training by gender
Female labour market participation in research	Shares of female researchers across age groups and countries
Gender-balanced representation in all levels of staff	Shares of female researchers across career stages
Gender-related discrimination against researchers and provision of equal opportunities	Share of female researchers who perceive recruitment as open, transparent and merit-based (by country and career stage, type of contract and position); female researchers' satisfaction with collaboration with leading researchers; female researchers' satisfaction with the quality of training and education; female researchers' satisfaction with the balance between teaching and research; female researchers' satisfaction with research funding; female researchers' satisfaction with access to research facilities and equipment; female researchers' satisfaction with research autonomy
Parenthood, work-life balance and research careers	Share of female researchers having children (by type of contract and type of position); contractual situation of female researchers (working part-time, having permanent contracts, etc.); career stages and type of position
Financial situation and the gender income gap	Female researchers' perceptions of remuneration (by contract type, type of position); female researchers' perceptions of job and social security (by

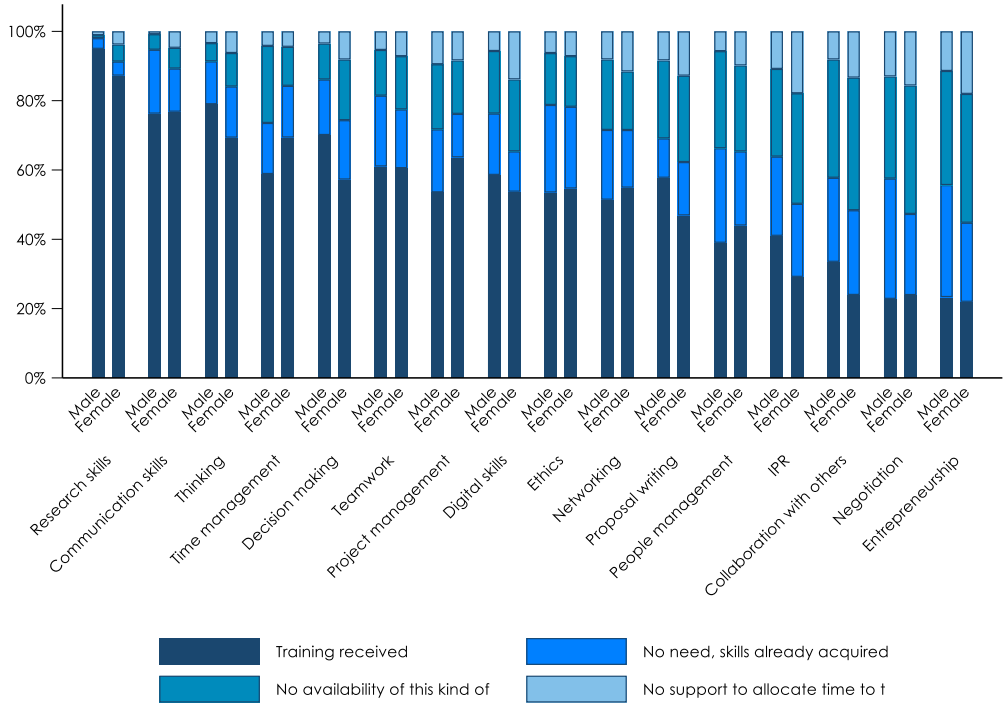
Category	MORE4 survey indicators
	contract type, type of position); female researchers' perception of remuneration compared with that outside academia

The analysis is structured according to the key topics listed in Table 17. Different aspects of gender equality, beginning with gender differences in PhD studies, and ranging from female labour market participation and gender differences in terms of career progression, to the financial situation of female and male researchers in the EU, are examined using the identified indicators based on MORE4 and MORE3 data.

14.1.2. PhD studies

The education and training of young researchers, particularly during their PhD studies, play a central role in influencing their subsequent research careers. The design and orientation of PhD studies (for instance, with respect to diverse training characteristics) could affect gender differences in the transition between education and the labour market. Gendered patterns in education are often used to explain gender segregation in the labour market.

Figure 26: Training modules in transferable skills, by gender (EU28)



Source: MORE4 EU HE survey (2019)

Notes:

Only R1 PhD candidates and R2 PhD holders who indicate that they have received any training in transferable skills during their doctorate.
Reasons why researchers did not receive training on different types of transferable skills (based on question 54). The possible reasons are: No need, skills already required; No availability of this kind of training; No support to allocate time to this kind of training; Others.

(n= 745)

Similar to the results of the MORE3 HE EU survey and the ERA progress report 2018, the MORE4 HE EU survey data do not suggest notable gender differences in the percentage of researchers currently enrolled in a PhD programme or already holding a PhD (93% of

female researchers and 91% of male). Neither are there huge differences in the MORE4 data between women and men regarding most of their PhD training content (Figure 26). The exceptions are training in decision-making, IPR, proposal writing and time management. While more male researchers than female received training in decision making (by 13 percentage points), IPR (by 12 percentage points) and proposal writing (by 11 percentage points), more female than male researchers received training in time management (by 11 percentage points). 18% of female researchers (10% of male researchers) report that training in decision making was not available; another 8% of female researchers (4% of male researchers) state that there was no support for allocating time to this kind of training. This result is particularly interesting as intensified training of female researchers in decision making during PhDs might improve gender balance at subsequent career stages, where decision-making skills are required. Skills in proposal writing and IPR are important prerequisites for a future career in research institutions or laboratories, as well as entrepreneurship.

14.1.3. Female labour market participation in research

In the EU28, an estimated 564,450 researchers (39.5% of all researchers; MORE3: 39%) are women; 865,313 are men (60.5%; MORE3: 61%) (Figure 28, upper panel). Thus, since 2012 the share of female researchers in the EU has remained constant (MORE2: 38%).

Indicators in the MORE4 Indicators report on researchers, developed on the basis of Eurostat data, further complement the picture on gender differences in the European research system: the average share of female researchers (FTE) in the labour force in the EU[258] has increased continually since 2000 (3.4 FTEs per 1,000 employees), but stagnated from 2013 (5.5 FTEs per 1,000 employees) onwards. In 2016, it stood at 5.6 FTEs per 1,000 employees. Conversely, since 2000 the total number of researchers per 1,000 employees has generally continued to increase on an annual basis, indicating that the increase in male researchers in the labour force has outperformed that of female researchers.

Table 18: Share of female and male researcher in different fields of science (EU28)

	FEMALE			MALE		
	2012	**2016**	**2018**	**2012**	**2016**	**2018**
Natural	30,1	28,6	28,5	45,4	44,9	46,5
Health	28,0	30,2	28,1	21,6	22,0	21,7
Social	41,9	41,2	43,4	33,0	33,0	31,8

Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012)

Notes:

Based on question 2: "What is your gender?" and question 11 "What is your main field of research in your current position?"

(2018: n=9,321; 2016: n=10,394; 2012: n=10,547)

Comparing MORE4, MORE3 and MORE2 data, female and male researchers' distribution across different fields of science remains unchanged: considerably more male (47%) than

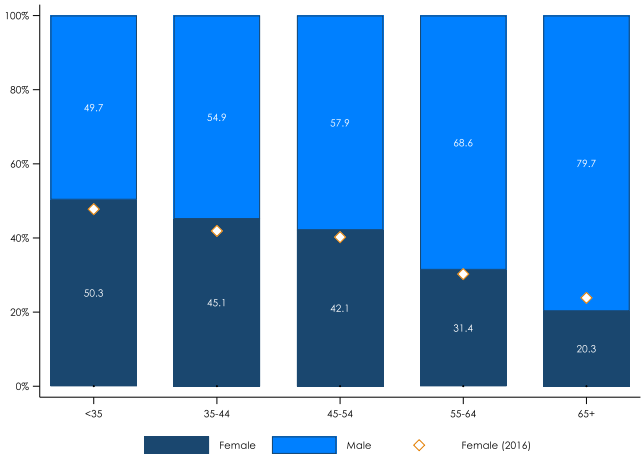
[258] Without Finland and the U.K. Both countries do not provide breakdowns by gender.

female (29%) researchers have chosen natural science as their field of research, while the opposite is observed for health sciences (22% vs. 28%) and social sciences (32% vs. 43%) (Table 18).

Figure 27, left panel presents the age structure of female and male researchers in the EU28. While among those researchers who are younger than 35 years old, no considerable gender differences can be observed, male researchers clearly outweigh female researchers among older age groups.[259] Only 20% (MORE3: 24%) of researchers older than 65 years and 31% (MORE3: 30%) of researchers older than 55 years are women. For the last three years, those shares have remained fairly stable, although a slight increase in the middle and lower age groups can be observed (+2-3pp). This might support the idea that gender differences in the age structure of researchers might reflect a cohort effect, as barriers to participation in the (academic) labour market have (slowly) decreased over the last 30 years. However, the result could also be interpreted as indicating that a glass ceiling persists for female researchers in European research systems, or may reflect different regulations regarding the retirement age of women and men in national pension systems.

Figure 27: Researchers' age structure, by gender (EU28)

Total



by country groups (share of female)

	North	South	West	East
<35	42,1	54,0	49,1	48,0
35-44	45,4	41,4	43,3	46,2
45-54	42,1	43,1	36,2	53,8
55-64	38,6	35,3	27,2	42,9
65+	25,6	23,2	18,2	32,2

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 2: "What is your gender?" and question 3 "What is your year of birth?"
Average shares of the following country groups are shown: East (CZ, EE, HU, LV, LT, PL, SI, SK, BG, RO, HR), North (NO, SE, FI, DK, IS), South (PT, ES, IT, EL, MT, CY) and West (BE, FR, DE, NL, LU, AT, UK, IE, CH).
(2019: n=9,321; 2016: n=10,394)

Interestingly, however, major differences can be observed between groups of countries (see Figure 27, right panel). The most extreme gender differences across age groups are seen in Western and Southern Europe. While the share of female researchers in Western

[259] Again, these results are in line with the MORE4 Indicators report on researchers: comparing the share of young female PhD graduates to the total share of female researchers indicates that in the early career stages, female researchers are better represented.

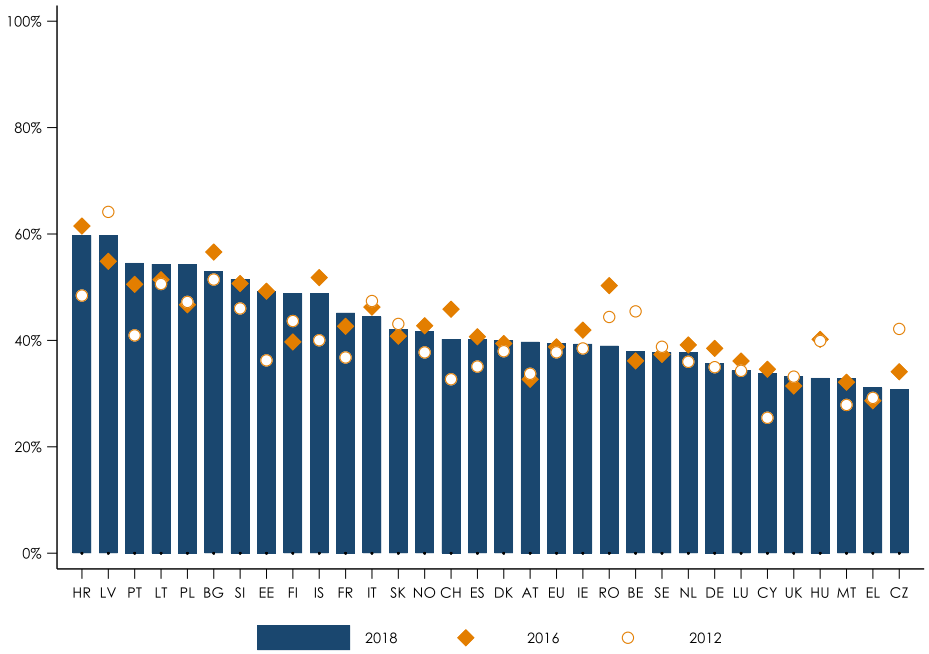
Europe continually decreases with increasing age- from 49% (MORE3: 49%) in the age group <35 years to just 18% (MORE3: 14%) in the age group >65 years-, the picture is more ambiguous in Eastern Europe: while the share of women rises between the age group <35 years (48%, MORE3: 43%) and the group of 45 to 54 years old researchers (54%, MORE3: 56% women), and only drop again among the older age groups (43% and 32%, MORE3: 37% and 33%). This inverse-U pattern was the same in MORE3, and might stem from differences in women's domestic and labour market position in the former command economies compared with Western European countries, particularly with regard to women's professional work and high education[260]. The relatively lower share of young female researchers <35 years in Eastern Europe might reflect a deterioration in the availability of childcare facilities, legal protection and government support for working mothers compared with previous systems in Eastern Europe. It is also in line with the findings of the *Enwise* Expert Group, which examines the situation facing women scientists in Eastern European countries and in the Baltic States[261].

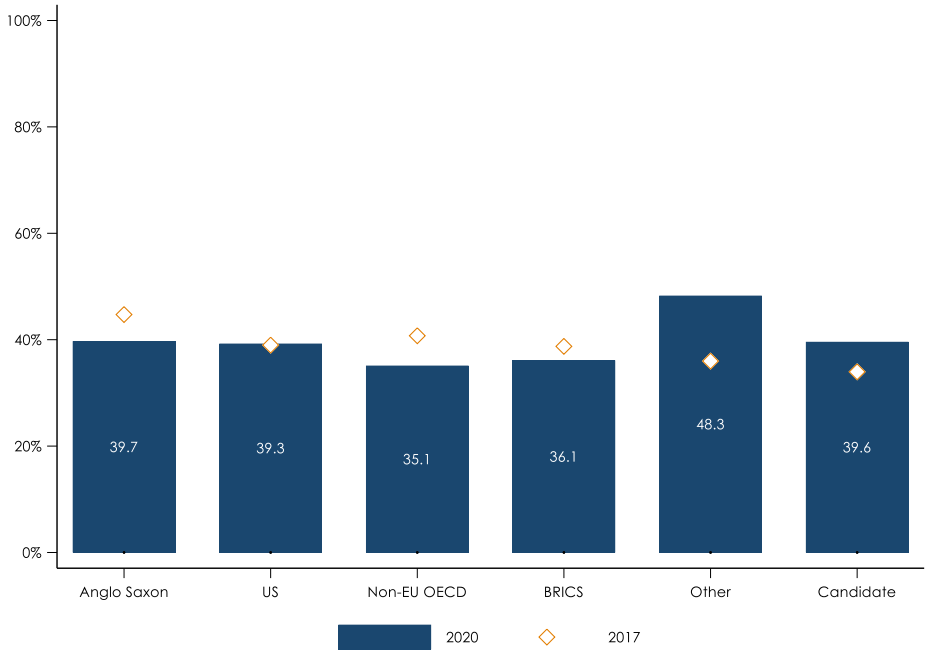
The participation of women in the research profession shows significant variation between countries, a result supported by the indicators in the MORE4 Indicators report on researchers, based on Eurostat data. In general terms, the MORE4 data for Eastern European and Baltic countries indicate higher shares of women than on average in the EU28 countries (40%). In some countries, female researchers even slightly outnumber male researchers – for instance, in Croatia (60%), Latvia (60%), Portugal (55%), Lithuania (54%) and Poland (54%). The largest imbalances are found in Czech Republic (31%), Greece (31%) and Malta (33%%). While the share of female researchers has increased in roughly half of countries since 2016, particularly in Finland (+9pp), Poland and Austria (+7pp), a considerable fall is observed in others (Romania: -11pp, Hungary: -7pp). However, compared to 2012 the share of female researchers has increased in almost all EU countries. The largest improvements in terms of the percentage share of female researchers between 2012 and 2019 are observed in Portugal (+14pp), Estonia (+13pp) and Croatia (+11pp). In contrast, the greatest decline (-11pp) can be seen in the Czech Republic.

The lower panel in Figure 28 represents the average shares of female researchers who participated in the MORE4 Global survey in various non-EU country groups. In 2020, 40% (MORE3: 40%) of researchers currently working outside the EU and captured in the MORE4 Global survey were women. The share of female researchers currently working in Anglo-Saxon countries is comparable to the EU average (40%). The highest average share of female researchers is currently working in the group of `other' countries (48%), such as the Ukraine, Argentina, Malaysia and Thailand. Compared with 2017, only small changes can be observed, with the largest increase in the share of female researchers being in `other' countries (+12pp). However, when comparing these results to MORE3 it must be considered that the sample of the MORE4 Global survey is not representative in terms of observation numbers and, thus, any direct comparisons between the MORE4 HE EU survey and the MORE3 Global survey should be made with caution.

[260] Pollert, A. (2003): Women, work and equal opportunities in post-communist transition. *Work, employment and society*, 17(2), 331-357.
[261] European Commission (2004): Waste of talents: turning private struggles into a public issue. Women and Science in the Enwise countries. Retrieved from https://ec.europa.eu/research/swafs/pdf/pub_gender_equality/enwise-report_en.pdf

Figure 28: Representation of women, by country





Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016) and MORE2 EU HE survey (2012).

Notes:

Based on question 2: "What is your gender?"

The country group "Candidate" includes researchers employed in Turkey (76), Albania (21) and Serbia and Montenegro (4).

(2019: n=8,540; 2016: n=9,412; 2012: n=9,015)

Generally speaking, and particularly in earlier career stages, international mobility experiences can boost research careers by providing better training and education opportunities, knowledge spill-overs, and by strengthening researchers' networks. Similarly to MORE3 and MORE2 survey findings, no differences between women and men were observed. Compared with 2016 and 2012, an increase in PhD mobility was observed

among both genders: 24% (MORE3 and MORE2: 18%) of male and 23% (MORE3 and MORE2: 19%) of female R2 and R1 researchers who are enrolled in a doctoral programme, were engaged in 'during-PhD mobility'[262]. In contrast to 2016, the reasons that prevent researchers from undertaking part (or all) of their PhD training in another country were fairly similar for both female and male researchers in 2019 (MORE4 EU HE survey Section 7.1).

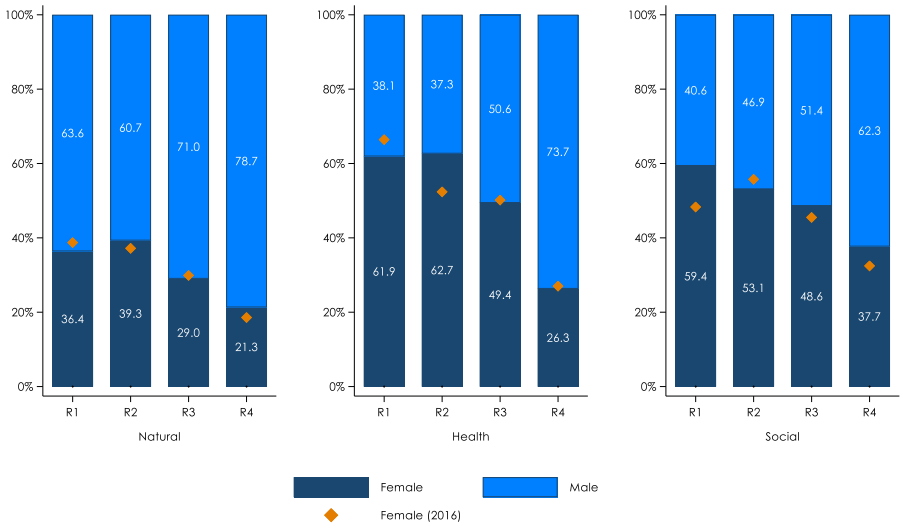
14.1.4. Gender-balanced representation among all levels of staff

The MORE surveys do not provide data on the specific tasks and responsibilities of individual researchers, but instead on researchers' career stages. On average in the EU28, women are clearly underrepresented among higher career stages: while 51% (MORE3: 50%) of R1 and 51% (MORE3: 50%) of R2 researchers are women, the percentage drops to 41% (MORE3: 41%) of female researchers in the R3 group and to just 28% (MORE3: 25%) of R4 researchers (see MORE4 EU HE Report, Section 5.1). Compared with 2012, these shares have increased by 5 percentage points at all career stages, with the exception of career stage R4. After a small drop in 2016, the shares of female R4 researchers have stabilised at a level comparable to 2012. Overall, the results indicate a positive trend in female labour market participation. Encouragingly, this trend is not restricted to lower-level researcher positions.

The discrepancy between female representation at different career stages is more pronounced in certain fields of science (see Figure 29). The biggest differences between career stages can be seen in the field of Health Science: while more female researchers than male are present in early career stages (R1: 62% female vs. 38% male; R2: 63% female vs. 37% male), the overall picture shifts dramatically at the highest career stage, where male researchers outnumber their female colleagues by more than 47 percentage points (R4: 26% female vs. 73% male). This result is in line with previous literature on gender inequalities in Health Science[263]. A similar, albeit less dramatic pattern can be observed in the field of Social Science: the gender gap ranges from 19 percentage points more female researchers than male in R1 (59% vs 41%) to a majority of 25 percentage points for male researchers in R4 (38% vs. 62%). In Natural Sciences, significantly fewer women than men are involved in research at every career stage (from -21pp in R2 to -57pp in R4).

[262] During PhD mobility is defined as >3 months mobility to a country other than the country where the researcher did/will obtain his or her PhD.
[263] Kuhlmann, E., Ovseiko, P.V., Kurmeyer, C. et al. (2017): Closing the gender leadership gap: a multi-centre cross-country comparison of women in management and leadership in academic health centres in the European Union. *Hum Resour Health* 15, 2.

Figure 29: Female representation across career stages in three fields of science



Source: MORE4 EU HE survey (2019) and MORE3 EU HE Survey (2016)

Notes:

Based on question 2 "What is your gender?", question 11 "What is your main field of research in your current position?" and question 13" "In which career stage would you currently situate yourself?" (2019: n=9,312; 2016: n=10,394)

These results are in line with other indicators presented in the MORE4 Indicators report on researchers that can be used to analyse women's career progression. In 2017, 26% of all grade A positions are occupied by women. Although in the last decade, a positive trend can be seen in the percentage share of women who are Grade A academic staff, the under-representation of women in grade A positions (i.e. GCI values above 1) can still be observed in several countries, as well as in the EU-average data in 2016 (GCI: 1.64, 2013: 1.68). Moreover, the share of women on boards across the EU has been stable over recent years, standing at 32% in 2017 (cf. SHE figures). In only three countries (Sweden, Luxembourg and Romania) are 50% of board positions occupied by women. Countries below the EU average include Croatia, Cyprus, Estonia, Greece, the Czech Republic, Belgium, Italy, Germany, Slovakia, Poland, Hungary, Portugal and Lithuania.

The higher overall share of women on boards compared with grade A positions may point to the role of the selection procedures used for board positions which, depending on the prevailing national regulatory framework and other factors, may take gender issues into account to a greater extent than the selection procedures for grade A positions.

Overall, the results indicate a fairly persistent gender pattern across different career stages in EU28 countries. The fact that the shares of female researchers at career stages R1 and R2 are fairly high could suggest that there will be a more gender-balanced situation at all career stages will emerge in the future. Equally, it could be interpreted as suggesting that a glass ceiling persists, at which female researchers drop out before reaching the R3 or R4 career stages.

14.1.5. Gender-related discrimination against researchers and the provision of equal opportunities

An open, transparent and merit-based recruitment process is an essential precondition for general equality between female and male researchers, in all member countries and at all

career stages. Otherwise, equal opportunities cannot be guaranteed, and gender discrimination by (potential) employers cannot be precluded. [264]

Table 19 shows that the shares of female researchers agreeing that recruitment in their home institutions is sufficiently externally and publicly advertised, transparent and merit-based are somewhat lower in every category than among the group of male researchers.

Compared with 2016, however, the share of satisfied female researchers in each category has increased by between 3 and 9 percentage points. The biggest improvement can be seen with regard to perceptions of the transparent and merit-based nature of researcher recruitment at later career stages (R3 and R4). Between 2016 and 2019, the same improvement in perceptions of recruitment procedures can be observed in the group of male researchers. The gender gap has remained constant over time.

Table 19: Researchers' perceptions of open, transparent and merit-based recruitment (EU28)

	ADVERTISEMENT		TRANSPARENT		MERIT-BASED	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
EU	85% (2016: 78%)	88% (2016: 82%)	79% (2016: 71%)	83% (2016: 76%)	81% (2016: 75%)	84% (2016: 78%)
R1	81% (2016: 76%)	84% (2016: 82%)	82% (2016: 75%)	80% (2016: 74%)	83% (2016: 81%)	87% (2016: 77%)
R2	83% (2016: 77%)	84% (2016: 83%)	74% (2016: 68%)	84% (2016: 73%)	79% (2016: 75%)	85% (2016: 78%)
R3	85% (2016: 78%)	89% (2016: 82%)	78% (2016: 69%)	83% (2016: 76%)	80% (2016: 72%)	83% (2016: 76%)
R4	88% (2016: 81%)	89% (2016: 82%)	82% (2016: 74%)	84% (2016: 78%)	82% (2016: 75%)	85% (2016: 80%)

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 2 "What is your gender?" and question 13 "In which career stage would you currently situate yourself?" and question 37 "What is your opinion on the following issues with respect to recruitment in your home institution?"
(n= 9,321)

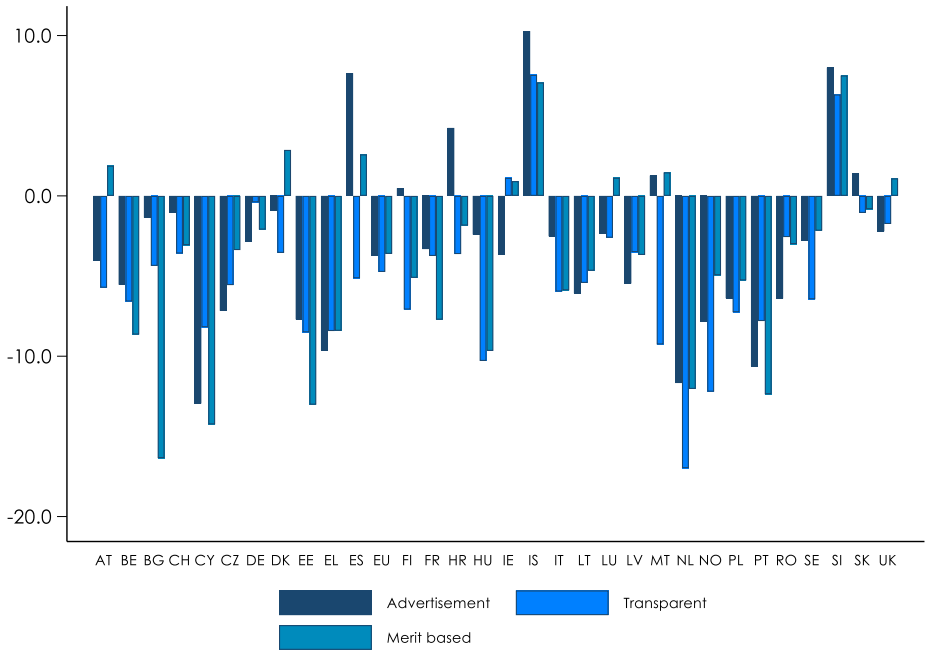
Gender differences between countries are illustrated in Figure 30. It is remarkable that in most countries, the shares of female researchers who perceive recruitment as open, transparent and merit-based are lower than the corresponding shares of male researchers (represented by negative values in Figure 30). Two exceptions stand out immediately: Iceland and Slovenia. In Slovenia in particular, the shares of female researchers who agree that recruitment is open, transparent and merit-based are higher than those of their male counterparts by 7 to 10 percentage points for all three aspects. Overall, however, comparing this result with the data from the MORE3 survey suggests that gender differences persist in researchers' perceptions of recruitment processes across most

[264] See report of the Working Group of the Steering Group of Human Resources Management under the European Research Area on Open, Transparent and Merit-based Recruitment of Researchers. https://cdn1.euraxess.org/sites/default/files/policy_library/otm-r-finaldoc_0.pdf

countries. In the Netherlands, Cyprus and Portugal in particular, fewer women than men perceive recruitment to be open, transparent and merit-based.

Indeed, designing recruitment processes in a transparent and merit-based manner is just one of the elements necessary to establishing and reinforcing gender equality in research and academic communities in the EU. The provision of equal opportunities for women and men throughout their career progression is equally important. Overall, as with recruitment, the share of male researchers who agree that career progression is transparent and merit-based is higher on average than the corresponding share of the group of female researchers in the EU28 (Table 20). Differences between female researchers at different career stages are small, ranging between 3 and 5 percentage points. Since 2016, however, there has been a slight improvement in all three categories across all career stages.

Figure 30: Gender differences in perceptions of open, transparent and merit-based recruitment, by country (EU28)



Source: MORE4 EU HE survey (2019).

Notes:

Based on question 2 "What is your gender?" and question 37 "What is your opinion on the following issues with respect to recruitment in your home institution?"
(n= 9,321)

Table 20: Researchers' perceptions of transparent and merit-based career progression (EU28)

	TRANSPARENT		MERIT-BASED		TENURE	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
EU	72% (2016: 67%)	79% (2016: 73%)	70% (2016: 61%)	76% (2016: 68%)	69% (2016: 58%)	76% (2016: 68%)
R1	71% (2016: 69%)	79% (2016: 72%)	74% (2016: 64%)	78% (2016: 64%)	69% (2016: 59%)	71% (2016: 69%)
R2	70%	76%	69%	75%	69%	75%

	(2016: 66%)	(2016: 73%)	(2016: 64%)	(2016: 64%)	(2016: 60%)	(2016: 69%)
R3	73% (2016: 63%)	77% (2016: 73%)	68% (2016: 57%)	73% (2016: 68%)	70% (2016: 55%)	74% (2016: 66%)
R4	74% (2016: 74%)	82% (2016: 74%)	72% (2016: 63%)	80% (2016: 70%)	67% (2016: 62%)	80% (2016: 69%)

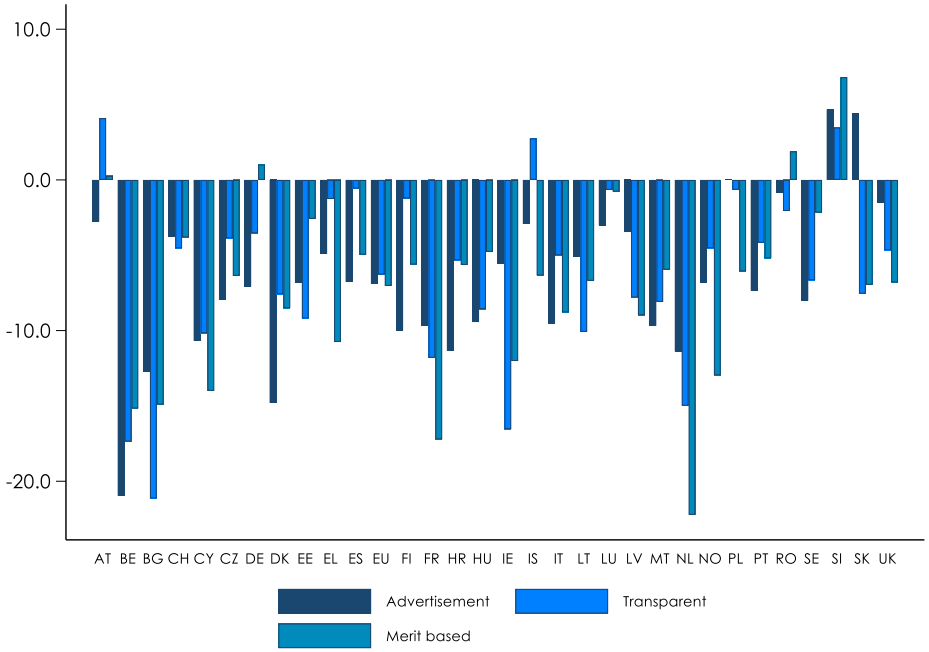
Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 2 "What is your gender?" and question 13 "In which career stage would you currently situate yourself?" and question 38 "What is your opinion on the following issues with respect to career progression in your home institution?"
(n= 9,321)

As with recruitment, some differences can be seen between countries with regard to the perceptions of female and male researchers concerning the transparent and merit-based nature of career progression – although it is not necessarily the same countries that stand out in a positive manner (Figure 31). The only country in which more female than male researchers perceive career progression in their home institution to be open, transparent and merit-based is Slovenia. Overall, the results indicate gender differences regarding researchers' perceptions of the fairness and transparency of career paths in almost all EU countries, and independent of career stages.

Figure 31: Gender differences in perceptions of transparent and merit-based career progression, by country



Source: MORE4 EU HE survey (2019)

Notes:

Based on question 2 "What is your gender?" and question 38 "What is your opinion on the following issues with respect to career progression in your home institution?"

(n= 9,321)

The picture concerning gender differences in recruitment and career progression is completed by looking at researchers' confidence in their future career prospects. Female researchers are, on average, less confident than their male colleagues (see Section 5.4.3.5 in the MORE4 EU HE Report, Figure 46). For instance, the share of female researchers who

feel very confident about their future career prospects (23%; MORE3: 18%) is 11 percentage points lower than the corresponding share of male researchers in the EU28. Furthermore, the share of female researchers who lack confidence in their future careers easily outweighs the corresponding share of male researchers, and is independent of the type of contract or career stage. These gender differences have remained stable since 2016.

The balance between the amount of time researchers spend teaching, compared with the time dedicated to research and publication activities, the quality of training, as well as opportunities to work with leading researchers, substantially affect the pace of researchers' development and the success of individual research careers. However, in the EU more male researchers (80%; MORE3: 76%) than female (73%; MORE3: 70%) are satisfied with their environment for scientific knowledge production. This includes research funding, access to research facilities and equipment, working with leading scientists, quality of training and education, balance between teaching and research, and research autonomy (see MORE4 EU HE, Section 6.2.1). With respect to each of the aspects mentioned, the shares of satisfied male researchers are higher than the shares of satisfied female researchers. In line with the results from 2016, the largest gender differences can still be found with regard to satisfaction with the balance between teaching and research. The share of satisfied male researchers (75%; MORE3: 71%) outweighs the corresponding share of female researchers by more than 11 percentage points (Table 21). Similarly, while only 47% of female researchers report being satisfied with their research funding, the figure for male researchers is 55%. With respect to satisfaction with opportunities to collaborate with leading scientists, the share of satisfied male researchers (88%) is also higher than the corresponding share of female researchers (81%) by 7 percentage points.

Table 21: Satisfaction with aspects of the environment for scientific knowledge production, by gender (EU28)

	MALE	FEMALE
Research funding	54.8% (2016: 44.2%)	46.6% (2016: 38.4%)
Access to research facilities and equipment	81.4% (2016: 78.6%9	74.0% (2016: 70.8%)
Working with leading scientists	88.4% (2016: 84.8%)	80.8% (2016: 78.3%)
Quality of training and education	90.3% (2016: 87.5%)	85.0% (2016: 83.9%)
Balance between teaching and research	74.8% (2016: 70.5%)	63.7% (2016: 62.1%)
Research autonomy	92.8% (2016: 89.8%)	87.5% (2016: 87.8%)

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 32 "Please indicate your satisfaction with each factor as it relates to your current position:" and question 2 "What is your gender?"
(n= 9,321)

International mobility offers the possibility of undertaking collaboration and knowledge exchange with leading scientists, and can be a decisive factor in determining the rate of progress in a researcher's professional career (and is a key factor in the attractiveness of different geographical research areas). The difference in the shares of female (25%) and

male (28%) researchers who have been mobile (>3 months) in the last 10 years is small (see MORE4 EU HE Report, Section 8.1).

However, the reasons for and against becoming mobile are not completely independent of a researcher's gender. 65% of non-mobile women mention failure to obtain research funding as an important factor in ultimately discouraging them from becoming internationally mobile. This contrasts with just 54% of non-mobile male researchers (Table 22)[265]. Similarly, the share of female non-mobile researchers who report lack of mobility funding as a major reason for not becoming mobile is higher by 11 percentage points than the corresponding share of male researchers (67% vs. 56%). However, problems in finding a suitable position and maintaining their level of remuneration are also more often referred to as mobility barriers by female researchers (64% and 53% of non-mobile women, respectively) than by their male counterparts (55% and 46% of non-mobile men).

These results are complemented by the analysis of different motives for mobility (MORE4 EU HE Report, Section 8.1.1.4). Female researchers who have been mobile for >3 months during the last 10 years more often mention opportunities for career progression (+9pp), as well as personal or family reasons (+7pp) as their main motives for moving abroad. In contrast, male researchers more often state a more attractive balance between teaching and research (+8pp) and better pension plans (+7pp) as motives for long-term mobility.

Table 22: Factors influencing non-mobility

	MALE	FEMALE
Potential loss of contact with your professional network	31.4% (2016: 26.6%)	35.1% (2016: 35.1%)
Access to research facilities and equipment for research	35.6% (2016: 27.5%)	33.1% (2016: 34.4%)
Quality of training and education	25.2% (2016: 26.1%)	31.0% (2016: 36.4%)
Finding a suitable position	55.4% (2016: 55.1%)	63.9% (2016: 56.5%)
Obtaining funding for research	53.6% (2016: 52.9%)	65.1% (2016: 61.0%)
Obtaining funding for mobility	55.7% (2016: 51.1%)	67.1% (2016: 64.3%)
Transferring research funding to another country	34.5% (2016: 29.9%)	37.7% (2016: 36.4%)
Maintaining level of remuneration	45.6% (2016: 36.0%)	53.3% (2016: 43.7%)
Transferring social security entitlements	37.5% (2016: 34.1%)	41.4% (2016: 41.9%)

[265] Mobile researchers were defined as researchers (R2, R3, R4) who have worked abroad for three months or more since completing their higher education (PhD or other) within the last 10 years.

	MALE	FEMALE
Transferring pension	36.2% (2016: 31.4%)	41.0% (2016: 38.4%)
Language barrier for teaching	25.0% (2016: 31.2%)	26.9% (2016: 28.7%)
Language barrier for contact/collaboration with colleagues	21.0% (2016: 25.7%)	23.2% (2016: 22.9%)
Culture	16.5% (2016: 13.1%)	14,80% (2016: 12.3%)
Obtaining a visa or work permit	23.3% (2016: 15.2%)	23.8% (2016: 18.2%)
Logistical problems	58.3% (2016: 43.1%)	64.1% (2016: 53.6%)
Other personal/family reasons	79.4% (2016: 80.2%)	79.2% (2016: 75.8%)

Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 80 "Which of the following factors were important in ultimately discouraging you from becoming internationally mobile and pursuing this path further?" and question 2 "What is your gender?" (n=1,618)

14.1.6. Parenthood, work-life balance and research careers

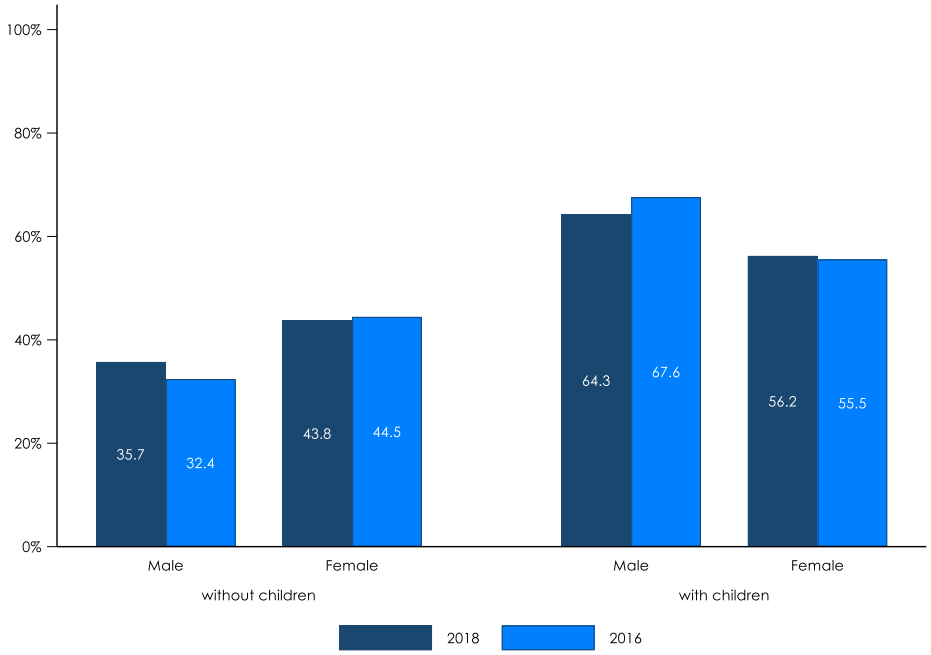
In the EU28, the share of male researchers who have children (64%) is higher by 8 percentage points than the share of female researchers with children (56%) in 2019 (see Figure 32). The overall share of researchers who have children (61%) remained stable since 2016, while the difference between men and women closed a little: in 2016, 68% of male and 56% of female researchers had children.

Gender differences with regard to children could be based on the combination of challenging working conditions for researchers and gender differences in care activities, rooted in traditional gender role models.[266] The high level of flexibility required by many research careers, and the insecurity inherent to them (for instance, with regard to international mobility or the chance of gaining access to a more secure fixed-term employment contract), is generally easier to accomplish when there is shared parental responsibility for childcare services and/or through the comprehensive provision of formal childcare arrangements. However, the latest statistics provided by Eurostat, based on EU-SILC, indicate that in 2019, out of the 23 EU Member States for which data were available, only 10 met the target for having 33% of children below three years old in formal care

[266] An alternative explanation could be that gender differences regarding children reflect a higher share of young female researchers compared with young male researchers, who do not yet have children. However, this possibility is unlikely since female researchers are not overrepresented in any age group, and are instead underrepresented in most (see Figure 27).

structures, and another 10 out of the 23 met the target of 90% of children between three and school-age being in formal care (the 'Barcelona targets')[267].

Figure 32: Family composition, by gender



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016).

Notes:

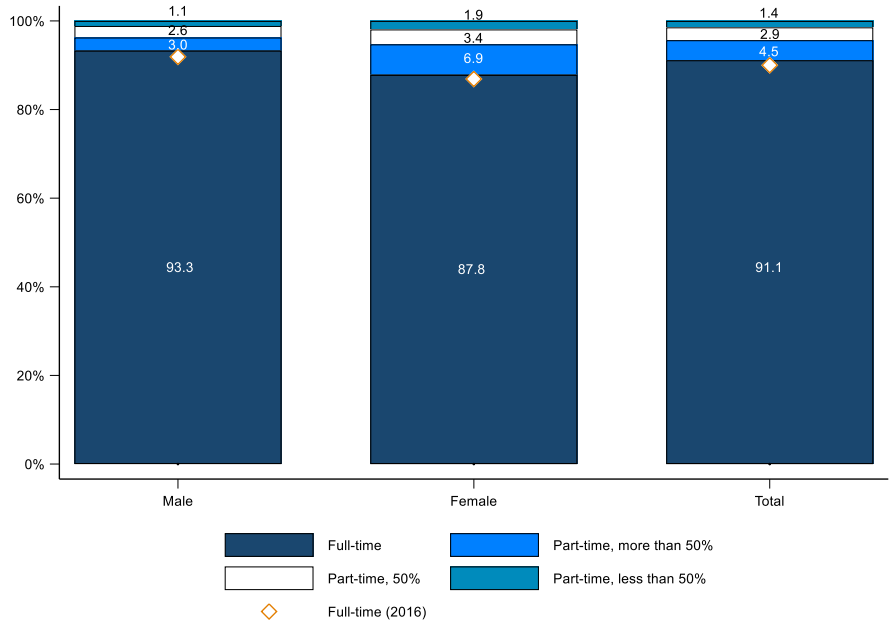
Based on question 2: "What is your gender?" and question 6 "What is your status?" (2019: n=5,963; 2016: n=8,306)

Alternative types of research careers – for instance, those associated with part-time work – can incorporate opposing aspects in relation to gender equality. On the one hand, different types of research positions can help to reconcile family duties and labour market participation (independent of a researcher's gender). On the other hand, in cases of unequal distribution of responsibilities for care activities between men and women, structural gender differences in the social and working environment may lead to the inadvertent reinforcement of gender disparities in career progression. Long-term, part-time work negatively affects research output and career progression, which in turn could prevent women from occupying key high-level decision-making positions. Moreover, it increases the likelihood of researchers finding themselves in financially tenuous situations, particularly at an advanced age.

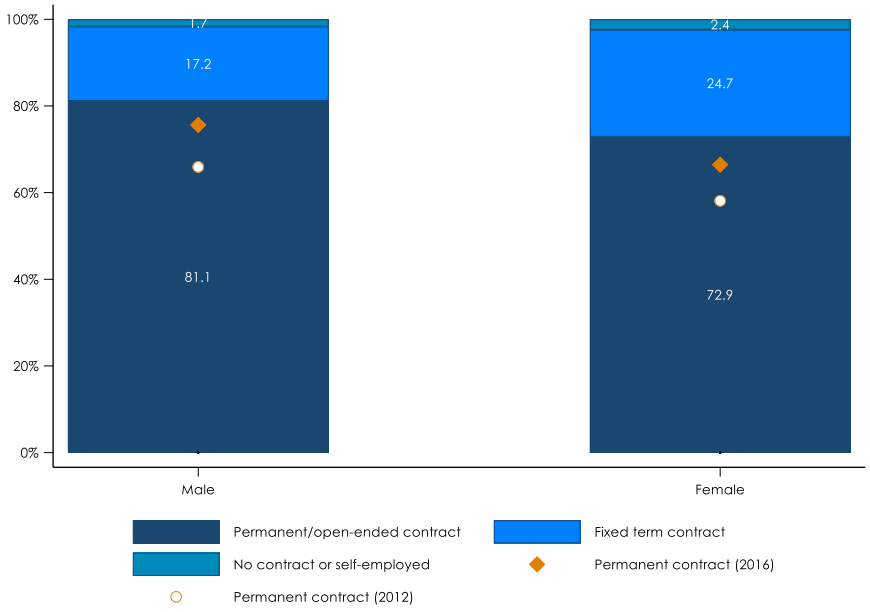
[267] In 2019, the countries that met the Barcelona targets regarding children below the age of three years were Denmark, Sweden, Belgium, Luxembourg, Malta, Portugal, the Netherlands, Spain, Slovenia, and Finland. Belgium, Denmark, Sweden, Estonia, Greece, Spain, Hungary, the Netherlands, Portugal and Slovenia met the target referring to children between three and school-age. For 2019, no data were available for France, Ireland, Italy, Slovakia, and the UK.

Figure 33: Distribution of researchers by type of contract, type of position and gender (EU28)

By type of position



By type of contract



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016) - Figure 8 in MORE4 EU HE report

Notes:

Based on question 2: "What is your gender?" and question 28 "Type of contract" and question 29 "Type of position"
(2018: n=9,161; 2016: n=10,184- 10,394)

The upper panel of Figure 33 shows that while full-time positions are the most common type of researcher position for both groups (88% of female and 93% of male researchers; MORE3: 87% vs. 92%), the percentage of women with part-time positions, especially those with 50% or more of the working time, is higher than in the case of men. Similarly, the share of researchers with permanent contracts is 8 percentage points higher among male

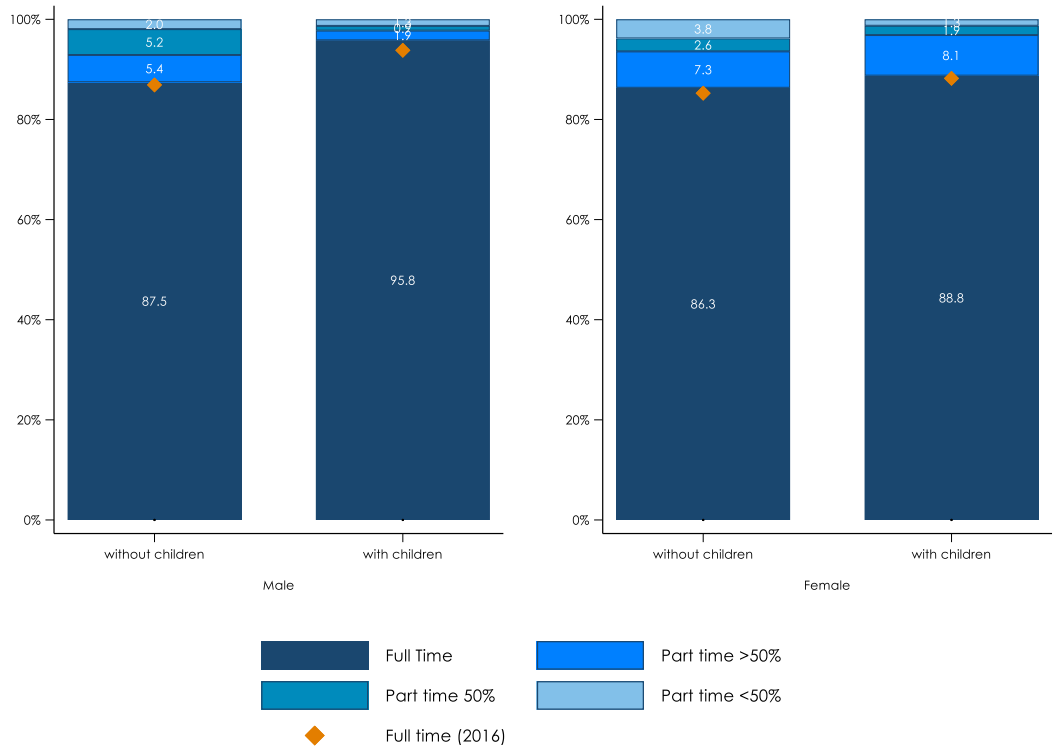
researchers than among their female counterparts: 81% versus 73% (MORE3: 76% vs. 66%; see lower panel of Figure 33). The shares of researchers who have a permanent contract have increased considerably in both groups since 2012; however, at the same time, the gap between female and male researchers has widened slightly (MORE2: 66% vs. 58%). These observations could, however, be related to the increasing number of female researchers in early career stages compared with later career stages.

A point often made in favour of part-time positions is their ability to facilitate the combining of family duties and labour market participation. This reasoning is, of course, gender-independent. Similarly to the results of MORE3, the share of part-time positions is (slightly) larger in the group of researchers without children for both women and men (see Figure 34). This might be based on the correlation between researchers' age and type of position.[268]

Moreover, the 2019 data shows the same pattern seen three years earlier: compared with the group of researchers without children, the group with children shows distinct gender differences with regard to researchers' types of position. While the share of female researchers who have children and work part-time hardly differs from the share seen among their counterparts without children (11% versus 14%), the share of male researchers who have children and working part-time (4%) is less than one-third to the size of the share of those working part-time without children (13%). This hints at a continuous transition of female researchers from part-time work in early career stages into part-time work induced by childcare responsibilities.

[268] Because early career stages and PhD studies are often connected with part-time positions and fixed-term contracts (see MORE4 EU HE survey), the share of researchers without children who are employed part-time may be higher in the group of young researchers (which includes fewer researchers with children) than in the group of older researchers (which includes more researchers with children).

Figure 34: Distribution of female and male researchers' types of position, by parenthood (EU28)



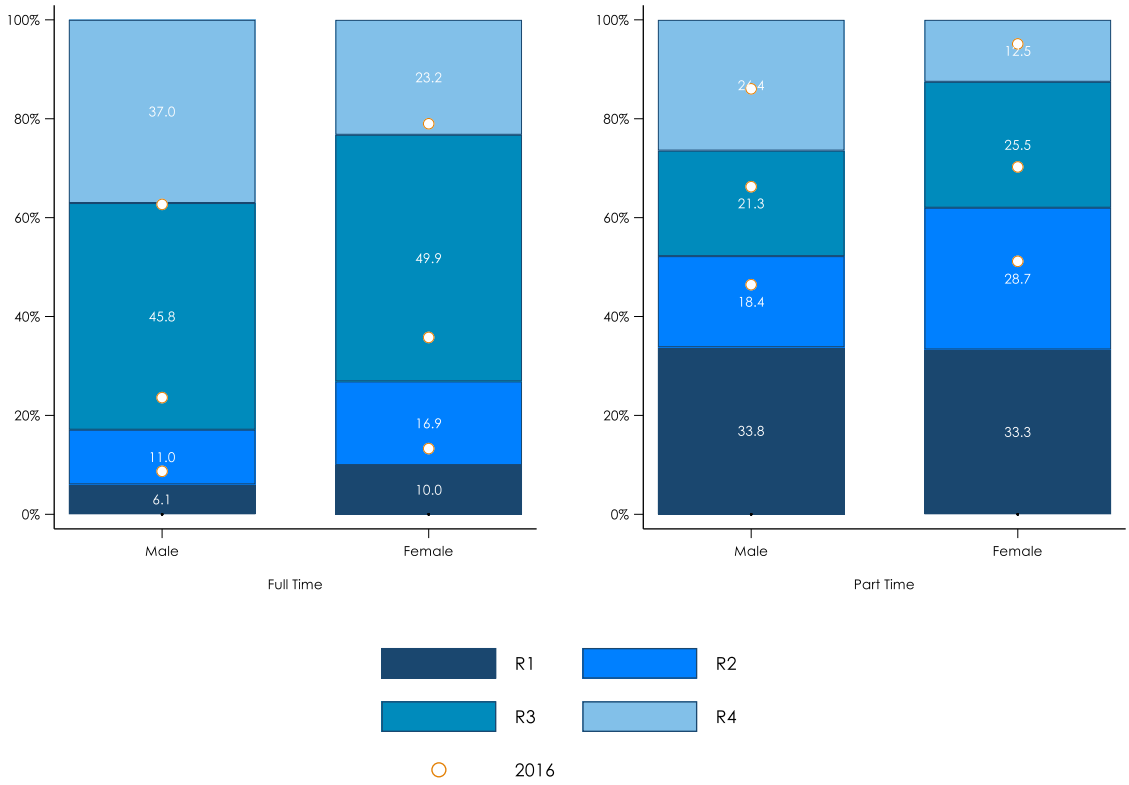
Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 2: "What is your gender?" and question 6 "What is your status?" and question 29 "Type of position?"
(2018: n=9,321; 2016: n=10,394)

If progressing to a more senior career stage is assumed to correlate with higher levels of decision-making power, part-time-work correlates negatively with decision-making power. In 2019, Figure 35 confirms this assumption to a certain extent: independent of researchers' gender, within the group of researchers who work part-time, the shares of early-stage researchers are particularly high, while the shares of established or leading researchers are particularly low in comparison to the group of researchers who work full-time. In addition, within the groups of both part-time and full-time workers, men appear much more frequently in career stage R4 than female researchers, which again points to a 'glass ceiling' effect. However, in 2019 both female and male part-time workers are much more equally distributed across career stages than three years earlier, indicating a general trend towards part-time working even at higher career stages. Women may ultimately benefit from this development.

Figure 35: Career stages and researchers' types of position, by gender



Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 2: "What is your gender?" and question 13 "In which career stage would you currently situate yourself?" and question 29 "Type of position?"
(2018: n=9,321; 2016: n=10,394)

14.1.7. Financial situation and gender income gap

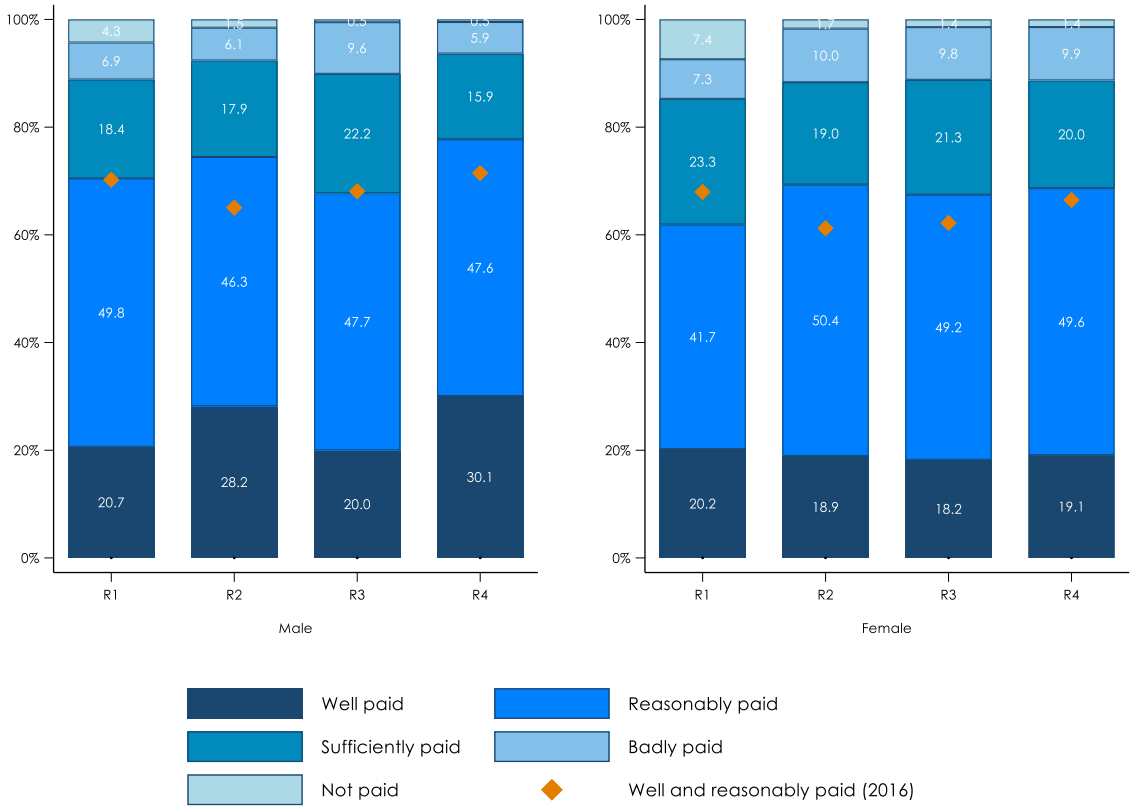
Examining gender-related differences in remuneration packages is critical. First, analysing female researchers' perceptions of their income situation and financial security is central to identifying, combatting and taking preventive actions against female poverty and social exclusion in the HE sector. Second, differentiation in remuneration between women and men might hint at potential discrimination against female researchers by their employers. Third, a comparison between academic and non-academic working conditions could be used to identify differences in the attractiveness of academic careers, and could help to increase the share of female researchers in both academia and in the private sector.

Research by Janger and Nowotny (2016)[269] reveals that female researchers attach a lower importance to salary compared with other features of research jobs. Given identical income levels, self-reported satisfaction with salary would, thus, be higher for women than men. Nevertheless, across career stages, the share of female researchers who assess themselves as being 'reasonably well' or 'well'-paid is slightly lower than the corresponding share of male researchers. The difference ranges between 1 (R3), and 9 percentage points

[269] Janger, J. & Nowotny, K., (2016) "Job choice in academia", Research Policy, 45(8), pp. 1672–1683.

(R1 and R4) (Figure 36). The opposite is true for badly paid researchers, or those struggling to make ends meet due to a poor salary.

Figure 36: Perceptions of remuneration package, by gender and career stage (EU28)



Source: MORE4 EU HE Survey (2019) and MORE3 EU HE Survey (2016)-

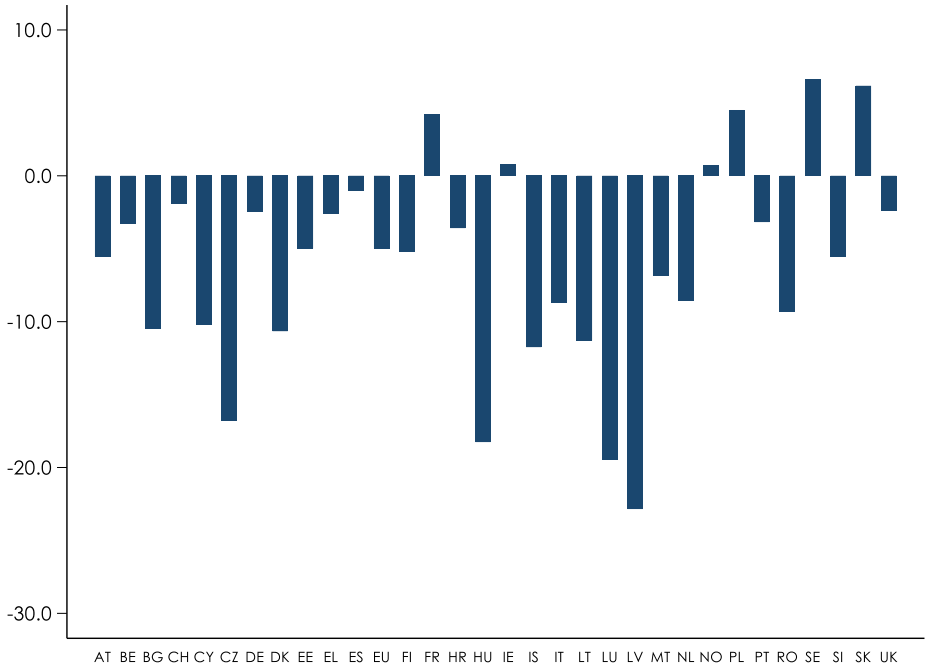
Notes:

Share of researchers who considering themselves 'well paid', 'paid a reasonable salary', 'paid sufficiently to only make ends meet', 'badly paid', 'struggling to make ends meet' or 'not paid'.
The category "not paid" doesn´t exist in MORE3 (2016).
Based on question 33: "How do you feel about your remuneration package (if you do not take into account a second income or, if applicable, the income of your partner)?"
(2019: n=9,321; 2016: n=10,394)

Gender differences in the perception of remuneration vary greatly between countries, though in almost all EU countries, the shares of female researchers who perceive themselves to be 'well' or 'reasonably well' paid are below those of male researchers. Figure 37 indicates that the share of female researchers who consider themselves to be either 'well' or 'reasonably well' paid is considerably lower than the corresponding percentage of male researchers, particularly in the Baltic countries (e.g. Latvia: -23pp), as well as in Eastern European countries (e.g. Hungary: -18pp). However, similar differences are also observed in Luxembourg (-19pp). No comprehensive, current and detailed data are available on the actual salaries of researchers in EU Member States that would allow researchers' perception of their remuneration to be contextualised. However, survey data from 2006 are available on researchers' remuneration in the public and private sectors. These generally support the large variation in gender differences between researchers'

salaries across EU countries.[270] At that time, gender pay gaps were found in almost every EU country, with the greatest differences between female and male researchers occurring in Estonia (47%), Portugal (37%) and the Czech Republic (37%)[271]. Overall, according to these survey data, female researchers earned on average 25% less than their male colleagues in 2006.

Figure 37: Gender differences in researchers‘ perceptions of remuneration, by country



Source: MORE4 EU HE survey (2019)

Notes:

Share of researchers who consider themselves ‘well paid’ or ‘paid a reasonably salary’.
Based on question 33 “How do you feel about your remuneration package (if you do not take into account a second income or, if applicable, the income of your partner)?” and question 2 “What is your gender?“
(n= 9,321)

When comparing their remuneration with that outside academia, both female and male researchers provide comparable assessments (see MORE4 EU HE survey). While only 10% of female and male researchers in the EU28 feel better paid than counterparts outside academia, 58% of female and 55% of male researchers perceived their income in academia as being worse than outside academia. However, differentiating between career stages shows that the higher the career stage, the higher the shares of female researchers (compared with their male colleagues) who perceive themselves as being worse paid than outside academia (Table 23).

[270] See European Commission. "Remuneration of researchers in the public and private sectors." (2007), p48.
https://cdn1.euraxess.org/sites/default/files/policy_library/final_report.pdf
[271] Survey data for Latvia are missing.

Table 23: Perceptions of remuneration compared with that outside academia, by gender and career stage (EU28)

	BETTER		SIMILAR		WORSE	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
EU	10% (2016: 12%)	10% (2016: 9%)	32% (2016: 28%)	35% (2016: 32%)	58% (2016: 60%)	55% (2016: 59%)
R1	9% (2016: 17%)	11% (2016: 12%)	37% (2016: 36%)	31% (2016: 41%)	54% (2016: 47%)	58% (2016: 47%)
R2	8% (2016: 10%)	7% (2016: 10%)	38% (2016: 35%)	47% (2016: 40%)	54% (2016: 55%)	47% (2016: 50%)
R3	11% (2016: 11%)	11% (2016: 8%)	30% (2016: 23%)	33% (2016: 30%)	59% (2016: 66%)	56% (2016: 62%)
R4	8% (2016: 10%)	10% (2016: 8%)	31% (2016: 25%)	36% (2016: 29%)	62% (2016: 66%)	54% (2016: 64%)

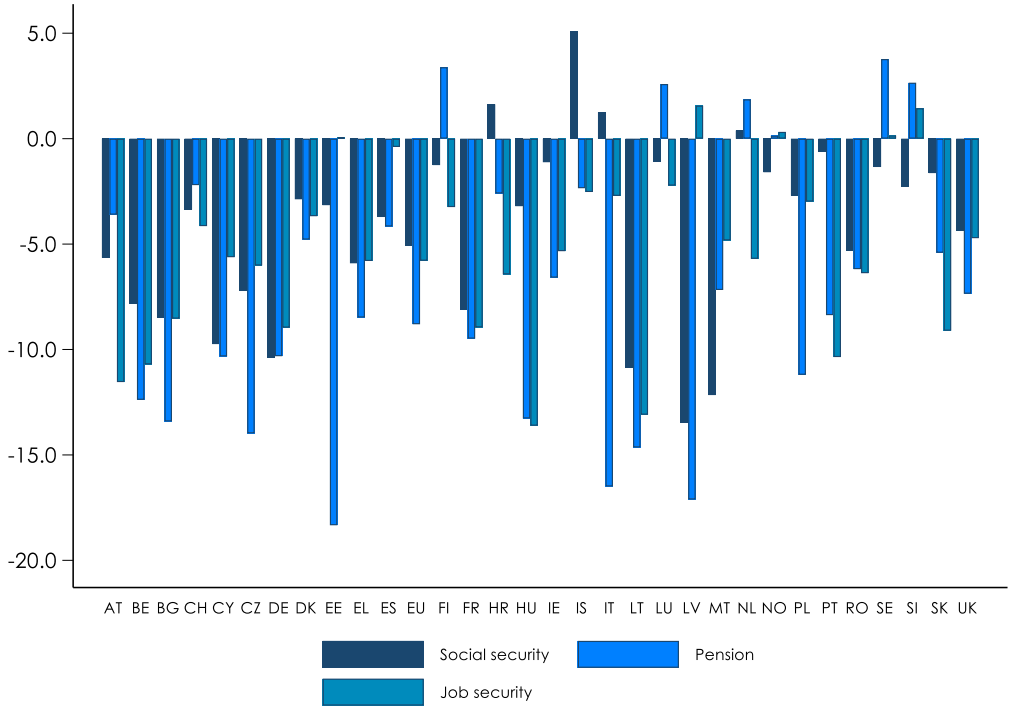
Source: MORE4 EU HE survey (2019) and MORE3 EU HE survey (2016)

Notes:

Based on question 35 "How would you compare your remuneration package to that of people with comparable skills and experience outside academia?" and question 2 "What is your gender?" and question 13 "In which career stage would you currently situate yourself?"
(n= 9,321)

Overall, the percentage shares of female researchers satisfied with their social security, pension system and job security are lower than the corresponding shares of satisfied male researchers in the EU28, by between 5 and 9 percentage points (Figure 38). This negative correlation between being a female researcher and researchers' satisfaction with social security, job security and the pension system remains significant even after controlling for part-time positions. The largest differences are observed with respect to pensions. In some countries – particularly in the Baltic countries, but also in Hungary, the Czech Republic, Germany and Belgium – the differences between the percentage share of satisfied female and male researchers easily exceeds 10 percentage points. In 2019, there is no country in which the share of satisfied female researchers is higher in all three aspects than that of male researchers.

Figure 38: Gender differences in satisfaction with job and social security attributes, by country



Source: MORE4 EU HE survey (2019)

Notes:

Based on question 32 "Please indicate your satisfaction with each factor as it relates to your current position:" and question 2 "What is your gender?"
(n= 9,321)

In comparison to MORE3, an upward trend can be observed: in 2019, the share of female researchers satisfied with social security was 84% (MORE3: 81%), 73% were satisfied with their pension system (MORE3: 68%) and 82% (MORE3: 76%) with job security (see MORE4 EU HE survey). This increase is not specific to female researchers, however, but mirrors the ongoing increase in average shares of satisfied researchers that have been observed since 2012.

14.2. EU policy aims and implications of MORE4 findings

At EU level, gender equality has been strongly integrated into all types of EU policies and programmes for researchers for more than 20 years. In 1999, for instance, the Communication on 'Women and Science'[272] presented specific measures concerning the

[272] COM(1999)76 final of 17.02.1999; see also the 'Women and Science initiative': ETAN working group report 'Science policies in the European Union: promoting excellence through mainstreaming gender equality', 1999; Resolution of the European Parliament on Women and Science of 03.02.2000 (EP 284.656); Commission working document "Women and science: the gender dimension as a leverage for reforming science" SEC(2001)771 of 15.05.2001; Council Resolution on science and society and on women in science of 26.06.2001; OJ C 199, p.1 of 14.07.2001; Report by the Helsinki Group on Women and Science "National policies on women and science in Europe" – March 2002.

strengthening of the gender dimension in European research policy. These were subsequently implemented through the 'Science and Society action plan'[273]. The Helsinki Group on Gender in Research and Innovation was also established in 1999 by the European Commission, to provide guidance on addressing the 'disadvantage of women' in research and science (support, dissemination and adoption of best practices, monitoring). The group continued to exist but in 2017 was transformed into the Standing Working Group on Gender in Research and Innovation (SWG GRI) under the European Research Area and Innovation Committee (ERAC), which advises the Council of the EU, the European Commission and Member States on policies and initiatives relating to gender equality in research and innovation (Priority 4 of the ERA)[274]. Since 2003, statistics on gender equality in science and research have been published in the SHE Figures reports[275].

In 2005, the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers were adopted by the European Commission. The Charter and Code recommend that "employers and/or funders should aim for a representative gender balance at all levels of staff, including at supervisory and managerial level." This was a positive signal with regard to achieving gender equality, given that 1,242 HEIs (mainly universities) signed up to the Charter and Code, according to the 30 September 2020 ERA Communication. A study has recently been commissioned by DG RTD, which focuses on ERA Priority 3 (open labour market for researchers) to consider the possible revision and updating of the Charter and Code.

Efforts have continued throughout every step of the ERA implementation process. Since 2012, gender equality and gender mainstreaming have become one of the six priorities for building the ERA. In 2015, the Competitiveness Council called for "translating national equality legislation into effective action to address gender imbalances in research institutions and decision making bodies and integrating the gender dimension better into R&D policies, programmes and projects"[276]. Moreover, later that year the Competitiveness Council encouraged "Member States and the Commission to set ambitious goals on gender equality and to take appropriate and concrete actions in their action plans or strategies to implement the ERA roadmap by mid-2016". It concluded that "making use of all talents and creating equal opportunities for men and women is not only a matter of fairness, but it is also an issue of economic efficiency. Embracing gender equality will contribute to EU competitiveness and to growth and job creation"[277].

Thus, all large EU programmes in the fields of R&I explicitly promote gender equality:

- The **Horizon 2020** programme explicitly implements this through its 'Vademecum on Gender Equality in Horizon 2020', agreed by the Helsinki Group

[273] Communication from the Commission (2001). *Science and Society Action Plan*.
[274] See ERA Portal Austria (2020). *SWG on gender in research and innovation.* Retrieved from https://era.gv.at/directory/85
[275] See European Commission (2018). *SHE figures 2018.* Retrieved from https://op.europa.eu/en/publication-detail/-/publication/9540ffa1-4478-11e9-a8ed-01aa75ed71a1
[276] Council of the European Union (2015). *Draft Council conclusions on the European Research Area Roadmap 2015-2020.* Retrieved from https://data.consilium.europa.eu/doc/document/ST-8975-2015-INIT/en/pdf
[277] Council of the European Union (2015). *Advancing gender equality in the European Research Area – Council conclusions.* Retrieved from https://data.consilium.europa.eu/doc/document/ST-14846-2015-INIT/en/pdf

delegates, which set the lines on gender equality, gender balance in research teams at all levels, and integrates the gender dimension into the content of research and innovation[278].

- The **Marie Skłodowska-Curie Actions** (MSCA) have from the outset emphasised gender equality. In line with the Charter and Code, and more recently, the Horizon 2020 commitments, they promote gender equality through transparent recruitment practices and good working conditions for researchers which, among other things, integrate work-(family) life balance. The MSCA also promote gender equality through the decision-making process (evaluation of proposals, human resources in project execution and supervision; decision making in the MSCA Advisory Group), and in the content of the research itself. The interim evaluation of the MSCA[279] found that the programme performs well in terms of gender equality. This evaluation, together with a recent study on research careers in Europe[280], recommends that the Career Re-start Panel be enhanced to further stimulate this aspect, for example by allowing for longer extensions and tailoring training support to the corresponding needs in order to enable restarters to fully re-establish themselves and compete with other researchers; or by supporting part-time fellowships in a more systemic way. This recommendation was addressed in the MSCA work programme 2018-2020.
- The **European Research Council** (ERC) has set up a dedicated Working Group to monitor gender balance in ERC calls. This Working Group on Gender Balance drafted consequent ERC Gender Equality Plans (2007-2013 and 2014-2020), with the objective of raising awareness among (potential) applicants, improving gender balance among ERC candidates and within ERC-funded research teams, identifying and removing any potential gender bias in ERC evaluation procedures, embedding gender awareness within all levels of ERC processes, while maintaining a focus on excellence, and striving for gender balance among ERC peer reviewers and other relevant ERC bodies[281].

In addition, it has been acknowledged that legislative and institutional levels are crucial to the achievement of gender equality, which calls for a combined effort by multiple stakeholders such as the Member States, research funding organisations (RFOs) and research performing organisations (RPOs). These developments mark a turning point from `fixing women' to `fixing institutions' through comprehensive gender equality plans to achieve institutional change, as well as `fixing knowledge', with Horizon 2020 and several national research funds ensuring that new research incorporates sex and gender analysis. This was an important step, both at the political level with regard to the systemic barriers

[278] See European Commission. *Gender equality*. Retrieved from https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/gender_en.htm

[279] FP7 *ex-post* and H2020 interim evaluation of Marie Skłodowska-Curie actions (2017). Directorate-General for Education, Youth, Sport and Culture
See https://publications.europa.eu/en/publication-detail/-/publication/27e546f6-c847-11e7-9b01-01aa75ed 71a1

[280] Research careers in Europe, Final Report (2016). Prepared by: PPMI Group (Lithuania) in cooperation with CARSA (Spain) and INOVA+ (Portugal) for the European Commission, Directorate-General for Education and Culture.

[281] See European Commission. *Working Group on Gender Issues*. Retrieved from https://erc.europa.eu/thematic-working-groups/working-group-gender-balance.

and disadvantages faced by female researchers, and in terms of the role of the gender dimension in research and innovation.

In 2018, the European Commission launched a proposal for the next EU Research & Innovation Programme (2021-2027), Horizon Europe[282]. According to the proposal, the programme will ensure that gender balance (e.g. in expert groups) is established and the gender dimension is followed through at all stages of the research cycle and is effectively promoted in research and innovation content.

In March 2020, the European Commission presented its `Gender Equality Strategy 2020-2025' for gender equality in Europe. This addresses various fields in which gender inequality still persists. The Commission "will introduce new measures to strengthen gender equality in Horizon Europe, such as the possibility to require a gender equality plan from applicants and an initiative to increase the number of women-led technology start-ups"[283]. These measures will be developed under the Horizon Europe European Innovation Council.

The ERA Progress Report 2016 indicated that different ERA Member States had achieved different levels of in progress gender equality, and had very different gender balance policies and initiatives. The ERA Progress Report 2018 found an increasing number of gender initiatives addressing various issues, including unconscious/implicit gender bias, and the inclusion of gender aspects in research, have been adopted across ERA countries in recent years. The report found varying degrees of progress, however.

The same report found that in recent years, one of the key areas of action in this area was the sharing of good practice examples among different ERA Member States and the development of gender equality guides for research organisations and funders. In 2017, Science Europe released a practical guide to improving gender equality in research organisations. The European Commission has supported the implementation of Gender Equality Plans (GEPs) in over 130 RPOs and RFOs through FP7 and Horizon 2020. Similar strategies have also been adopted at national level. France's MENESR (the Ministry for Education, Higher Education and Research) published France's road-map on gender equality in 2016, which presented a number of policies and measures to boost gender equality in the fields of higher education and research.

In general, over recent years, ERA Member States have implemented various measures focusing on gender equality in research. Examples of these are provided below:

- **Production of recruitment and selection guidelines for professorial appointments and training on gender bias.** RFOs in Austria, Germany, Spain, Finland, Ireland, Italy, Norway and Sweden have implemented measures regarding gender equality for scientists and/or the integration of the gender dimension into research content in their evaluation criteria. Before the Danish NAP was published, most Danish universities had already drafted management strategies for increasing equality, while some had also integrated gender equality

[282] European Commission (2018). *Regulation of the European Parliament and of the Council establishing Horizon Europe*. Retrieved from https://ec.europa.eu/commission/sites/beta-political/files/budget-may2018-horizon-europe-regulation_en.pdf
[283] ERA Portal Austria (2020). *Commission presents gender equality strategy.* Retrieved from https://era.gv.at/object/news/5203

into general diversity strategies. A number of universities have also appointed gender equality or diversity committees.

- **Better representation of women on scientific committees and advisory boards.** The main progress with regard to the implementation of the Dutch NAP under Priority 4 relates to close cooperation between representatives of the Ministry of Education, Culture and Science, the Netherlands Organisation for Scientific Research (NWO), the Royal Netherlands Academy of Arts and Sciences (KNAW), the Association of Universities in the Netherlands (VSNU), and The Dutch Network of Women Professors (LNVH). These bodies organised a number of joint meetings, themed days, workshops and other activities. In addition, some LNVH activities are directly linked with the goal of achieving numerically proportional representation of women on committees and advisory boards in the field of academic research and education. LNVH also regularly produces the publication 'Female Professors Monitor', and conducts studies on the gender gap. The Ministry of Education, Culture and Sciences dedicated an investment of EUR 5 million to appoint 100 female professors in upcoming years.
- **Awareness and communication activities aimed at the whole academic community, to enhance awareness regarding gender equality and unconscious bias.** In Ireland, the SFI's staff received sector-specific unconscious bias training in 2016, to minimise gender inequality in the organisation.
- **Learning and teaching – exploring teaching evaluations by gender, grade and ethnicity; including various aspects of equality and bias in their programmes; courses on the impact of gender stereotypes on career paths and research.** For example, with regard to the integration of a gender dimension into research content and/or teaching, Spain has implemented policies to promote this, and universities and accreditation agencies have been key actors in mainstreaming gender analysis in curricula. Portugal has implemented policies to promote the integration of a gender dimension in research content and/or teaching, and Portuguese universities and accreditation agencies have been identified as key actors in mainstreaming gender analysis in curricula.
- **Monitoring and evaluation – measuring the impact of training and reporting progress on gender equality annually.** Sweden has increased its monitoring and evaluation practices on gender equality and gender mainstreaming. As of 2016, a series of gender equality observations had been conducted in Sweden.
- **Several initiatives, programmes and policies have been adopted to promote the enrolment and retention of women in science.** In France and Spain, work-life balance was made explicit in policy documents. In Malta, the adoption of work-life balance related measures has increased (e.g. extension of maternity leave allowance, additional free childcare centres, etc.). Similarly, Italy has seen improvements in hiring policies, with more transparent recruitment procedures being introduced recently in RFOs and RPOs. In Denmark, some universities have signed three-year development contracts with the Ministry of Higher Education and Science, under which concrete goals have been set for increasing the share of women in academic positions or the share of female applicants for professorships.

Part 3. Policy implications and recommendations for further research

15. OVERARCHING POLICY IMPLICATIONS

15.1. Attractiveness of the ERA: global awareness of drivers of attractiveness meets heterogeneity in national research systems[284]

In general, MORE4 confirms and updates the findings of MORE3: policy implications are by consequence remarkably stable, and well in line with the priorities of the new ERA Communication. Overall, there is something of a 'global mindset' as to what makes for an attractive research career (in academia), or which characteristics of research jobs are most conducive to a successful research career. Characteristics that relate to long-term career perspectives, such as research autonomy, working with leading scientists, an appropriate balance between time for teaching and time for research, and sufficient funding to allow for the implementation of research agendas, are characteristics that influence the scientific productivity of researchers. These were found to be more important factors than those aspects of researchers' careers that relate to the 'material' conditions of a job or quality of life.

A shared understanding also exists as to what skills and training (a PhD) matter for a research career, and which factors matter for recruitment and career progression. Intersectoral mobility between public research or HEIs and private companies are regarded as less important for recruitment or career progression than international and interdisciplinary mobility. The findings of the MORE4 Global and EU HE surveys[285] with respect to what matters for attractive jobs in research are also consistent with the previous literature.[286]

By contrast, perceptions regarding the ways in which countries organise and structure their research systems (i.e. the conditions they provide for researchers to achieve their creative research potential) are much more diverse. While diversity can be positive and may provide opportunities for learning, low levels of satisfaction with funding and financial security, or very high shares of fixed-term contracts, are not conducive to positive diversity. Another example is that the structure of PhD training varies considerably, with the more traditional master-apprenticeship model still widespread in many countries, and also in the EU, while doctoral schools or more team-based PhD programmes dominate in US research universities. More structured PhD training might also make it easier to impart a wider set of transferable skills. In addition, variations exist across the EU in terms of satisfaction with merit-based recruitment and career progression.

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[284] Due to the often unchanged nature of the results and the continuing policy relevance of the topics raised, also in light of the new ERA communication 2020, several parts of this text are unchanged with respect to the MORE3 study.

[285] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.

[286] e.g. Friesenhahn, I. & Beaudry, C. (2014). *The Global State of Young Scientists*. Berlin: Akademie Verlag; Janger, J. & Nowotny, K. (2016). Job choice in academia, *Research Policy*, 45(8), p. 1672-1683.

The discrepancy between a 'global awareness' of what matters for successful research careers, and differences between national research systems, gives rise to varying perceptions of attractiveness between countries, as well as varying patterns of international mobility, including asymmetrical mobility or 'brain drain'. This not only pertains at global level, between high-income countries with strong research systems and lower-income countries with weaker research systems, but also at European level.

Whereas MORE4 – and the findings of previous MORE surveys – point to persistent differences between EU countries, this heterogeneity is not just a result of different higher education systems and career structures, but also of economic development influencing public budgets for research, and hence research funding and the salaries of researchers. **A continued emphasis on reforming national research systems** is hence a clear policy implication of MORE4, particularly with regard to the ERA aim of helping weaker research systems to catch up with the top systems within the EU. The issue of reform has become even more prominent in the new ERA Communication (Priority 1, prioritising investments and reforms and in priority 2, access to excellence), but also with regard to matching the conditions that non-EU research institutions provide for their researchers to maximise their scientific productivity. The nature of the relationship – win-win or win-lose – between the 'Global Research Area' and the 'European Research Area' will also depend to some extent on how level the playing field will be. Research institutions sharing a similar level of attractiveness will lead to knowledge exchange and brain circulation, while big differences may lead to brain drain.

Other lessons from the MORE4 surveys on the evolution of the ERA

MORE4 findings cannot causally attribute changes between MORE2, MORE3 and MORE4 to reforms, either at EU or national level. However, on the basis of the MORE4 findings, it is possible to summarise changes and the current *status quo* **with respect to EU policy aims**:

- On the one hand, there are **several positive developments that have continued since MORE2 in 2012**. Among these are the growing share of externally advertised positions; the rising agreement of researchers that recruitment and career progression are merit-based and transparent; a decreasing share of fixed-term contracts; and increasing satisfaction with working conditions (although these results need to be interpreted with care). As an example, these positive developments at EU level mask strong variations between countries. The limitations outlined in Section 1.4 also apply here in relation to the margin of error: e.g. in terms of gender, positive developments are observed among early stage researchers, but it is not clear yet whether these will be sustained to significantly change the 'glass ceiling' phenomenon observed in most EU countries.
- Another important finding confirmed by successive MORE surveys is that **research careers are attractive by nature**: researchers are intrinsically motivated by their enjoyment of the intellectual challenge and the level of responsibility that come with the activity of research. Increasing the number of researchers is hence less a task of building motivation, but of improving working conditions and career paths to enable researchers to do what they are interested in. Poor working conditions lead to researchers opting out of a research career, or to 'forced' international mobility. Attractive working conditions and career paths, together with high levels of satisfaction with the content of research jobs, can also compensate for dissatisfaction with pay, as regards comparisons

between academia and the private sector, and/or with non-EU, OECD countries such as the US.

- There are also **areas in which little change has taken place, though not necessarily reflecting insufficient policy efforts**. One such example is international mobility, which remains comparable in 2019 to results from 2016 and 2012. This is a type of indicator that is not expected to change in the short run; but it will be necessary to continue monitoring longitudinal trends. In the longer term, the influences of continued EU policy and programming support may be better assessed.
- On the other hand, **several areas addressed by EU policy aims appear to be in further need of reform**. The considerable heterogeneity across the ERA, and differences in the perceived attractiveness of different national research systems (and of the ERA in comparison to other research areas globally) have already been pointed out. This issue has been fully acknowledged at EU level through the new ERA Priority 2 (access to excellence). As a further example, perhaps surprisingly, a majority of PhD candidates or recent graduates indicate that they are supervised by a single researcher, whereas positive developments towards increasingly structured training are noted on the basis of university initiatives by the EUA and ERA Working Group on Human Resources, for example. The scale of recent progress may simply not have been enough to compensate for the wide gap between the EU and the US, where structured doctoral training in research universities is the dominant mode.
- In line with MORE3, the MORE4 findings also indicate that interest in **intersectoral mobility** among researchers currently working in EU HEI remains low, not just in terms of dual positions or mobility stints, but also in terms of whether industry exposure or intersectoral mobility are perceived as important for PhD training, or whether entrepreneurship and IPR rights are important skills for a research career. However, it must be pointed out that this picture is no different from countries outside the EU. The evidence available from the MORE4 Global survey (in line with MORE3) suggests an even lower role for intersectoral mobility in recruitment and career progression in the US, despite the fact that the US is often cited as an example of a research system that is good at turning knowledge into growth. An important issue in this respect is that **scientific productivity is positively associated with the commercialisation of research results**, so that fostering the former will also boost the latter[287].
- Transferable skills are regarded by 86% of researchers in the EU as being very important for career progression and recruitment, while 91% consider project-related work experience to be very important. However, only 32% of PhD candidates and recent graduates indicate they have received training in transferable skills such as time and people management, grant writing or communication and presentation skills. This remains unchanged from MORE3.

[287] See, for example, Perkmann, M., King, Z. & Pavelin, S. (2011). Engaging excellence? Effects of faculty quality on university engagement with industry. *Research Policy*, *40*(4), 539-552; Di Gregorio, D. & Shane, S. (2003). Why do some universities generate more start-ups than others?. *Research policy*, *32*(2), 209-227; Abramovsky, L., Harrison, R. & Simpson, H. (2007). University research and the location of business R&D. *The Economic Journal*, *117*(519); Van Looy, B., Landoni, P., Callaert, J., Van Pottelsberghe, B., Sapsalis, E. & Debackere, K. (2011). Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs. *Research Policy*, *40*(4), 553-564.

With regard to the attractiveness of the EU as a place to do research, several findings emerge:

- First, the more advanced the non-EU research system from which researchers come, or in which they have worked, the less positively they view the EU as a place to do research (and the other way around);
- Second, the EU's strengths are perceived as relating to job characteristics such as social and job security, pension plans and the quality of (undergraduate) education and training (subject to the variation between countries mentioned previously). The EU is perceived as being less good on balance than the most advanced research systems when it comes to drivers of attractiveness and international mobility (factors influencing the scientific productivity of researchers, particularly career paths) and also in relation to enablers of attractiveness (research funding and availability of positions).
- Third, among the four groups of EU and non-EU-researchers[288] with comparative knowledge of EU versus non-EU research systems, only the non-EU researchers who have been mobile to the EU in the past generally regard the EU as better across all dimensions than their current countries of employment.
- Fourth, in terms of specific countries or regions, the US continues to be perceived as much more attractive.
- Fifth, it is important to stress that the above findings are based on results for the EU as a whole, but that these findings are at the same time driven by large differences between Member States and institutions – with some institutions being very competitive at a global level.

This points to well-known strengths of the EU (vs. the US), such as social and job security, as well as good quality of life, but also the quality of broad (undergraduate) education and training. However, after basic education and training, talented EU researchers seem to perceive working conditions as being better for a career in science in the US or in Switzerland, possibly due to independence at an earlier stage (autonomy), collaboration with leading scientists, and (in the case of the US) attractive career paths (tenure track models, which link a tenured position solely to a researcher's output; these are, however, also in decline in the US). Again, substantial heterogeneity must be borne in mind. This perception of attractiveness is consistent with bibliometric studies of EU research performance[289] and various university rankings. In the purely bibliometric ranking by the university of Leiden (see Figure 39 below), the US occupies 14 spots in the top 25; 31 in the top 50; and 49 in the top 100. Among the top 25, there are also two Swiss HEIs, two Chinese HEIs, one HEI in Iran, one Israeli HEI and five UK HEIs. These results are hence

[288] The four groups were: EU researchers currently working abroad; EU researchers currently working in the EU but with a mobility experience outside the EU; non-EU researchers currently working in the EU; and non-EU researchers currently working abroad but with a mobility experience to the EU.

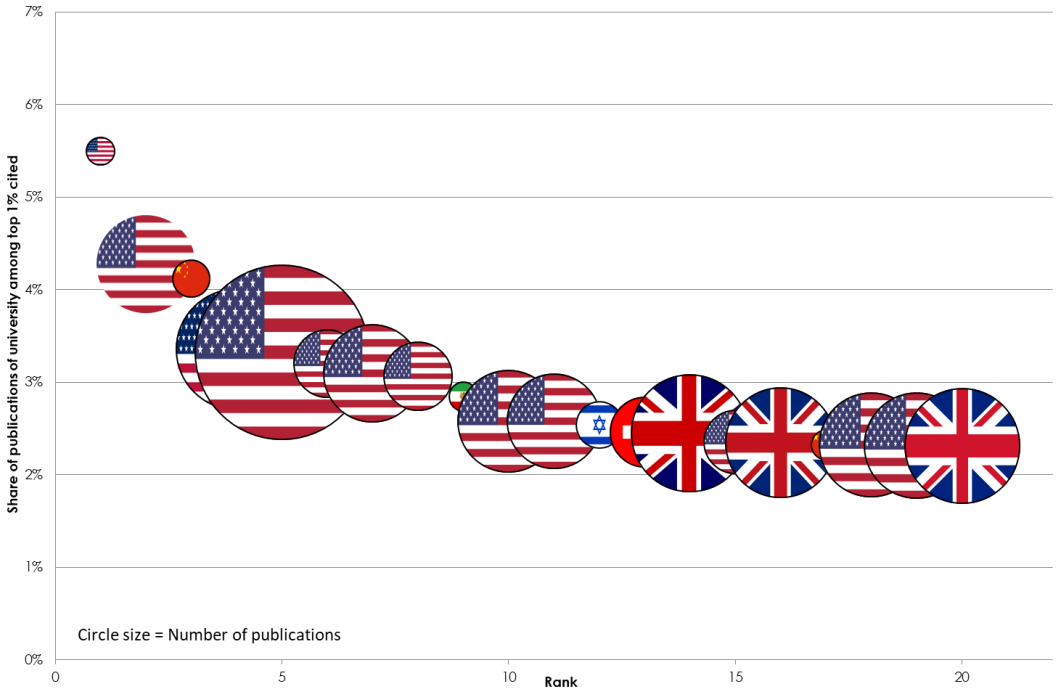
[289] See, for example, Rodríguez-Navarro, A. &Narin, F. 'European Paradox or Delusion—Are European Science and Economy Outdated?' Science and Public Policy. Accessed 22 May 2017; Albarrán, P., Crespo, J.A., Ortuño, I. & Ruiz-Castillo, J. (2010). 'A Comparison of the Scientific Performance of the U.S. and the European Union at the Turn of the 21st Century'. *Scientometrics* 85, no. 1(20 April 2010): 329–44; Bonaccorsi, A., Cicero, T., Haddawy, P. & Ul Hassan, S. (2016) 'Explaining the Transatlantic Gap in Research Excellence'. Scientometrics, 11 November2016, 1–25. doi:10.1007/s11192-016-2180-2; Hunter, R.S., Oswald, A.J. & Charlton, B.G. (2009). 'The Elite Brain Drain*'. The Economic Journal 119, no. 538: F231–F251. Note also the much stronger mobility flows of talented Chinese researchers towards US research universities than to European universities (Veugelers, R. 'The challenge of China's rise as a science and technology powerhouse', *Bruegel Policy Contribution* Issue N.19, July 2017.

different in emphasis from the report by the High Level Group on maximising the impact of EU R&I programmes, which found excellent scientific knowledge production in Europe, but deficits in terms of turning this knowledge into innovation and growth. While there is certainly excellent research in the EU, and the structure of some EU basic research renders this excellence less visible (e.g. top German and French basic research institutes such as the Max Planck Institutes or CNRS research institutions do not appear in the university rankings), there is definitely room for broadening research excellence in the EU, in particular now that the UK is no longer part of the EU.

It should be noted that many leading research-focused universities in Europe have pointed to deficiencies in the way in which the ranking criteria work. Looking ahead, improved metrics are required.

In conclusion, the MORE4 findings suggest the need for **a continued emphasis on reforms to national research systems**, or more generally on reforms to make the EU more attractive as a place to do research (including measures to increase the effectiveness of national research systems, in order to make PhD training, career paths and working conditions, including perspectives for mobility, more attractive compared with international counterparts).

Figure 39: Ranking of universities by share of publications among the top 1% of publications in terms of citations, as well as number of publications (circle size)



Source: CWTS Leiden Ranking 2020.

Policy implications

From the findings above, which have remained remarkably stable throughout the various editions of the MORE surveys, it is clear that increasing the attractiveness of the EU or of the ERA as a place to do research hinges on many factors. We have conceptualised these factors as **drivers and enablers of attractiveness**.

Enablers: research funding and the availability of positions are perceived to be the two greatest barriers to mobility across the board in MORE4 (as they were in MORE3). Improving these factors would reduce barriers to mobility and make it easier for researchers to become mobile. We therefore term these two areas 'enablers of attractiveness': factors that, if improved, will no longer form a barrier to mobility and will enable all those interested in an international move to do so. Researchers cannot join an otherwise attractive research system if there are insufficient numbers of suitable positions and/or insufficient research funding. Further enablers of attractiveness, in particular in an international context and when a new job involves changing countries, relate to pension portability or immigration rules. However, these administrative barriers are not perceived to be the main barriers to international mobility.

Drivers: The quality of the working conditions that influence scientific productivity, such as working with leading scientists, long-term career perspectives (the tenure track model), research autonomy and the balance between teaching and research, are the main drivers of attractiveness for jobs in research: factors that drive the decision of researchers to become mobile. Previous evidence from MORE2 shows that researchers are "willing to pay", i.e. to sacrifice some potential salary, in exchange for higher quality-working conditions relevant to scientific productivity.

In summary: as a general takeaway, reducing administrative barriers to mobility, such as enabling pension portability or liberalising entry regulations are important – but they will not on their own make the EU more attractive. What is needed in addition are attractive working conditions for researchers which help them implement their research agenda. This implies that a **strong policy focus is required at institutional and governmental levels on boosting scientific productivity** to foster the symmetrical mobility of researchers (brain circulation), and the attractiveness of the EU as a place to do research.

This implication can be illustrated by a suggestion for policies aimed at increasing cooperation and mobility flows between the EU and China[290]. Increasing bilateral cooperation programmes does not in itself increase the attractiveness of research institutions, and Chinese researchers go specifically to US universities because of their prestige – in fact, the Shanghai university ranking was set up precisely with the aim of guiding Chinese students in their choice of research location. Attracting Chinese researchers to European universities will, on top of bilateral cooperation programmes, require improved working conditions including research funding, research autonomy, and working with leading scientists.

Another illustration is provided by policies to encourage return mobility. MORE4, like MORE3, shows that the return mobility of researchers is high when they are in their early career stages. Conversely, once they are established or tenured at a prestigious university, it is very difficult to encourage them to return. Sending out talented researchers without a level playing field in terms of the attractiveness of research institutions, as suggested for increasing mobility flows, may hence constitute a risk. This means that efforts aimed at recruiting the most promising researchers at early stages of their careers, rather than at later stages, are likely to be more successful. In practice, this implies offering attractive career perspectives to early-stage researchers in terms of, for example, a tenure track-career model. In this model, researchers join a HEI as assistant professors on a fixed-term

[290] Veugelers, R. The challenge of China's rise as a science and technology powerhouse, Bruegel Policy Contribution Issue N.19, July 2017.

contract, but turning this fixed-term contract into a permanent one depends solely on the research performance of the researchers. Trying to recruit leading researchers at later career stages would be more costly by comparison. This is not to say that return mobility policies are necessarily ineffective, but that they cannot replace an attractive research system for early-stage researchers. Both bilateral cooperation programmes and return mobility policies need, therefore, to be complemented by efforts to improve the conditions for scientific knowledge production.

Implications for the use of policy instruments: in terms of overall instrument use, increasing the attractiveness of the ERA in terms of conditions for knowledge production could follow a four-pronged strategy:

- **Further increasing research funding**, which continues to be perceived as the working condition in the EU with the least satisfaction; low success rates in Horizon 2020 have already been discussed, and also apply to specific initiatives such as European Industrial Doctorates. The new ERA Communication makes this a clear priority (Priority 1 on investments). While there is some increase in budget for Horizon Europe, a substantial increase in research funding will have to come from EU Member States. Without an increase in research funding, it will be difficult to improve the availability of research positions or research projects that can be funded. This could lead early-stage researchers to look at research systems which offering more attractive conditions in this regard.
- **Increasing research funding could also be used for science-business research cooperation**, as in the COMET funding programme by the Austrian research promotion agency FFG, for example. This funds research cooperation between firms and research institutions, including universities, by funding research centres in which both industry and academic researchers work together, and where pre-docs also work. This could be a way to boost both research funding overall, linking science and business as well as opening up avenues for PhD students. This could be particularly interesting for countries with low business-science cooperation, or with very low interest by academics in industry exposure, as well as low research funding (e.g. Spain, Italy).
- **Ensuring that this money flows to the most talented**, particularly in systems with a limited overall amount of public research funding. Both the ERC and MSCA are funding schemes that are clearly successful in allocating money to highly promising researchers.
- **Attracting the most talented researchers**, based on attractive career paths and working conditions for research, as outlined above. Satisfaction with career perspectives is third-lowest among all working conditions in the EU, and researchers in particular perceive career perspectives as being better outside the EU than within it; several EU instruments are also important here in terms of an open labour market (ERA) and Open, Transparent and Merit-based (OTM) recruitment, as well as the MSCA and ERC.
- **Ensuring that knowledge is shared among policy makers** with regard to how the first three elements can be achieved most effectively. The diffusion of best practices on how to structure recruitment policies, career paths and conditions for scientific knowledge production, in order to spread excellence from existing centres in the EU to wider areas of the EU, needs to be tailor-made to take into account the heterogeneous nature of the EU. It requires country-specific issues to be addressed, such as the balance between teaching and research in some Central and Eastern European countries, as well as transparent and merit-based recruitment and career paths in certain Southern European countries. Moreover, while a high share of fixed-term contracts exists in countries such as Germany, this is not the case in many

other European countries, meaning that researchers' careers continue to be characterised by their precariousness with an over-dependency on short-term careers. Increasing evidence is available from comparative studies on achieving this, including from the MORE projects and the Policy Support Facility (PSF), which is an instrument that supports a growing number of Member States (see the new ERA Communication).

Some specific caveats need to be added, taking account of other literature:

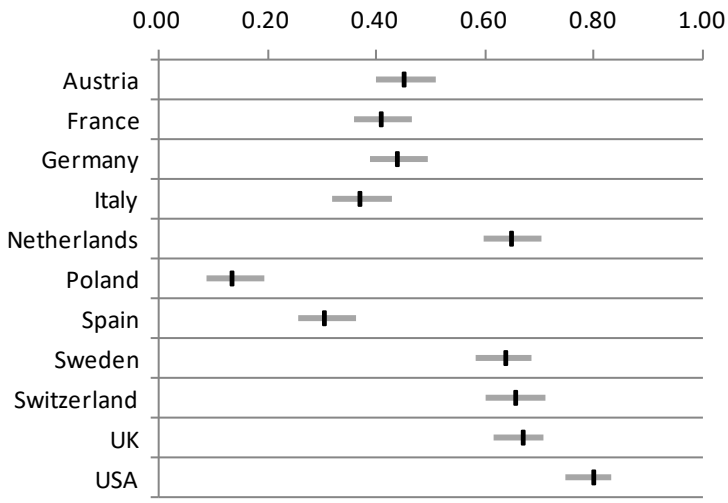
- First, satisfaction with the **balance between teaching and research** is second-lowest, next to funding and career perspectives. But what is an "optimal" balance between teaching and research? Research based on MORE2 data found that "research-only positions" are actually not a driver of attractiveness, and that some teaching is even preferred to no teaching at all. However, too much teaching clearly decreases the attractiveness of a job in research[291].
- Second, when a higher share of researchers hold tenured positions, care needs to be taken to **keep incentives for scientific productivity high over the life-cycle of researchers**. This can be achieved through allocation of funding (see above), or by making time for research and for teaching in part dependent on research performance. Of course, this requires careful independent evaluation over longer a time horizon, e.g. 10 years. Otherwise, time horizons for research would be shortened, leading to risk aversion. In principle, however, such flexibility will not only keep positions open for early stage researchers, but will also help to address the balance between teaching and research.
- An increased **emphasis on drivers of attractiveness does not mean that enabling conditions should be overlooked**. For instance, a general enabling prerequisite for international mobility, or people coming towards the EU, is simply the ability to teach in English – not in terms of the researcher speaking English, but in terms of the university allowing the researcher to teach a course in English. This often limits the recruitment of international researchers. Finally, several EU instruments are in place to improve social security/pension portability (the EURAXESS network and the RESAVER programme, the first ever pan-European pensions scheme).

EU and national-level initiatives are addressing many of these points (see Sections 4-14). MORE4 cannot evaluate the effectiveness of these initiatives, but the MORE4 findings clearly indicate the need to continue efforts to increase the attractiveness of the EU as a place to do research, as is the goal of the new ERA Communication. This not just in comparison to strong research systems outside the EU, but also involves further concentrating efforts to help weaker EU research systems to catch up with the top EU performers – again, as indicated in the new ERA Communication with its emphasis on excellence, brain circulation and widening. Such efforts could benefit from regular monitoring of the attractiveness of research systems in terms of attractive job offers. The figure below shows an index of job attractiveness for selected countries, based on the findings of MORE2 and further work. Such a regular 'ranking' of research systems with

[291] See Janger, J. & Nowotny, K. (2016). Job choice in academia. *Research Policy*, *45*(8), 1672-1683; the "optimal" share of teaching in combined teaching-research time (without administrative tasks) was found to be roughly 27% for early stage researchers, and somewhat higher for later stage researchers.

respect to their attractiveness could provide reform incentives for policy-makers, similar to the rationale for the European Innovation Scoreboard (EIS).

Figure 40: Example of an indicator- and expert-based assessment of job attractiveness in academic research



Source: Janger, J., Strauss, A. & Campbell, D. (2019). "Attractiveness of jobs in academia: a cross-country perspective ". *Higher Education* 78(6), p. 991-1010.

15.2. Lessons for optimal knowledge exchange and circulation through researcher mobility

Aside from the attractiveness of the ERA, optimal exchange and circulation of knowledge within and outside the EU is a key dimension in the realisation of the ERA, and in the setup of the MORE studies (see the conceptual framework in Section 3). Under the concept of optimal exchange and circulation of knowledge, international, intersectoral and interdisciplinary mobility play a crucial role, as well as other forms of exchange through research collaborations. Mobility both mirrors and affects attractiveness. Many of the ideas mentioned above will thus also affect mobility. In the following section, we will therefore not repeat these overarching points, but rather focus on specific policy implications by type of mobility. We also discuss the concept of Open Science under the heading of knowledge circulation. Based on a comparative analysis of findings from the various MORE4 surveys and reports[292], a number of policy-relevant conclusions are outlined.

[292] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.
PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Researcher Indicators report. European Commission, DG Research and Innovation.

International mobility[293]

As stated before, international mobility is generally considered a key dimension of international networking and knowledge exchange, with positive effects for the individual researcher and for the research and knowledge ecosystem as a whole. At individual level, researchers see positive effects on the advancement of their skills and scientific productivity, as well as on their career progression. At system level, international mobility facilitates capacity-building and interconnectivity within the system.

An analysis of the findings of consecutive MORE studies makes it clear that there are many different forms and motives for undertaking mobility, and not all forms of mobility are voluntary. Forced mobility points to a heterogeneity in terms of available research positions, funding, career progression and working conditions. Self-chosen mobility refers to a positive choice for exchange and networking. The main questions arising in the policy context are how to further foster mobility, how to address the issue of forced mobility, and how to evolve towards more balanced brain circulation in Europe.

Many policy initiatives tend to focus on facilitating administrative processes (e.g. visa procedures), human resource practices or even social security and pension rights. However important these efforts are to reducing barriers to mobility and creating a level playing field, the responses to the MORE4 EU HE survey indicate that **at an individual level**, researchers mainly move for reasons relating to scientific production. Researchers move to another country because of networking opportunities, to work with leading scientists, and for research autonomy. They also feel that it has a positive effect on their career progression. A balance between removing barriers and improving conditions that drive the mobility of researchers will be essential both to attract mobile researchers and to enable them to undertake this step to, or within, Europe.

In this context, it is necessary to give attention to the specific situation of early-stage researchers. Even though the drivers of mobility for early-stage researchers are generally the same as those for post-PhD researchers, early-stage researchers are at the same time more focused on their training and on the availability of research funding and positions. In this respect, actions or services can be further addressed towards young researchers by taking these specific needs into account.

The effects of mobility can also be further optimised by encouraging researchers to return voluntarily to their home countries, maintaining their networks from their mobility experiences and benefitting from the knowledge exchange this entails. This can be considered for early-stage researchers (less bound to permanent positions) and those in later career stages (highly positive effect in terms of bringing with them networks, knowledge, skills, etc.), but will only be effective when the research environment is sufficiently attractive for them to consider a return.

At the same time, the concept of knowledge exchange and mobility can evolve over time. The increased focus on digitalisation and sustainability, as well as recent experiences with digital tools during the COVID-19 pandemic, may have an impact on mobility behaviour

[293] In the MORE4 EU HE survey, international mobility refers mainly to transnational mobility within the EU – and only to a lesser extent includes information on flows outside Europe.

over the coming years, with virtual collaboration and mobility becoming more important than before. The availability of information technology and digital solutions can further facilitate virtual exchanges[294]. The MORE4 study shows that virtual mobility can, to some extent, replace (mainly) short-term visits[295]. A report by the ERA-SGHRM Working Group[296] also foresees opportunities to foster virtual mobility, in particular when combined with short term visits[297]. The combination of physical and virtual mobility thus remains important for reaping the full benefits of collaboration and exchange. An additional advantage of virtual mobility is that it can enable interaction with top researchers who do not want to move for a longer period of time, or with researchers who have moved to more attractive research regions but who want to continue collaborating and to support capacity building in their home country.

At the system level, fostering brain circulation within the EU and increasing the attractiveness of the EU as a destination for researchers at a global level requires a continued effort to reduce the impact of differences in R&I and HEI systems across countries. As stated by the Joint Research Centre (JRC) in a report on international mobility[298], divergences between countries will persist as long as excellence in research is fragmented and dispersed. By contributing to the research excellence of Member States and harmonising existing best practices, the EU will not only foster 'internal' international circulation, but will also strengthen its attractiveness outside Europe. This cannot be seen in isolation from other policy domains, i.e. in the field of innovation, education, regional development, etc. Synergies have been sought between funding programmes, and will continue to be strengthened.

The new ERA Communication[299] strongly emphasises the need for this: it will support ESFRI with regard to research infrastructures, and will work together with the European Education Area (EEA) to strengthen the public science system. Moreover: "Large-scale concerted action in support of the institutional transformation efforts of universities will be based on a roadmap of EU, national and regional actions for better use of synergies between Union programmes including Horizon Europe, Erasmus, ESF+ and ERDF and private R&I investments, notably through the support of the InvestEU programme."

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[294] See, for example, ERA-SGHRM Working Group (2016). Innovative Transnational Research Mobility and Welcoming Researchers to Europe; Inzelt A. (2010) Analysis of Researchers' Mobility; European Science Foundation (2013) Science Policy Briefing. New Concepts of Researcher Mobility, a comprehensive approach including combined/part-time positions.
[295] See MORE4 EU HE report: Virtual mobility seems to have an increasing impact on the reduction of international mobility. 57% of the researchers in MORE4 indicate that virtual mobility can reduce short term visits, while this share was 51% in 2016 (MORE3) and 50% in 2012 (MORE2). For long-term visits, 22% of the researchers in MORE4 indicate this option, versus 9% in 2012 and 11% in 2016.
[296] ERA-SGHRM Working Group (2016). Innovative Transnational Research Mobility and Welcoming Researchers to Europe https://cdn3.euraxess.org/sites/default/files/policy_library/final_era-sghrm_innovative_transnational_research_mobility_and_welcoming.pdf
[297] This refers to the EuroScience Open Forum meeting, which concluded that virtual mobility would work, but should be combined with short-term visits to other labs to allow face-to-face contact. See O'Carroll, C. (2014). Virtual mobility can drive equality. *Nature*, 511, 292
[298] Fernández-Zubieta, A. & Guy, K. (2010). Developing the European Research Area: Improving knowledge flows via researcher mobility. JRC Scientific and Technical Report, JRC-IPTS.
[299] European Commission (2020) Communication. A new ERA for Research and Innovation.

Reforms to R&I systems will also continue to be supported through Horizon Europe, and in particular the 'Widening participation and strengthening the ERA' package. This will support the 'lower-performing' Member States to valorise and connect existing ecosystems and thereby improve access to excellence[300]. The 'widening programme' operates in synergy with the Cohesion Policy: "A smart and coherent use of Cohesion policy support should complement EU and national R&I programmes in upgrading knowledge infrastructures, building capacity and inducing structural transformations, on the basis of well-designed smart specialisation strategies."

Interdisciplinary mobility and collaboration

The MORE4 study defines interdisciplinary mobility as moves between fields and collaboration with other fields. Researchers indicate that they generally regard this as a positive factor for recruitment and career progression – less so than international mobility, but more so than intersectoral mobility. The extent to which interdisciplinarity is necessary or beneficial for researchers might depend on the career type and research topic. But in general, where policy supports interdisciplinarity, it also supports individual researchers in their careers. MORE4 data indicates, for example, that researchers who have worked in projects funded by an MSCA or ERC grant tend to display higher levels of interdisciplinary mobility and collaboration than the general population of researchers.

However, one issue that arises in the interpretation of the data and contextualisation within the existing literature is that there is no commonly accepted definition of interdisciplinary research, mobility or collaboration. This makes it difficult to compare or benchmark findings. A clear-cut definition would include a definition of the concept of a "discipline" and a differentiation between the ways in which research is carried out (i.e. the integration of theories, methods, data, etc.) and the ways in which researchers work and collaborate (i.e. with colleagues working in the same discipline, or in a different one).

Although the concept of interdisciplinarity is a lesser part of the picture than international mobility and intersectoral exchange, it is also of increasing importance at system level. The missions to be launched under the mission-oriented policy approach applied in Horizon Europe are expected to link activities across disciplines and types of R&I[301]. The scientific and innovation solutions needed to help solve some of the most challenging problems of this time will require an interdisciplinary approach, and this will be further supported via the Horizon Europe programme.

Intersectoral mobility

Intersectoral mobility is considered a key element of knowledge transfer, at all career stages and in all fields. Initiatives promoting intersectoral mobility – and more generally, a strong interconnectivity with other sectors and other actors, can be one of the solutions to closing the gap between academia and industry. The new ERA Communication (2020)[302] mentions the need for intersectoral mobility schemes that can incentivise researchers to

[300] Ibid.
[301] European Commission. *Missions in Horizon Europe.* Retrieved from https://ec.europa.eu/info/horizon-europe/missions-horizon-europe_en
[302] European Commission (2020). *Communication. A new ERA for Research and Innovation.*

pursue a career outside academia and "boost the permeability of talents across Europe's economy and society".

However, the MORE4 findings show that interest in intersectoral mobility among researchers currently working in EU HEIs remains low, not just in terms of dual positions, or mobility stints, but also in terms of whether industry exposure or intersectoral mobility is perceived as important for PhD training, or whether entrepreneurship and IPR rights are important skills for a research career.

- The share of researchers working in the private sector in the EU (based on Eurostat data) is low in comparison with other advanced economies (Japan or the US). Instead of converging, the MORE EU surveys show that the levels of intersectoral mobility in the EU have decreased from 30% in 2012 to 25% in 2016, and to 24% in 2019.
- In addition, researchers who currently work in academia generally do not attach great value to intersectoral mobility as a positive factor for recruitment or career progression. Initiatives promoting the positive recognition of intersectoral mobility in performance evaluations or recruitment in academic settings are still rare.
- Researchers who have experienced intersectoral mobility have different reasons for doing so These also depend on the sector(s) in which they have worked. Contribution to society is more frequently mentioned among those who have worked in the government and not-for-profit sectors. Gaining first-hand experience of industry, remuneration and bringing research to the market are more commonly cited motives among those with experience in private industry[303]. Future initiatives to promote intersectoral mobility should therefore take into account researchers´ motivations in order to trigger as much interest as possible from individual researchers.
- Differences are also observed between fields, and the motivations or expected benefits can differ for researchers from different fields. From the policy-making perspective, future initiatives would need to take into account the differences between fields of science, and should explicitly define the expected benefits.

Aside from mobility to other sectors, other forms of exchange and collaboration should be fostered to exploit the potential of industry-science linkages and the transfer of ideas. MSCA co-funding of doctoral programmes already positively takes into account "collaboration with a wider set of partner organisations, including from the non-academic sector, which may provide hosting or secondment opportunities or training in research or transferable skills"[304]. The MSCA Research and Innovation Staff Exchange (RISE) (previously IAPP, or Industry-Academia Pathways and Partnerships) is a further example of exchange opportunities, offering support for short-term mobility of research and innovation staff at all career levels, from the most junior (post-graduate) to the most senior (management). They are based on flexible intersectoral exchanges (within Europe) and international exchanges (with third countries) of highly skilled research and innovation

[303] See Table 14 in Section 12.1.
[304] European Commission (2020). *Co-funding of regional, national and international programmes*. Retrieved from https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/msca-cofund-2020

staff. Innovative Training Networks (ITN) explicitly mention the meaningful exposure of researchers to the non-academic sector as an important factor in increasing their employability[305].

However, intersectoral mobility is not considered widely recognised in the evaluation of researchers' performance. This hinders researchers´ incentives to engage in this type of career move. In the renewed policy context (i.e. Horizon Europe and ERA), intersectoral cooperation and mobility of researchers, and the importance of training in relevant skills for multiple research career paths, are again confirmed. This may support initiatives towards the stronger recognition of cross-sectoral research opportunities in the future.

Open Science

Open Science is highly relevant in the context of knowledge exchange and research careers. The concept has become increasingly important in the European Research Area and in funding/grant programmes at European level. It is expected to increase efficiency and creativity, reinforce excellence, and strengthen society's trust in science[306].

Reinforcing a culture of Open Science begins with education and training. In 2017, the Working Group on Skills of the Steering Group Human Resources and Mobility (SGHRM) focused on the introduction of Open Science education and training tailored to the four career stages (R1-R4), as well as in doctoral training programmes, and in earlier education (i.e. Master's, Bachelor's, high school)[307]. For this purpose, the working group identified the skills necessary for Open Science and proposed a European Skills and Qualifications Matrix for Open Science.

One of the main challenges in this context is the rewarding and incentivising of Open Science contributions, in a variety of possible career paths. The Working Group on Rewards of the SGHRM recommended[308], among other things, that ERA policies, ERA roadmaps and National Action Plans should be reviewed through the lens of Open Science to ensure compatibility. Assessments for recruitment, career progression, grant evaluation, etc. should therefore include Open Science elements (see the proposed OS-Career Assessment Matrix).

In 2020, the new ERA communication[309] supports Open Science under the pillar of 'Deepening the ERA', and sets the following objectives:

- To continue building the European Open Science Cloud (EOSC) as a common, federated, European framework for openly sharing research data and accessing services;

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[305] European Commission (2020). *Innovative Training Networks.* Retrieved from https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/msca-itn-2020 ITNS
[306] European Commission (2020) Communication. A new ERA for Research and Innovation.
[307] European Commission Open Science. Retrieved from https://ec.europa.eu/research/openscience/index.cfm?pg=skills_wg
[308] Working Group on Rewards under Open Science (2017), Evaluation of Research Careers fully acknowledging Open Science Practices; Rewards, incentives and/or recognition for researchers practicing Open Science https://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf#view=fit&pagemode=none
[309] European Commission (2020) Communication. A new ERA for Research and Innovation.

- To develop an Open Research Europe publishing platform for open access to scientific publications (via Horizon Europe);
- To incentivise Open Science practices by improving the research assessment system.

The upcoming Horizon Europe Framework programme will be strongly based on Open Science as its *modus operandi*, going beyond Horizon 2020's open access policy to require immediate open access for publications and data, and research data management plans. The EC states that the Programme will "encourage the proliferation of FAIR data (findable, accessible, interoperable, and re-usable) and support a sustainable and innovative scholarly communications ecosystem. It will foster activities to improve researcher skills in Open Science and the reward systems that promote this. Research integrity and citizen science will play a central role, as will the development of a new generation of research assessment indicators." This will be facilitated through the European Open Science Cloud (EOSC), which provides an environment for hosting and processing research data to support EU science.[310]

The updated Skills Agenda[311] stipulates the need to develop Open Science and science management curricula for researchers, to support the upskilling of scientists.

Given the increased policy attention to Open Science at EU level, the MORE4 study included a number of new options and questions to address this evolution and gain further insight in the concept. The key finding are:

- On the training aspect, the MORE4 EU HE survey shows that only 19% of PhD candidates received training in Open Science approaches. Open Science is thus not yet explicit in training for the majority of researchers.
- In terms of assessment, we find that Open Science practices are less often considered positive for recruitment or career progression, in comparison with most other factors. Comparing this perception regarding Open Science practices as positive factors for recruitment and career progression with activities that researchers have already engaged in, we find the following:
    - Although publication in Open Access journals is not among the top factors positively affecting recruitment and career progression (69% of researchers consider it positive for recruitment, 71% for career progression), 83% of researchers have already published in Open Access journals.
    - Similarly, 81% have participated in public awareness activities (these activities are considered to be positive for recruitment/career progression by 74%/77% of researchers, respectively).
    - Moreover, most researchers are willing to share research data, software and codes publicly. By 2019, 75% of the researchers had at some point shared this kind of information. Time will confirm whether this trend persists.

[310] European Commission (2020). *European Open Science Cloud (EOSC)*. Retrieved from https://ec.europa.eu/info/research-and-innovation/strategy/goals-research-and-innovation-policy/open-science/eosc_en

[311] European Commission (2020). Communication. European Skills Agenda for sustainable competitiveness, social fairness and resilience.

- From the MORE4 EU HE survey, there are indications that funding can play a role in better understanding Open Science and encouraging an Open Science culture. Although there are other factors for which the effects of grants are confirmed by more researchers, 70% of researchers in EU HE still think that grants affect their understanding and application of Open Science approaches. In general, European grants are associated more often than national grants with effects on Open Science.
- International mobility (>3 months post-PhD mobility) has a smaller effect on the understanding/application of Open Science approaches than it does on other factors such as networking, advancing research skills, recognition in the research community, etc. Around half of the mobile researchers indicate this factor remained unchanged after international mobility.
- Working within the HE sector is considered slightly better for Open Science approaches than working outside the HE sector (although the majority of researchers find it to be similar in both contexts).
- Open Science is considered to be much better in the EU than in many other countries (BRICS and others), but slightly worse than in the non-EU OECD countries (this observation is similar to that for other factors).

The findings thus confirm the need to continue efforts in the field of training and assessment frameworks, as well as encouragement through the integration of elements of Open Science into EU research funding instruments, to further support an Open Science culture among researchers and the HEIs they work for.

15.3. Achieving gender equality in science

Although a quantitative 'catching up' by women in terms of access to academic positions has been observed over the past few decades, key literature, supported by the statistics, demonstrates that there are ongoing gender inequalities in terms of the recruitment and career advancement of women in higher education systems. Besides the omnipresent wage gap between women and men, this is particularly true for more qualitative aspects of researchers' lives, such as access to senior level, decision-making positions and to full-time positions; the balance between teaching and research; and conflicts between roles (i.e. between work and family).[312] Of course, the scope of gender inequality differs between higher education systems, fields of science, and countries. The findings of the MORE4

[312] e.g. Bryant, L.D., Burkinshaw, P., House, A.O., West, R.M. & Ward, V. (2017). Good practice or positive action? Using Q methodology to identify competing views on improving gender equality in academic medicine", BMJ Open, 2017, 7(8), p. e015973; Goastellec, G. & Pekari, N. (2013). Gender differences and inequalities in academia: Findings in Europe, The work situation of the academic profession in Europe: Findings of a survey in twelve countries, Springer, 2013, pp. 55–78; Herman, C. & Hilliam, R. (n.d.). The Triple Whammy: Gendered Careers of Geographically Marginalised Academic STEM Women, Science and Technology, p. 19; Kuhlmann, E., Ovseiko, P.V., Kurmeyer, C., Gutiérrez-Lobos, K., Steinböck, S., von Knorring, M., Buchan, A. M. & Brommels, M. (2017). Closing the gender leadership gap: a multi-centre cross-country comparison of women in management and leadership in academic health centres in the European Union, Hum Resour Health, 15(1), p. 2; Leisyte, L. & Hosch-Dayican, B. (2013). Changing Academic Roles and Shifting Gender Inequalities: A Case Analysis of the Influence of the Teaching-Research Nexus on the Academic Career Prospects of Female Academics in the Netherlands, Journal of Workplace Rights, 17(3–4), pp. 467–490; O'Connor, P., O'Hagan, C. & Brannen, J. (2015). Exploration of masculinities in academic organisations: A tentative typology using career and relationship commitment, Current Sociology, 63(4), pp. 528–546.

Global and EU HE surveys[313] on gender inequalities in research jobs are, by and large, consistent with the previous literature.

The results of MORE4 show that the participation of female researchers in the EU labour market has stagnated since 2012. In total, compared with the share of female researchers at earlier career stages, women are less often found in leading scientific positions, with the gap being particularly high in Health Sciences. Improving the share of female researchers at more senior-level career stages may also result in them being more confident about their financial situation. Overall, women perceive their financial situation in a less confident way than men, and are less likely to be satisfied with their pension plan, social and job security. This is accompanied by an unequal distribution of female and male researchers in terms of contracts and positions. Although the overall share of researchers with permanent contracts has increased since 2016, the gender gap still prevails, with more women than men having fixed-term contracts. Fewer female researchers hold full-time positions compared with their male colleagues, though male researchers are more likely to have children.

Suggested initiatives and measures targeting gender inequality are manifold. In 2018, eight countries[314] received specific recommendations under the European Semester framework to improve female labour market participation[315]. Existing gender inequalities threaten to worsen as a result of the COVID-19 pandemic and economic crisis. A strategy for economic recovery that improves access to inclusive, high-quality early childhood care, education and upbringing – which is known to compensate for social disadvantages – would bring socioeconomic benefits in the medium and long term, and could open up opportunities for women to participate more fully in the labour market. Even in countries with relatively high female employment rates before the crisis (e.g. Austria), a high share of women were employed part-time. To some extent, this is the result of the sub-optimal provision of childcare facilities, which prevents a reduction of the gender pay gap. In scientific research, the issues relating to part-time work may be even more pronounced due to the 'masculine orientation' of the research ethos, which builds on the notion of science as a mission performed by a devoted researcher with no commitments outside science[316]. Combined with increasing competition for the best brains, which encourages risk-taking and tough behaviour, researchers working part-time will find it difficult to gain scientific recognition and thus decision-making positions.

The literature has identified three complementary approaches to address gender imbalance: individual, cultural and structural approaches[317]. While approaches involving

[313] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
PPMI, IDEA Consult & WIFO (2020). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.
[314] Austria, the Czech Republic, Germany, Estonia, Ireland, Italy, Poland, and Slovakia.
[315] Report on equality between women and men in the EU
[316] Linková, M. (2017). Academic Excellence and Gender Bias in the Practices and Perceptions of Scientists in Leadership and Decision-making Positions, *Gender and Research*, 18(1), pp. 42-66.
[317] See Schmidt, E.K., Cacace, M. (2018). Setting up a dynamic framework to activate gender equality structural transformation in research organizations, *Science and Public Policy* 46(3), p. 18, for a comprehensive overview on the topic.

'fixing the individuals' focus on mentoring, training and coaching programmes, it has been widely acknowledged that institutional gender barriers that reproduce gender stereotypes and privilege male career progression within university faculties need to be tackled at the same time[318]. Because gender inequality is linked to other organisational problems, various measures such as diversity training for decision-makers, are therefore recommended to address managerial and organisational bias[319]. Moreover, institutional hierarchies determine the likelihood of an individual rising to a higher, decision-making position within an organisation. Thus, one of the most promising ways to address structural issues might be "practices that assign responsibility for change to the organisation"[320]. Schmidt and Cacace point out that in the case of Denmark, where many supportive programmes and services were already in place, the biggest problem was lack of awareness of the persistency of gender inequality and its effects on scientific careers. "Symbolic and interpretive negotiations were therefore mostly needed in this situation, as a prerequisite for the mobilisation of internal and external stakeholders"[321].

The evaluation of policy measures to improve gender equality is, however, challenging. In the framework of the PRAGES Project[322], Kalpazidou-Schmidt and Cacace (2017)[323] evaluated survey data on 125 gender equality programmes in Europe, North America and Australia during the last three decades. The interventions most often implemented in these programmes are networking initiatives, dissemination of information material, mentoring programmes, training courses, empowerment schemes and mainstream actions. The introduction of quotas and the establishment of specific targets to increase the share of women in leading positions were the least common. While most of the programmes are highly relevant and sustainable, the weak point of all programmes is efficiency, and one in 10 programmes demonstrate only minor impact. Furthermore, in comparison with North America and Australia, European programmes appear "to have a greater capacity to impact the gender dimension of research, teaching, and design, while they seemed to have less objective impact on the creation of an enabling environment for women"[324]. This is supported by the MORE4 results, which show little improvement in female researchers' satisfaction with their job environment, promotion and participation in high-level positions over recent years. The authors conclude that project quality and impact are non-linearly related: "These results highlight the complexity of the task and the difficulties for gender equality programmes to achieve significant impacts even when they meet high-level quality standards in terms of management and implementation"[325].

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[318] e.g. Van den Brink, M. & Stobbe, L. (2009). Doing gender in academic education: The paradox of visibility, Gender, Work & Organization, Wiley Online Library, 16(4), pp. 451–470.
[319] See Willemsen, T. & Van Vianen, A. (2008). Gender issues in work and organizations, Applied social psychology: Understanding and managing social problems, Cambridge University Press, Cambridge, UK, pp. 206–225.
[320] Kalev, A., Dobbin, F. & Kelly, E. (2006). Best practices or best guesses? Assessing the efficacy of corporate affirmative action and diversity policies", American sociological review, Sage Publications Sage CA: Los Angeles, CA, 71(4), pp. 589–617.
[321] Ibidem.
[322] Practising Gender Equality in Science (PRAGES) Project: https://cordis.europa.eu/project/id/217754/reporting
[323] Kalpazidou Schmidt, E. & Cacace, M. (2017). Addressing gender inequality in science: the multifaceted challenge of assessing impact", Research Evaluation, Oxford University Press, 26(2), pp. 102–114.
[324] Ibidem.
[325] Ibidem.

The results of the EFFORTI project[326] show that the optimal approach is a combination of interventions aiming to improve gender balance higher up the career ladder, along with interventions aimed at more structural change. Moreover, gender-equality interventions are better legitimised when synergies between different initiatives are exploited. Thus, German DFG standards[327] and the Excellence initiative were cited as positive examples of gender equality initiatives. Gender-biased recruitment or promotion procedures could be overcome by tools such as 'future potential analysis', under which "a candidate for a leadership position is assessed for her/his 'future potential' as opposed to past achievement"[328]. Gender equality was observed to have an impact on R&D outcomes particularly in the case of interventions that incorporate gender dimensions in tertiary education and research content. Moreover, the implementation of legislation by accreditation agencies appears to be an effective instrument for integrating gender dimensions into tertiary education, demonstrating the key role of the governance framework.

Though somewhat rarely used in HE sectors, the setting of quotas connected to university funding could be used to target gender imbalance. For instance, to promote good employment practices for women working in science, engineering and technology in the UK, the NIHR started shortlisting only medical schools with an Athena SWAN Silver status for certain research grants in 2011. Recent research on this initiative shows that there was a marked improvement of women succeeding in medical schools, but so far the initiative has not demonstrated a significant overall impact on female researchers' career paths in the long run[329].

Another key challenge is to achieve not only top-level but also bottom-up commitment to addressing gender equality. Measures such as funding that is specifically targeted at women, while providing a more concrete programme objective that can lead to higher demand, run the risk of causing resentment in some parts of an organisation. The literature indicates that even the `good' guys, i.e. men who would be seen by their colleagues as pro-feminist, exhibit "a reluctance to forego the material, interactional or ideological privileging of masculinity or to change the structures which perpetuate it"[330]. Thus, positive attitudes and motivation toward gender equality initiatives are as essential as formulating targets and standards followed up by monitoring (i.e. information and indicators regarding the intervention must be available). Thus, strategies to soften resistance are necessary, such as integrating gender equality problems into meetings with directors and managers

[326] Evaluation Framework for Promoting Gender Equality in R&I (EFFORTI): https://efforti.eu/
[327] Deutsche Forschungsgemeinschaft (2018). *The Research-Oriented Standards on Gender Equality.* Retrieved from https://www.dfg.de/en/research_funding/principles_dfg_funding/equal_opportunities/research_oriented/index.html
[328] Palmén, R. & Müller, J. (2019). Synthesis on the Case Study Work (Work Package 4), https://efforti.eu/sites/default/files/2019-05/EFFORTI_Summary_Case%20Studies.pdf.
[329] Gregory-Smith, I. (2015). The impact of Athena SWAN in UK medical schools. The Sheffield economic research paper series (SERPS); Ovseiko, P.V., Chapple, A., Edmunds, L.D. & Ziebland, S. (2017). Advancing gender equality through the Athena SWAN Charter for Women in Science: an exploratory study of women's and men's perceptions. *Health research policy and systems*, 15(1), 1-13.
[330] O'Connor, P., O'Hagan, C. & Brannen, J. (2015). Exploration of masculinities in academic organisations: A tentative typology using career and relationship commitment. *Current Sociology*, 63(4), 528-546. Also, Armato, M. (2013). Wolves in sheep's clothing: Men's enlightened sexism & hegemonic masculinity in academia. *Women's Studies*, 42(5), 578-598.

to highlight gender equality as a relevant issue for the institution. Awareness of gender inequality and a strong commitment to change across institutional levels must be a central policy goal. For instance, Manchester et al. report that despite existing university policies to exclude time after a birth from the 'tenure clock', female researchers experienced a wage penalty when using this regulation because it was perceived as a lack of commitment to the institution[331]. After all, the success or failure of all initiatives crucially depends on gender competence, experience and knowledge, which is- another reason to promote participation in gender equality actions and its positive acknowledgement within recruitment processes.

15.4. Reflections on current policy instruments

The Marie Skłodowska-Curie action and the ERC grants are two of the EU instruments most frequently used by researchers to undertake different forms of mobility. The Marie Curie Actions were launched in 1994 and their name was changed to Marie Skłodowska-Curie actions (MSCA) in January 2014, while the ERC was set up in 2007. The general objectives of MSCA and ERC grants are aligned with the overarching objectives pursued by the Framework Programmes. The MSCA and ERC programmes were part of the previous 7th Framework Programme, though they were encompassed in different specific programmes. The ERC was included in the Specific Programme IDEAS, providing project funding for individuals and their teams engaged in 'frontier research'. In this context, this type of research is referred to in the following terms: "basic research in science and technology is of critical importance to economic and social welfare, and on the other that research at and beyond the frontiers of current understanding is an intrinsically risky venture, progressing on new and most challenging research areas and is characterised by an absence of disciplinary boundaries"[332].

The MSCA, meanwhile, were included in the Specific Programme PEOPLE, funding "actions to improve the training, career development, and mobility of researchers between sectors and countries worldwide"[333]. Its main objective was "to make Europe more attractive to researchers […] by pursuing a considerable structuring effect throughout Europe on the organisation, performance and quality of research training, on the active career development of researchers, on knowledge-sharing through researchers between sectors and research organisations, on increasing partnership between industry and academia, and on strong participation by women and early-stage researchers in research and development."[334]

Under the Horizon 2020 Framework Programme, both the MSCA and the ERC funding schemes share similar overarching objectives. These are summarised in Article 14 of Regulation No. 1291/2013, which calls for linkages and interfaces to be implemented across and within the priorities of Horizon 2020. Various objectives defined by this Regulation are of interest to this note:

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[331] Manchester, C.F., Leslie, L.M., & Kramer, A. (2013). Is the clock still ticking? An evaluation of the consequences of stopping the tenure clock. *ILR Review*, *66*(1), 3-31.
[332] (2006) Council Decision concerning the Specific Programme "Ideas" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013) L 400/265
[333] European Commission (2013). Seventh FP7 Monitoring Report (p.4)
[334] (2006) Council Decision on the Specific Programme "People" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)L 400/282

- The development and application of key enabling and industrial technologies as well as future and emerging technologies;
- Interdisciplinary and cross-sectoral research and innovation;
- Fostering the functioning and achievement of the ERA and of the flagship initiative 'Innovation Union';
- Widening participation across the Union in research and innovation and helping to close the research and innovation divide in Europe;
- International networks for excellent researchers and innovators;
- Cooperation with third countries;
- Responsible research and innovation including gender;
- SME involvement in research and innovation and broader private sector participation;
- Enhancing the attractiveness of the research profession; and
- Facilitating cross-border and cross-sector mobility of researchers.

Excellent research, as well as international, interdisciplinary and intersectoral mobility, are therefore at the core of all MSCA and ERC funding schemes funded both under FP7 and H2020. This will remain so under Horizon Europe, where the ERC and MSCA are included under the pillar of Excellent Science.

The MORE4 EU HE survey[335] was designed to analyse patterns of mobility and working conditions of researchers in Europe. As such, it was not specifically tailored to analysing the characteristics of MSCA and ERC grant holders, nor researchers employed by projects funded by these initiatives. Although (as we will later show) some questions in the MORE4 EU HE survey relate to the general objectives of these programmes, the specific goals and expected impact of each of them cannot be analysed in detail. These programmes provide various types of grants destined for specific target groups, and it was not part of the design of the MORE4 survey to target them specifically. Some important remarks are worth highlighting:

- The survey does not provide information on the role of respondents in relation to MSCA or ERC grants: i.e. there are no insights as to whether the respondents were principal investigators of a project, unique beneficiaries of a fellowship, or employed in a project funded by these initiatives[336].
- The survey does not allow differentiation between current grant holders and those who have benefited from these grants in the past.
- The survey does not provide any information on the period during which the grant or fellowship was received, or when the project was carried out.

Due to these limitations, it is not possible to analyse causal relationships based on the MORE EU HE surveys. However, the MORE surveys offer high-quality counterfactual data for studies analysing the impact of these instruments on researchers´ working conditions, career paths and mobility patterns. By looking at the high-level objectives in which the

[335] PPMI, IDEA Consult & WIFO (2019). MORE4 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, EU Higher Education Report. European Commission, DG Research and Innovation.
[336] The wording of the question referring to this in the questionnaire was "*Have you obtained competitive funding for basic research (based on peer review) from one or more of the following sources? Please tick all that apply*".

MSCA and the ERC grants are embedded, it is possible to identify those indicators that could be more appropriate for analysing the impact of these instruments. It is at this level that analysis of these groups on the basis of the MORE4 survey is feasible (and also more accurate). These high-level objectives can be found in the priorities of the H2020[337] and Seventh Framework Programmes[338;339]. Table 24 shows how these objectives can be encompassed within broader dimensions for analysis. Although these dimensions are closely related to one another, we will consider them separately for analytical reasons and clarity.

Table 24: Objectives of the programmes and dimensions.

FRAMEWORK PROGRAMME	TARGET GROUP	HIGH-LEVEL OBJECTIVES	RELATED DIMENSIONS COVERED IN MORE4
7th Framework Programme, Specific Programme People	MSCA	*To restructure the organisation, performance and quality of research training*	- Working conditions - Career development
		To reinforce the active career development of researchers	- Career development
		To promote knowledge-sharing through researchers between sectors and research organisations	- Intersectoral mobility
		To foster the partnership between industry and academia	- Intersectoral mobility
		To increase the participation by women and early-stage researchers in research and development	- Researchers´ sociodemographic profile - Career development
7th Framework Programme, Specific Programme IDEAS	ERC	*To develop "Frontier science"*	- Positive outcomes of high quality research in terms of: • Working conditions • Career development • International mobility
		To promote basic research in science and technology	
		To foster interdisciplinary research	- Interdisciplinary collaboration and mobility[340]

[337] (2013) Council Decision of 3 December 2013 establishing the specific programme implementing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decisions 2006/971/EC, 2006/972/EC, 2006/973/EC, 2006/974/EC and 2006/975/EC.
[338] (2006) Council Decision concerning the Specific Programme ""Ideas"" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013) L 400/265
[339] (2006) Council Decision on the Specific Programme: ""People"" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)L 400/282
[340] Interdisciplinary research, collaboration and mobility tend to be related to different modes of interdisciplinarity: interdisciplinary research does not necessarily involve working with others, whereas collaboration and mobility are closely related to research teams and working with others.

Table 25: Dimensions, expectations and indicators

DIMENSION	SUB-DIMENSION	HYPOTHESES DERIVED FROM THE OBJECTIVES OF THE FRAMEWORK PROGRAMMES	RELATED ITEM OF INFORMATION IN THE MORE4 SURVEY QUESTIONNAIRE
Profile	Gender balance (Inclusion of female researchers)	*Higher share of female researchers compared to total population (control for career stage)*	Share of women (per career stage)
Career development / Working conditions	Training & skills	*Higher levels of satisfaction with training received than in the total population of researchers*	Share of researchers that are satisfied with the training received in their current position (R2,R3 and R4)[341]
	Type of contract and duration of contracts	*Higher shares of researchers with more stable working conditions than in the total population of researchers*	Share of researchers in each type of contract
	Satisfaction with working conditions	*Higher levels of satisfaction with working conditions than in the total population of researchers*	Levels of satisfaction with working conditions
Mobility	International mobility, intersectoral mobility, interdisciplinary mobility	*Higher levels of different types of mobility compared to the total population of researchers*	- Share of researchers who have been short-term mobile - Share of researchers who have been long-term mobile - Intersectoral mobility: sectors and top three motives (possibility of distinguishing before and after grant) - Interdisciplinary mobility

Table 26 shows the characteristics of those researchers who have at some point obtained an MSCA or an ERC grant, compared with those of the general population of researchers – specifically focusing on gender, current career stage, and the field of science in which they work. Table 27 presents an overview of findings with regard to the some of the main indicators of the MORE4 EU HE survey for these two subgroups.

Table 26: General characteristics

		MSCA	ERC	TOTAL*
Gender	% of female researchers	36.5%	32.7%	39.5%
Career stage	R1	4.7%	6.3%	9.9%

[341] The survey also included questions on training received by R1 and R2 researchers. However, the number of individuals in these stages who have received an ERC or an MSCA grant is too small to perform statistical analyses and extract meaningful conclusions from them.

		MSCA	ERC	TOTAL*
	R2	12.0%	9.5%	14.2%
	R3	42.1%	31.2%	45.3%
	R4	41.2%	53.0%	30.7%
Field of Science	NAT	57.2%	49.3%	39.4%
	MED	19.7%	22.1%	24.2%
	SOC	23.1%	28.7%	36.3%

Source: MORE4 EU HE survey (2019)
*The figures for the total population of researchers are weighted according to the procedure presented in the MORE4 EU HE survey report. The figures for MSCA and ERC grantees are not weighted, as the survey was not designed to obtain representative figures for these subgroups.

Table 27: Main indicators

	MSCA	ERC	TOTAL*
% Fixed term contract	20.9%	13.8%	20.2%
% of researchers that are very or somewhat confident with their future prospects	88.0%	93.4%	82.7%
% of researchers that have been internationally mobile for MORE than 3 months is the last 10 years	37.6%	22.1%	26.5%
% of researchers that have been mobile for LESS than 3 months in the last 10 years	34.6%	29.5%	31.8%
% of researchers that have been interdisciplinary mobile	26.8%	31.2%	18.9%
% of researchers that have been intersectorally mobile	26.1%	29.8%	23.8%

Source: MORE4 EU HE survey (2019).
*The figures for the total population of researchers are weighted according to the procedure presented in the MORE4 EU HE survey report. The figures for MSCA and ERC grantees are not weighted, as the survey was not designed to obtain representative figures for these subgroups.

In general terms, it can be seen that results across these dimensions for researchers who have benefitted from MSCA or ERC grants are positive – bearing in mind all the limitations of the MORE data in relation to analysing these questions on this subset of researchers. Some dimensions are worth highlighting:

Gender

The first dimension refers to **gender** – namely, the extent to which the MSCA and ERC are successful in attracting and retaining women in the research profession. This is one of the explicit high-level priorities of the Specific Programme PEOPLE, but it also appears as one of the main objectives of ERC grants. The **Horizon 2020** programme explicitly implements this through its 'Vademecum on Gender Equality in Horizon 2020', agreed by the Helsinki Group delegates, which set the lines on gender equality and gender balance in research

teams at all levels, and integrate the dimension of gender into the content of research and innovation[342].

From their outset, the MSCA have emphasised gender equality. In line with the Charter and Code, and more recently the Horizon 2020 commitments, they promote gender equality through transparent recruitment practices and good working conditions for researchers that (among other factors) integrate work-(family) life balance into the decision process (evaluation of proposals, human resources in project execution and supervision, decision making in the MSCA Advisory Group), as well as in the content of the research itself. The latest MSCA Interim evaluation (2017) indicates that 40% of MSCA-supported researchers are women (37% in FP7)[343]. The MORE4 EU HE survey results indicate that the share of female researchers who have received an MSCA grant in the past are at roughly the same level (36%): this share is slightly lower than the overall share of women in the population of researchers but the gap (3pp) is not sufficiently large to draw any conclusions on the existence of gender bias. The latest MSCA Interim evaluation recommended that the Career Re-start Panel be enhanced – for example, in terms of its duration – to further stimulate gender equality[344].

With regard to the European Research Council (ERC), previous reports have highlighted that the share of female applicants to ERC grants has never surpassed 40% since 2007[345]. Concerned with this gap, the ERC set up a dedicated working group to monitor gender balance in ERC calls. This Working Group on Gender Balance drafted ERC Gender Equality Plans (2007-2013 and 2014-2020) with the objective of raising awareness among (potential) applicants; improving gender balance among ERC candidates and within ERC-funded research teams; identifying and removing any potential gender bias in the ERC evaluation procedures; embedding gender awareness within all levels of ERC processes (while maintaining a focus on excellence); and striving for gender balance among the ERC peer reviewers and other relevant ERC bodies[346]. When looking at the findings of the MORE4 EU HE survey, a larger gap can be seen with respect to the share of female researchers who have benefitted from an ERC grant, compared with MSCA grantees: 40% of the population of researchers are women, compared to 33% among the ERC subgroup.

Working conditions

Through some of its programmes, the EU aims to raise standards for working conditions in the research profession across the Member States. There is some evidence that participation in MSCA or hosting ERC holders has a positive effect on hosting institutions,

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[342] See See European Commission (n.d.). *Gender equality.* Retrieved from https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/gender_en.htm.
[343] FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Final report: https://ec.europa.eu/research/mariecurieactions/sites/mariecurie2/files/interim-evaluation-msca-report.pdf
[344] FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Final report: https://ec.europa.eu/research/mariecurieactions/sites/mariecurie2/files/interim-evaluation-msca-report.pdf
[345] https://erc.europa.eu/sites/default/files/document/file/Gender_statistics_Dec_2016.pdf
[346] See European Research Council (n.d.) Working Group on Gender Issues. Retrieved from https://erc.europa.eu/thematic-working-groups/working-group-gender-issues https://erc.europa.eu/thematic-working-groups/working-group-gender-balance

in terms of more open and fair recruitment and career progression procedures[347;348]. This dimension receives more explicit attention in the priorities of the MSCA and the Specific Programme PEOPLE, than in the ERC and the Specific Programme IDEAS. However, these improvements in working conditions are said to be related to excellence in research quality: institutions are more likely to be able to attract excellent researchers if they offer very good working conditions. Similarly, the degree to which researchers have stable and high-quality working conditions reinforces the capacity of the EU to attract and retain the best talents. Previous studies have shown how MSCA fellowships or ERC grants often lead to an improvement in working conditions for most researchers: higher salaries, longer contracts, and the less frequent use of stipends and grants afterwards as main or only means of earning a living as a researcher[349].

The results of the MORE4 EU HE survey point to an important difference between MSCA and ERC grantees: the share of ERC grantees under fixed-term contracts (14%) is lower than in the general population of researchers (20%), and among those who have obtained an MSCA grant (21%). Similarly, researchers´ confidence in their future prospects varies across both subgroups: 93% of current and former ERC grantees consider themselves to be very or somewhat confident about their future prospects, compared with 83% of the MSCA subgroup (and 88% of the general population of researchers).

Other studies offer more in-depth information about this, most notably the latest interim MSCA evaluation: this study showed that the MSCA programme helps some researchers to find a permanent position, and that the participation in the programme helped them to attain a subsequent career stage, or to do so more quickly[350].

International mobility

International mobility is deeply rooted within the MSCA and ERC, since many grantees or fellows cross borders when they receive these grants. Several studies have already pointed out that the extent to which researchers benefit from these grants is unequal between countries. For instance, a study on MSCA fellows showed that while some countries were net receivers of MSCA Individual Fellowships (UK, Switzerland, Norway and Denmark), others were net providers (Italy, Spain, Poland, Hungary, Romania, Bulgaria and Slovakia)[351]. However, the distribution of the origin and destination of fellows might depend on the type of fellowship or grant. It is important to note, however, that the survey does not provide information on whether the mobility occurred before, during or after having been involved in these research projects. Therefore, inferences on causality cannot be

[347] (2012). Ecorys. FP7 Marie Curie Life-long Training and Career Development Evaluation: Individual Fellowships and Co-funding Mechanism. Final Report.
(2013). PPMI. "FP7 Marie Curie Actions Interim Evaluation". Final report.
[348] This positive impact is in line with efforts relating to European Commission policy initiatives such as the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (https://euraxess.ec.europa.eu/jobs/charter).
[349] Ecorys. (2012). FP7 Marie Curie Life-long Training and Career Development Evaluation: Individual Fellowships and Co-funding Mechanism. Final Report.
PPMI. (2013). "FP7 Marie Curie Actions Interim Evaluation". Final report.
[350] FP7 ex-post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Final report:
https://ec.europa.eu/research/mariecurieactions/sites/mariecurie2/files/interim-evaluation-msca-report.pdf
[351] Ecorys. (2012). FP7 Marie Curie Life-long Training and Career Development Evaluation: Individual Fellowships and Co-funding Mechanism. Final Report.

drawn from these data. The MORE4 EU HE survey shows that, while 27% of the general population of researchers have been long-term mobile in the last 10 years, this figure reaches 37% among former and current MSCA grantees. This figure confirms the results of the 2017 MSCA Interim evaluation, which showed (via a bibliometric analysis of the affiliations of MSCA fellows and a comparison group of researchers) that MSCA fellows are much more internationally mobile throughout their careers[352]. The opposite is observed in the ERC subgroup, where 22% of researchers indicated having had this type of experience. Similar patterns are observed when looking into the patterns of short-term (<3 months) mobility in the last 10 years.

Interdisciplinary mobility

In spite of the absence of a clear-cut definition of the term 'interdisciplinarity', the MORE4 survey shows that the share of researchers indicating they have switched to another (sub)field of research during their academic career is higher among the ERC and MSCA subgroups (31% and 27%, respectively) than it is among the total population of researchers (19%). However, the latest MSCA Interim evaluation showed large disparities exist between types of MSCA, with ITN being more prone to engage in interdisciplinary research than IF grantees. The latter are on average less likely to carry out interdisciplinary research than the global average[353].

Intersectoral mobility

As mentioned above, the MORE4 survey does not allow causality to be established between researchers having benefitted from these grants (or worked in projects funded by these initiatives) and the intersectoral experience. However, the results of the survey indicate that former and current MSCA and ERC grantees show slightly higher shares of intersectorally mobile researchers (26% and 30%) compared with the general population of researchers (24%). These results confirm the conclusions of the 2017 MSCA Interim evaluation, which highlighted the positive impact of participation in this programme in terms of intersectoral mobility and collaboration[354].

In general terms, the preliminary and partial findings of the MORE4 EU HE survey offer a view that is consistent with the high-level objectives of these funding schemes. The evidence presented in this section is only indicative, however, as the survey was not designed to obtain representative data for these groups and, hence, the results from these analyses should be interpreted with caution. Future research, including specific surveys targeting researchers involved in MSCA or an ERC project, could potentially provide more detailed information about the extent to which these groups differ, and the factors that explain these differences.

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[352] FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Final report: https://ec.europa.eu/research/mariecurieactions/sites/mariecurie2/files/interim-evaluation-msca-report.pdf

[353] FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Final report: https://ec.europa.eu/research/mariecurieactions/sites/mariecurie2/files/interim-evaluation-msca-report.pdf

[354] FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA). Final report: https://ec.europa.eu/research/mariecurieactions/sites/mariecurie2/files/interim-evaluation-msca-report.pdf

Future analyses should take into account the differences between individual grants, as well as the point in researchers' careers when the grant or fellowship was received, in order to be able to examine the effects of these grants over time.

16. RECOMMENDATIONS FOR FURTHER RESEARCH

The consecutive MORE studies are a major step forward in contributing to the large and growing body of relevant research on different aspects of researchers' careers and mobility in European HEIs. This extensive research provides answers for today's policy makers, but also raises new questions regarding the implications and future evolution of the trends and developments indicated in the study findings. In this section, a number of questions are identified that are of interest for further research from a policy perspective.

Research to address the research and innovation divide between countries

The consecutive MORE studies demonstrate great heterogeneity between countries in Europe in relation to several aspects of research careers and mobility. The MORE team has screened national-level initiatives in this final report that can illustrate and inform this discussion. However, **specific country-level expertise could be brought in to further interpret and refine some of the key findings in this respect.** Although this was the case in the MORE2 study, it was not retained in the scope of the MORE3 and MORE4 studies.

In addition, further research is recommended to explore the ways in which the research and innovation divide between EU Member States and regions can be addressed through a mix of EU and national policy interventions, recognising that R&I is a competence shared between the EU and Member States. Although mechanisms for monitoring the performance of research systems and smart specialisation strategies have been developed to provide information about the achievements of these strategies, it would be important to assess their contributions to the development of national and regional R&I systems, particularly in less-developed countries, in order to make proposals to inform the development of the next generation of programmes. Developing measurement frameworks for the attractiveness of national research systems on a regular basis – similar to the European Innovation Scoreboard – could provide a benchmark to stimulate the implementation of policies. Such frameworks could also include efforts to measure the extent to which the mobility of researchers within the EU is symmetrical (i.e. brain circulation) or asymmetrical (brain drain). This should be taken into account in the design, development and implementation of a new ERA monitoring framework, which needs to be upgraded in 2021 to replace the current ERA monitoring system 2015-2020, and to reflect the priorities of the new ERA.

In terms of policy instruments, research could look at alternative ways of funding researchers – e.g., not through project funding, as in the ERC or collaborative funding, but through institutional funding. EU funding could be considered for the creation of new excellent research universities, or to support the structural transformation of existing universities aimed at aligning their teaching and research practices with international best practice examples.

Gender: further evidence is needed on the effectiveness of gender-related policies targeting structural change

Over the past decade and more, significant efforts have been made at EU level and in many Member States to implement and evaluate various **gender equality initiatives**. In the

large majority of ERA countries, **gender monitoring** is already in place[355]. However, programmes intended to promote the employment and career development of female researchers may not always work as well as expected, and **structural changes** may only occur at a very slow pace, making it impossible to carry out a comprehensive impact assessment of an initiative's success in a short period[356].

Further attention should be given to evaluating initiatives that lead to structural change, and which have a longer-term implementation span and effect (initiatives implemented in education systems, promoting the presence of women in leading positions in S&T, etc.). This is now even more important, as existing gender inequalities threaten to worsen as a result of the **COVID-19** pandemic and economic crisis. This development has taken place within just one year, and demonstrates again how deeply rooted gender inequality is in various parts of European societies. A strategy for economic recovery that improves access to inclusive, high-quality early childhood care, education and upbringing – which is known to compensate for social disadvantages – would bring socioeconomic benefits in the medium and long term, and open up opportunities for women to participate fully in the labour market.

Further evidence on what really drives structural change in the long-run could feed into **mutual learning exercises** and help to counteract the undesirable effects of the COV19 crisis. Even with better evidence, however, it is unlikely that a 'silver bullet' will emerge that will reduce gender equality. Continuing and intensifying a broad range of comprehensive initiatives that include multiple stakeholders appears the most promising strategy.

PhD studies: towards structured PhD training and the greater involvement of industry

Analysing cost-effective design for structured PhD training is one of the topics on which further research is most necessary, particularly if support exists for the idea of gradually replacing the predominant single-researcher model of supervision in the EU with structured PhD programmes, and for reducing heterogeneity between European Member States in this respect.

Further research could also investigate how to more effectively integrate **transferable skills** into PhD training. This relates to the gap found between the increasing importance of transferable skills to researchers´ careers, and the relatively low share of researchers who have undertaken such training and skills development during their PhD.

The differing prevalence and assessment of intersectoral collaboration and industry funding at PhD stage across European countries is another important issue meriting further research. In general, PhD candidates consider intersectoral collaboration – particularly with industry – as being of low importance. However, this depends on their future aspirations for their research career. Many intend to pursue a career in academia, and are less interested in intersectoral mobility; however, awareness-raising continues to be needed regarding the benefits of such mobility, as insufficient numbers of permanent researcher positions and academic tenured positions exist within academia, such that many

[355] A screening of the ERA NAPS shows that gender is addressed through many measures.
[356] Grubbs, K.C. & Grubbs, S.J. (2016). Increasing Female Academics in Science in the United States: An Examination of Policies. *International Journal of Gender, Science and Technology*, 8(2), 279-299.

researchers will need to explore using their research skills in other sectors. Evaluations of cooperative research centres at national level that produce PhDs, such as the COMET funding programme by the Austrian research promotion agency FFG, can also shed further light on these issues.

Career paths: unveiling best practices to foster attractiveness

Research careers remain an interesting field for further research. Among many other potential topics, comparative analysis could further characterise the career and higher education systems in different countries. This would also make it easier for policy analysis to perform best practice and benchmarking studies, comparing like-with-like, and choosing suitable policy avenues to address country-specific problems.

Heterogeneous national career paths form a barrier to the single market for researchers (ERA), even if we recognise that heterogeneity at institutional or country level may also be considered beneficial from certain perspectives (e.g. allowing a diversity of research topics to be pursued and to enable the co-existence of different approaches to the training and skills development of researcher across Europe.

Convergence in the framework conditions for career paths and structures could lead to increased levels of international, intersectoral and interdisciplinary researcher mobility and exchange. This should, of course, be driven by convergence towards best practice models. Such best practice models have been discussed in terms of 'tenure track'-models, but further research is certainly necessary.

Moreover, international comparative research could look into the determinants of the differing lengths of early career stages, with a long period of contractual uncertainty and reduced research autonomy being unattractive to the pursuit of a research career. This point also relates to the relative scarcity of studies analysing the impact of different types of contracts (i.e. fixed-term versus tenure-track contracts) and their suitability for different research frameworks and objectives.

Further research should therefore focus on those conditions that are important to researchers. This would contribute to the design of effective policies that can help to improve the balance between incoming and outgoing mobility, and hence maximise the benefits of brain circulation, as opposed to the 'zero sum game' of addressing brain drain from some countries, and brain gain in others.

Working conditions: matching funding schemes to researchers´ motivations and expected benefits

Further research could look into how the working conditions offered by different higher education systems (including institutional heterogeneity within countries) foster the attractiveness of research careers and of the ERA in general. In general, past research has tended to take a more general approach, and has shown that for research jobs to be attractive, both remuneration-related working conditions (salaries, social security, etc.) and research-related working conditions (the availability of funding, quality of peers, research autonomy, time horizons for research etc.) are important. Early-stage researchers are, however, particularly willing to move to other countries or institutions in search of better working conditions for research, even if the salary is not higher. The results of this type of research can also inform EU research funding policies, as the availability of research funding is a clear policy lever of EU initiatives.

Further research is also needed on the interactions and interdependencies between specific working conditions, with a view to understanding the conditions for attractiveness and optimal scientific knowledge production. Examples of research questions that could be addressed are:

- How do different ways of allocating research funding (e.g. project-based vs. institutional block funding) interact with time horizons for research to determine the riskiness of the research paths chosen?
- How do different funding schemes foster organisational changes in HEIs?
- How does funding shape the potential for intersectoral cooperation (see also below)?

International mobility: analysing brain drain and impact of a changing context

Long-term, consistent monitoring is important for further research in the field of researchers´ international mobility. This could be integrated into the new ERA monitoring framework, and feed into the development of a Scoreboard type approach. The consecutive MORE studies provide insights into key mobility indicators over time, and reveal a stable pattern of mobility among EU researchers even within an evolving policy framework. The longer term impact of policy changes in reducing barriers (e.g. the pension plan for researchers and VISA policy), or of efforts to foster more balanced brain circulation within Europe, will only become visible over time. Continued monitoring will provide the necessary benchmarks for these kind of considerations.

To understand the issue of brain drain, further research can be done on the determinants and effects of escape, expected and exchange mobility. The MORE studies shed light on the drivers and barriers experienced by individual researchers, as well as on the extent to which researchers feel forced to move due to a lack of positions in their home country, for example. Further research on the links with the national context and policies (e.g. the openness and structure of economic and R&I systems, and the availability of public funding for research) and on the impact of structuring measures, would be relevant to identify best practices and design effective policies to foster brain circulation and to adequately address brain drain issues.

Further research is needed to assess the impact on international mobility of the increased focus on digital skills and sustainability, but also of experiences (e.g. of using digital solutions) during the COVID-19 pandemic. Although different in nature, these factors may have an impact on mobility behaviour in the coming years, with virtual collaboration and mobility becoming more important than before. In this context, further research into virtual mobility and on how to implement, measure and assess it, will be very relevant in anticipating potential evolutions in research culture and assessment. One important dimension to consider is that virtual mobility is likely to be easier to implement once researchers have already developed a network, while special attention would need to be given to the impact and effects of virtual mobility on early career stage researchers.

Finally, further research can provide useful insights into the extent to which improving collaboration with non-EU researchers could improve the EU´s attractiveness. This could entail analysing the consequences of EU researchers moving to non-EU countries or collaborating with non-EU researchers, but also the consequences of non-EU researchers being mobile to the EU. In this sense, the MORE4 studies have provided evidence to suggest that non-EU researchers who have been mobile to the EU,

later maintain strong links with their EU network. The role played by the EURAXESS networks in this can be further considered, based on the outcomes of further research.

Intersectoral mobility and collaboration: impact, best practices and recognition

We have observed little change in the way researchers perceive intersectoral mobility. The MORE studies show that researchers do not perceive intersectoral mobility as one of the stronger assets for recruitment or career progression. Research into the determinants of this perception can help to address this gap, paying special attention to the differences between sectors and fields of science. It will be interesting to **continue monitoring this perception in the future, in particular to see the impact on researchers' perceptions of the growing attention being paid to intersectoral mobility**, as well as the importance of multiple career paths, experience in and exchange with industry, and cooperation with industry and other actors, etc.

In this context, **further research is also needed into the ways in which intersectoral moves could become more valued and recognised in academia**. Research could shed light on the mechanisms via which this type of mobility could be better valued, the types of intersectoral experience (e.g. sectors, contracts, career stages, etc.) and their impact on individuals, research output and research institutions. This can be achieved through the identification of best practices in which intersectoral mobility is valued and promoted (in academia and in other sectors – industry, the private not-for profit sector, public and government sectors) and disseminating this information to the relevant stakeholders. An essential aspect that requires further research is how to lower researchers´ reluctance to engage in intersectoral mobility, by integrating positive evaluations of relevant intersectoral experiences in a more systematic way into recruitment processes.

Furthermore, openness to the scientific and industrial communities, and even broader openness to regional policy makers and citizens, will imply **a change in the types of skills needed by researchers.** They will, for example, increasingly consult these groups in their research in connection with societal questions and in translating their research into commercial applications. Although the MORE studies have provided first insights into the skills required and the extent to which they are provided and valued today in research training, further research will be highly valuable in following up on this trend.

Interdisciplinary mobility and collaboration: effects and determinants

Although the MORE4 survey has shed light on the degree to which researchers working in Europe engage with other disciplines, further research could look deeper and more specifically into patterns of interdisciplinary collaboration and mobility.

Further research needs to look into the definition of interdisciplinarity and the aims of this type of approach. While interdisciplinary approaches and mobility might be essential to address current societal challenges, they are also important in delimiting the discussion about what it is and what is expected from it. This discussion will help to develop a clear definition of interdisciplinary research, mobility and collaboration at EU level. The integration of STEM, Arts and the SSH (Social Science and Humanities) in research avenues and teams could be fostered on the basis of a clear conceptual framework. This approach needs to be developed without jeopardising the solid basis of disciplinary research that will remain essential in the future. These efforts are currently being promoted in some Horizon 2020 programmes (e.g. through GOVERNANCE CSA actions), but support for the development of robust definitions that can be applied across programmes would be beneficial.

In relation to intersectoral mobility, **it remains interesting to look into the determinants of differing perceptions regarding interdisciplinary experience.** The development of policies that aim to foster interdisciplinarity among European researchers will greatly benefit from studies looking into the barriers to these types of mobility and collaboration. In addition, the impact on such perceptions of the emphasis placed on interdisciplinary collaboration in the European Commission's mission-oriented approach, will be interesting to monitor over the coming decade.

F**urther research into the effects and impacts of interdisciplinary research could further enhance understanding, and improve the ways in which it can be measured and valued in research careers.** It will be interesting to investigate differences across disciplines and career stages.

Open Science: expanding the evidence base

The MORE4 surveys included new questions and options to collect evidence on the importance of Open Science in Europe. This concept has been developed in recent years, and continues to increase in importance. Further monitoring of its implementation is needed, as well as research into how researchers use Open Science, and the extent to which they perceive it as having an impact on research practices and careers. Two specific areas that should be monitored are the implementation of training for researchers, and improvements in the recognition of Open Science practices in research careers – two areas in which the EU policy framework has evolved and been further developed in the past few years, and where further work is ongoing.

Continued monitoring efforts: structural and non-structural indicators

The MORE studies point to the existence of a set of more structural indicators that tend to remain relatively stable over time. Equally, certain other indicators show greater volatility over time and therefore require more frequent monitoring to efficiently assess whether the objectives of instruments are met.

- Examples of structural indicators could be the shares of researchers with experience of international, intersectoral or interdisciplinary mobility. These indicators are likely to change slowly over time, and hence would need to be monitored every three or four years.
- Researchers´ perceptions, e.g. on their career progression or the degree of transparency in recruitment process, are examples of more volatile indicators that should be measured more frequently (e.g. every year) to capture progress towards policy targets.

The results of the MORE4 project, and the evidence available from the comparison with the previous MORE studies, confirm the need to build a strong evidence base, and to continue monitoring the indicators that relate to researchers' careers and mobility over time.

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The MORE4 study aims to update, improve and further develop the set of indicators used in previous MORE studies in order to meet the need for indicators over time and to assess the impact on researchers of policy measures introduced to develop an open labour market for researchers. This study gathers data to highlight emerging policy needs and priorities with regard to mobility patterns, career paths and the working conditions of researchers.

The study carries out two surveys: one addressed to researchers currently working in the EU (and EFTA) in higher education institutions, the other addressing researchers currently working outside Europe.

Studies and reports

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