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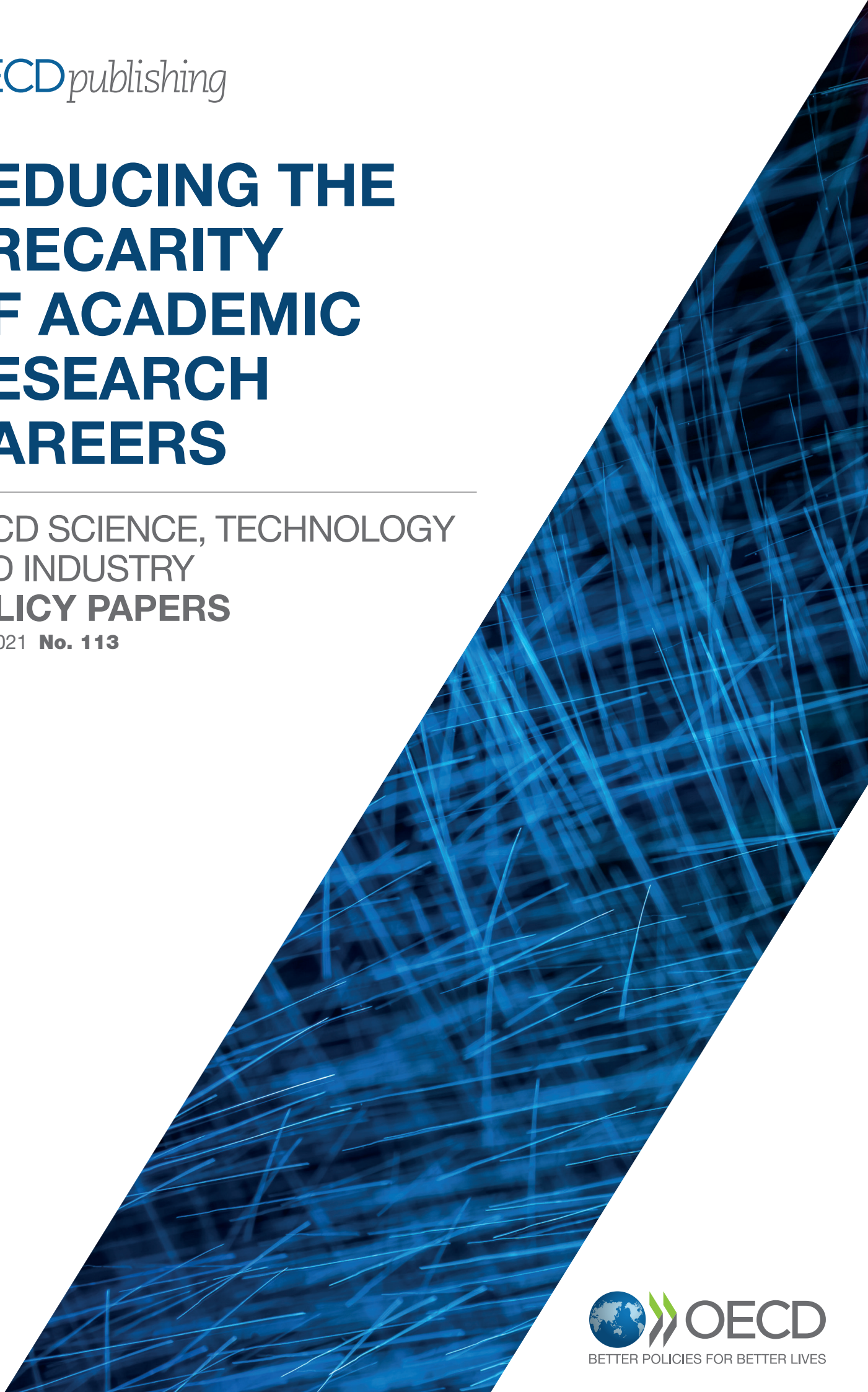

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This report analyses academic research careers, with a focus on the "research precariat", defined as postdoctoral researchers holding fixed-term positions without permanent or continuous employment prospects. It identifies policies and practices that aim to improve researchers' well-being, develop more diverse, equitable and inclusive research systems, attract and retain the best talent in academia, and ultimately improve the quality of science.

The report presents a conceptual framework and synthesis of available data and policy information. It draws on a survey of OECD countries that included country notes and interviews with policy officials, funders, representatives of research performing organisations and researchers. It offers recommendations and a set of policy options to improve working conditions and professional development, better link funding to human resource policies, make governance more inclusive, promote equal opportunities and diversity, improve human resource management, promote inter-sectoral and international mobility, and develop the evidence base on research careers.

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Foreword

Precarity in research careers is not a new issue but it is one that has been raising increasing concerns and policy attention in recent years. Academic research has changed considerably over the past decade, with the introduction of new approaches and technologies. Data-intensive research and Open Science have impacted on all fields of research and digital technologies, machine learning and artificial intelligence are enabling and accelerating scientific discovery. However, the future of scientific research and its capacity to deliver the new knowledge and solutions that are necessary to address urgent societal challenges, depends on the scientific workforce. Tomorrow's science depends on the early career scientists – PhD and postdoctoral researchers, who are entering the system today. For many of these highly skilled individuals that future does not look as attractive as one might hope.

The COVID-19 pandemic was confirmed early in 2020, after the project that is summarised in this report got underway. Science has responded in an unprecedented way and delivered the new knowledge, diagnostic tools, therapies and vaccines that are necessary to control the pandemic. At the same time, COVID-19 has exposed serious flaws in the way that academic research is organised and supported. In particular, it has emphasised the precarious working conditions and stresses to which the majority of early career researchers are exposed.

Looking back to 2016, in the pre-COVID era, OECD carried out an analysis of the main trends that were impacting on STI and whose influence was likely to increase in the coming years. Many of these were external drivers such as digitalisation or societal inequalities but others were internal to the conduct of research and principle among these was the precarity of research careers. Whilst casualisation of jobs is a general trend across many sectors and is not exclusive to academic research, it presents a particular challenge for academic research, which depends on the long-term commitment and motivation of talented individuals.

It was against this background that, in 2018, the OECD Global Science Forum (GSF) agreed to scope a new project on precarity in research careers and this project was launched in September 2019. The aim was to explore the factors influencing precarity, the effects of precarity and the policy initiatives that are being taken to address precarity. This policy report is the outcome of that analysis and includes recommendations and practical policy options for governments, research agencies and funders, and research providers – including universities. All of these groups have a key role to play in grasping the opportunity for reflection that the current pandemic has inadvertently provided, to address one of the most important challenges for science – the future of its workforce.

Acknowledgements

An international Expert Group (EG, Annex A) was established through nominations from GSF delegates, to oversee and implement this project. The EG was co-chaired by Luis Sanz Menéndez, Spain and Roseanne Diab, South Africa. The project was initially managed by Frédéric Sgard, and then by Cláudia Sarrico, OECD-GSF Secretariat.

EG members were responsible for coordinating the drafting of country notes and co-organising policy interviews with relevant stakeholders. The interviewees contributed with their time and expertise (Annex D). A number of experts participated in a workshop in October 2019 that launched the project, as well as in a final workshop, in November 2020 to discuss the findings of the project. The final workshop was co-hosted by the Observatory of Research and Scientific Careers, F.R.S-FNRS, Belgium, with thanks to EG member, Neda Bebiroglu.

This final policy report is the product of the work of the EG. Cláudia Sarrico drafted it, with contributions from Tiago Santos Pereira, consultant to the OECD, and EG members. The work benefited from input from the rest of the OECD-GSF Secretariat: Carthage Smith, Frédéric Sgard and Yoshiaki Tamura. Florence Hourtouat and Chrystyna Harpluk provided administrative support. Michela Bello made a contribution with the analysis of relevant data from the OECD International Survey of Scientific Authors.

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Executive Summary

The precarity of academic research careers is a widespread phenomenon across OECD countries and across different research systems. As in many other sectors of work, Covid-19 is making the situation worse for the research precariat, as field and lab work, as well as academic recruitment processes are being cancelled or postponed. There is evidence that many businesses are reducing their investment in research, and so career options outside of academia are also being reduced. However, Covid-19 is only aggravating a pre-existing problem, the precarity of research careers is not a temporary challenge that will simply disappear over time as the pandemic dies out. The precarity of research careers had already become an issue of public debate, and a major concern for science policy in many countries prior to the pandemic.

Doctorate level attainment in the populations of OECD countries is rising fast. Many doctorate holders find themselves in a long period of postdoctoral work on temporary, and often short-term or undesired part-time contracts in academia. The precarity experienced by early-career researchers is having detrimental effects on their well-being, as high levels of competition have created unkind and aggressive working conditions. Selection procedures for the few secure academic positions that do become available are often not open or transparent. There are concerns about the diversity of the researcher workforce as a whole, and a perception that only those from privileged backgrounds can afford prolonged precarity. Women are disproportionately affected by these conditions and many "drop out" during the transition from early to mid-career. Ultimately the quality of science is being imperilled by a "publish or perish" culture, in which risk aversion hinders novel research, and research integrity and rigour are of diminishing importance in the face of excessive competition.

This report explores these challenges and how they are being perceived and addressed in different countries. The focus is on the "research precariat", defined as postdoctoral researchers holding fixed-term positions without permanent or continuous employment prospects. The report presents nine overall policy recommendations to: 1. Improve the working conditions and offer more transparent, predictable and flexible career prospects for postdoctoral researchers; 2. Offer broad professional development during postdoctoral training; 3. Promote equal opportunities, diversity and inclusion in research careers by identifying and addressing existing biases and challenges; 4. Establish better links between research assessment and funding, and human resource management policy objectives; 5. Improve institutional practices regarding human resource management in research; 6. Promote the inter-sectoral mobility of researchers 7. Support the international mobility of researchers; 8. Develop the evidence base on research careers, and 9. Include all relevant stakeholders in the governance and coordination of research careers and ensure concerted, systemic action.

A review of the scholarly and policy literature reveals changes in the conduct of research, in the supply and demand for doctorate holders, and in research career structures as the three main drivers of worsening working conditions for academic researchers. Building on this review, a conceptual framework is proposed that recognises that precarity is both a systemic issue and is context specific. Science policy to address the precarity of postdoctoral researchers is developed in a context of changes to the funding, competition, and labour market for researchers. The role of government in defining policy, the policy levers used, and

the role of different stakeholders in the policy-making process are dependent on the governance models of academic research systems. These models have strong historical roots and vary considerably across countries and regions.

Countries are addressing research precarity by taking policy action in a variety of areas, such as recruitment, employment status, working conditions, professional development and mobility. They use regulatory, funding, informational, and organisational policy levers that involve a variety of stakeholders. Ultimately, the merit of these policies needs to be evaluated by the effect they produce in terms of the improved well-being of postdoctoral researchers, more inclusive and diverse research systems, and higher quality science. In order to carry out such evaluations and provide a solid evidence base for policy development, the appropriate data needs to be systematically collected over time.

Starting from the conceptual framework the report looks at existing data and policy information. The recent expansion of doctoral level attainment has been staggering: a 25% increase across the OECD during 2014-2019. However, there is little comparable international data on R&D personnel, especially those in non-standard employment, which makes it difficult to have a clear picture of the precarity of research careers across countries. Nonetheless, what data are available give some valuable insights into the extent of precarity, especially among younger researchers, and the significant differences observed between those on indefinite and fixed-term contracts in terms of job security, earnings, research activity, performance, and mobility. There is recent evidence also that Covid-19 is worsening the career prospects of postdoctoral researchers and having a detrimental effect on their wellbeing. Women and younger researchers are more likely to be affected by precarity and by the negative effects of the pandemic in this regard.

This project overcame the gaps in the existing knowledge base by combining information from: i) an international database on STI policies – OECD STIP Compass, ii) dedicated country notes provided by 15 countries specifically for this project, and iii) interviews with panels of policy officials, funders, employers of researchers, and representatives of researchers, in 11 countries, at the European regional level and with the Trade Union Advisory Committee to the OECD (TUAC). The interviews involved circa 100 people.

The country cases identified policies and practices that address a number of shared concerns regarding research careers and the academic research workforce more broadly. These policy initiatives are the inspiration for the policy toolkit presented at the end of this report which offers countries different policy options they can choose from to address precarity in their own research systems, depending on their specific priorities and context. It is recognised that the most appropriate solutions are very much context dependent and likely to differ between countries.

There is a need for systemic change in how research careers are structured and supported in order to attract and retain a diversity of talent. New and more attractive career paths that offer greater security and a diversity of options for mobility between academia and other sectors will increase the flexibility and resilience of research systems, which will also be beneficial to deal with the economic and social consequences of Covid-19 and other future shocks.

Recommendations

The following nine recommendations for reducing the precarity of research careers, and an associated policy toolkit described in the final section of this report (see Table 1), emerged from the data analysis and review of challenges and policy initiatives gathered through a survey of participant countries. Despite the fact that precarity of research careers is a common concern across most OECD countries, different countries have different contexts. As such, the priority given to each policy recommendation will vary across countries as will the most appropriate policy options to implement them. Moreover, the division of responsibilities for implementing the recommendations, between central or local government, funders or research performing organisations, will be different depending on the governance arrangements in each country. Federal systems, such as Germany and Switzerland have distributed responsibilities across central and local government. In the UK and Australia, institutions have more autonomy regarding human resource policies than in more centralised countries, such as France and Portugal, where national legislation is an important lever.

1. Improve the working conditions and offer more transparent, predictable and flexible career prospects for postdoctoral researchers

The main factor underlying the increasing precarity of postdoctoral researchers is their employment status. Many are on stipends rather than employment contracts, and many others are on fixed-term contracts, often short-term and part-time. These stipends and contracts tend to be associated with fixed-term funding for research projects, and exist outside of established research career statutes and frameworks, without clear conditions for progression to continuing employment. Many postdoctoral researchers experience a succession of fixed-term contracts with intervals between them, during which they are not eligible for any associated welfare benefits. Governments, funding agencies, research and higher education institutions need to develop initiatives to improve the working conditions of postdoctoral researchers and offer them better career prospects. The effect of these initiatives needs to be monitored via registry data and regular surveys of postdoctoral researchers.

2. Offer broad professional development during postdoctoral training[1]

While some doctorate holders may take employment opportunities outside of academic research directly after attaining their doctorate, the choice of pursuing postdoctoral research should not limit the longer term career options of postdoctoral researchers. The importance of the diversity of career options for postdoctoral researchers stems both from the fact that the opportunities for career progression within the academic research system are limited, as well as from the recognition that postdoctoral researchers develop advanced skills that are valuable beyond the traditional academic research career. It is important that early career researchers are fully aware of the diverse set of long-term career opportunities and are supported in considering other options before it becomes too difficult to make a transition to a career beyond academic research. National frameworks for the professional development of researchers can ensure concerted effort by all actors involved.

3. Promote equal opportunities, diversity and inclusion in research careers by identifying and addressing existing biases and challenges

The research system has often been hailed as an example of meritocracy, rewarding high achievers with highly protected employment (e.g. tenure and civil servant status) and social status. However, the expansion of the research system has created greater demand for these limited positions, increasing pressure on selection processes for recruitment and promotion,. It is important that academic employment opportunities are widely advertised and selection processes are fully transparent and open. Where appropriate, applications may be anonymised and evaluated against clearly defined selection criteria or, on the contrary, specific demographic factors may be explicitely included for consideration as part of the selection criteria. Recruitment processes should promote diversity in the research workforce, and offer clear and equal opportunities for women and under-represented groups. Institutions need to address "academic inbreeding" and promote diversity through targeted policies that address the barriers faced by under-represented groups in research. Progress should be monitored by publishing research workforce data disaggregated by specific population groups of interest.

4. Establish better links between research assessment and funding, and human resource management policy objectives

The overall research assessment framework is central to the situation of postdoctoral researchers and their career prospects. The dominance of bibliometrics in research assessment that then determines funding permeates the incentive structures of institutions, principal investigators (PIs) and researchers. While research excellence is certainly important, it ought to be complemented by additional criteria that promote good human resource management. The inclusion of criteria that value the career development of researchers, the societal impact of research, the quality of the research environment, and institutional strategies and practices on equity, diversity and inclusion can have a positive impact on the career development of researchers and the research system. In addition, the balance of core funding and project-based funding, as well as the balance of funding for doctoral education and postdoctoral training relative to the rest of the career ladder, needs to be monitored over time and adjusted where necessary.

5. Improve institutional practices regarding human resource management in research

With the increasing diversity in researcher profiles and career options, as well as in the breadth of activities involving doctorate holders, human resource management in institutions is particularly important. There is a need to develop institutional practices and incentives to promote and support the career development of postdoctoral researchers, through an integrated approach to recruitment, professional development, career guidance, performance assessment, promotion decisions, and career paths. The aim should be to fully integrate postdoctoral researchers in the life of a research institution, providing a clear framework to manage individual expectations and providing support, where necessary. Monitoring of individual trajectories together with the regular publication of relevant institutional data, can help provide the necessary information to prompt positive changes in institutional culture and practices.

6. Promote the inter-sectoral mobility of researchers

Initiatives that support inter-sectoral mobility between academic research, the business sector, government, and the non-profit sector, can open up new avenues for postdoctoral researchers. Doctoral education and postdoctoral training need to be geared not only for careers in academic research but increasingly for research careers beyond academia, or in non-research careers that can benefit from the advanced skills of doctorate holders. Postdoctoral researchers, including those who are engaged in basic rather than applied research, and those from arts, humanities and the social sciences, will benefit from being offered work-based opportunities in a diversity of sectors. It is also important to remove structural

factors which create barriers for inter-sectoral mobility, such as the lack of portability of pension rights. Professional experience and skills acquired in other sectors should be recognised in recruitment and promotion processes in academia. Career choices beyond academic research should be welcomed as positive options and not seen as a sign of failure by postdoctoral researchers or their senior colleagues.

7. Support the international mobility of researchers

Research has long been an international endeavour. While digitalisation increasingly facilitates international communication, international mobility remains an essential part of knowledge exchange and scientific development, facilitating the transfer of tacit knowledge and institutional learning and supporting a critical, open research culture. The international mobility of postdoctoral researchers can be supported through different mechanisms, such as study visits, academic exchanges, and involvement in international research projects. Institutions and policy-makers should work together to reduce existing barriers to international mobility, relating to the recognition of qualifications, portability of pension rights, access to welfare benefits, language skills or immigration rules. It is important that appropriate support be provided to incoming researchers, in relation to local and institutional integration, and that employment conditions are, at a minimum, on a par with national researchers. Considering the value of international experience, particular attention should be given to research diaspora and removing barriers to returning postdoctoral researchers.

8. Develop the evidence base on research careers

While there is consistent evidence regarding the precarity faced by postdoctoral researchers, this evidence has mainly accumulated through ad-hoc studies or institutional or national initiatives that focus on particular dimensions of the career trajectory of researchers. There is a need to strengthen the evidence base on research careers in a formal and systematic way. Internationally recognised statistical guidelines have been developed by the OECD through the Frascati Manual and the Career of Doctorate Holders (CDH) survey, which includes a dedicated module on early-career researchers. These tools can be used by national statistics offices to collect data in an internationally comparable way. The analysis and publication of these data can better inform policy action across research systems, and provide an up to date and systemic characterisation of research careers, their evolution and the impact of policies.

9. Include all relevant stakeholders in the governance and coordination of research careers and ensure concerted, systemic action

While the specific actors in each country may vary, as will the balance of responsibility between them, it is expected that government, funders, research organisations, employers, and researchers themselves will all have a role to play in implementing these recommendations. For them to be effective they cannot be implemented as standalone measures or by a single stakeholder. They are an integrated set of proposals that require that key stakeholders at the national, regional and local level come together and agree on concerted efforts and distribute responsibilities accordingly. Formal collective agreements or less formalised concordats can be important to embed such collective approaches and muster the necessary support. The governance structures in research performing institutions as well as in relevant policy-making processes at national level, need to involve postdoctoral researchers, recognising their role as integral actors in the research system.

Introduction

The precarity of research careers is a widespread phenomenon and has become an issue of public debate in the mainstream media (Box 1), and a major concern for science policy in many countries. The Covid-19 pandemic is aggravating the situation for a large research precariat, as cancelled or postponed field and lab work, and cancelled or postponed recruitment, is further delaying the transition to a secure career in academic research for many. At the same time, there is evidence that many businesses and charitable funders are reducing their investment in research, and so alternative career options are also being reduced. Addressing the problem of precarity will help improve the resilience of science systems, and better prepare them to address future shocks.

There is no agreed international definition of a "postdoctoral researcher", and in some countries, the term is not used, and other expressions such as "research assistants and associates" may be used to reflect the same roles. In some instances, they are "hidden researchers", who pursue research when employed to perform other functions such as teaching, whilst they wait for a research position to become available. The latter may be more frequent in the arts, humanities and social science disciplines, but also occurs in other areas (The Concordat, 2018[1]).

Box 1. The precarity of researchers discussed in mainstream news media

The Financial Times

"*The academic precariat deserves better. For those reliant on short-term university contracts, work can be chaotic and uncertain*." (O'Connor, 2020[2])

The Guardian

"*UK academics must stand up to stop universities becoming sweatshops: Employment practices akin to dubious fashion outlets mean qualified professionals are used as poorly paid casual labour*." (Jones, 2020[3])

Le Monde

« *A l'université et dans les laboratoires aussi, la précarité a des effets négatifs. De nombreuses études détaillent les conséquences des contrats courts.* » (Larousserie, 2020[4])

The New York Times

"*The Bleak Job Landscape of Adjunctopia for Ph.D.s: Ruthless labor exploitation? Generational betrayal? Understanding the job crisis in academia requires a look at recent history*." (Carey, 2020[5])

Times Higher Education

"*Academics 'not best' to advise postdocs on leaving academia: Event hears calls for improved careers services in universities to help steer PhD students and postdocs on opportunities*." (Baker, 2020[6])

"*Pressure to publish forces Chinese to rethink childbearing: Women on fixed-term contracts twice as likely to have moved forward or delayed plans to start a family compared with permanently employed*." (Lau, 2020[7]).

The working conditions of researchers in universities and public research organisations has been of concern in OECD countries for some time (OECD, 2006[8]; OECD, 2012[9]), and despite increasing public investment in science this concern persists and in many countries it appears to be increasing. Following a discussion during a meeting of the OECD Global Science Forum in April 2018, on the theme of Trust in Science, it was decided to explore the challenges relating to the precarity of research careers as a potential

area of future work. A preliminary issues paper for the topic was discussed during a meeting in October 2018 and a scoping paper was developed. The final terms of reference for a project on the Research Precariat were agreed in April 2019.

An expert group (EG), composed of national experts nominated by countries (see Annex A), was established to steer the project and this group first met in September 2019. The project was launched with an international workshop on reducing the precarity of research careers, in October 2019. A second workshop took place in November 2020, where countries and a variety of concerned stakeholders met to discuss the findings, share the main lessons learned and contribute to the policy recommendations in this report.

The purpose of this report is to promote good management of academic research careers, with a focus on the "research precariat", defined as postdoctoral researchers holding fixed-term positions without permanent or continuous employment prospects. The report identifies policies and practices that address a number of major concerns regarding research careers and the academic research workforce more broadly. It proposes a conceptual framework, underpinned by a review of the scholarly and policy literature, and an analysis of available data and policy information. It then draws on a policy survey of OECD countries that included country notes and interviews with policy officials, funders, representatives of research performing organisations, and researchers. It offers countries a set of policy options to improve working conditions and professional development, promote equal opportunities and diversity, better link funding to human resource policy objectives, improve institutional practices regarding human resource management, promote inter-sectoral and international mobility, develop the evidence base on research careers, make governance and coordination more inclusive, and ensure concerted systemic action to address precarity.

Overview of precarity in research careers

This section presents a brief review of the scholarly and policy literature on the evolving context for academic research, and how this relates to the phenomenon of precarity in research careers. These various contextual factors – the main variables and determinants of precarity – are then brought together in an overall analytical framework that guided the further collection and analysis of information from countries.

Following the Frascati Manual (OECD, 2015[10]) classification of researchers by seniority, postdoctoral researcher concerns the first grade into which a newly qualified doctoral graduate would normally be recruited, for a fixed-term without the prospect of extension, either with an employment contract or a stipend. It is thus distinguished from other first grade positions (Category C), such as permanent posts as researcher or assistant professor, or posts with a fixed-term but with the prospect of permanent or continuous employment (e.g. tenure-track).

Changes in the conduct of research

The research context has been changing as a result of changes in the funding of research, the assessment of research, the development of a global labour market for researchers, the increase in participation in doctoral studies, the rise of team science, and the decoupling of teaching and research careers in higher education. There is an increasing expectation that public research will rapidly lead to new innovations and economic returns and the space for long-term curiosity-driven or blue-skies research is being squeezed (OECD, 2018[11]).

Public expenditure on research across the OECD declined after the financial crisis of 2007-2009 and has remained relatively flat in many countries since then (OECD, 2018[12]), with some exceptions (e.g. Korea and Germany). Until recently, the situation was not expected to improve, as the OECD population is aging, putting pressure on public budgets to fund health, long-term care and pensions (OECD, 2019[13]). The

Covid-19 epidemic is bringing changes to priorities for research although it is not clear how it will affect overall research investment in the longer term.

The way research organisations and researchers are funded has been changing. Most systems have witnessed a move away from core basic funding for research institutions to allocation via competitive mechanisms, and diversification of funding sources and types of funding (e.g. blue sky or fundamental research vs. mission-led or applied research, funding for individual and team projects vs. funding for research organisations). The result is more funding variability over time for research organisations, teams, and individuals. Stagnation in funding and future uncertainty lead to a demand for flexibility in staffing, so that academic research organisations can adapt accordingly.

Competition for funds puts a premium on researchers who can demonstrate high performance against easily measured indicators, such as citations for publications, and ability to attract research funds. Research is an international endeavour, with English as its lingua franca, and mobility of staff, in search of better opportunities and infrastructure, is widespread. The mobility of researchers is generally thought to play a role in raising the quality of research as measured using bibliometric indicators (OECD, 2017[14]), although citation network effects can complicate such analysis. The combination of all these factors has resulted in a competitive global market for researchers, with some countries being highly dependent on overseas recruitment, particularly at postdoctoral level. At the same time, there are more recent countervailing trends that inhibit international mobility. There is a rise in nationalism and anti-immigrant sentiment, with some countries introducing stringent visa requirements and other controls on academic exchange. Such restrictions have implications for the internationalisation of research careers, decrease the opportunities for some, and impair the flow of scientific talent into and out of some countries.

These trends in the way research is organised and conducted are having an impact on research careers, with an increase in the number of researchers who are not in a standard employment relationship, where this is understood as work that is full time, indefinite, as well as part of a subordinate relationship between an employee and an employer (ILO, 2016[15]). The types of standard employment in research careers will vary between systems, but typically include those permanently employed (e.g. tenure), continuously employed with no pre-set term, or those that although they are in fixed term employment, have prospects to transition to either permanent or continuous employment, should they attain a priori defined performance objectives (e.g. tenure track assistant professor). For the research precariat, non-standard employment means fixed-term and without permanent or continuous employment prospects (and often involuntary part-time and unpaid overtime work (DGB, 2020[16])).

The growth of non-standard employment is not specific to academic research. Around a third of the OECD labour force are in temporary, part-time and self-employment (OECD, 2019[17]). In addition, there is a growing trend for people to change jobs on a regular basis in order to progress their careers. However, the scale of non-standard employment is much bigger in the academic research sector, especially in higher education (Boman, 2017[18]). Many countries are experiencing the emergence of a dual labour market, with the coexistence of a shrinking protected research elite and a large precarious research class that now represents the majority in most academic systems. Some are equating this class to an “academic proletariat” (albeit a highly qualified one), hence the emergence of the expression “research precariat” (Teixeira, 2017[19]).

Changes in the supply and demand for doctorate holders

The longevity of the general workforce also has an impact on research careers. More people are living and working to retirement age and beyond. Many of those over 65, the threshold commonly used to calculate the so-called “old-age dependency ratio”, are in good health and continue working. This is especially the case for knowledge workers. In some national research systems, this may mean that the rate at which new doctorate holders are seeking to enter a research career is higher than the rate at which

older doctorate holders are exiting from the career (Willekens, 2008[20]), further complicating the transition from postdoctoral researcher to a secure research position.

The emergence of the knowledge economy has prompted policy makers to support policies to increase investment in higher education, research and technology. The knowledge economy requires a highly qualified labour force and this has translated into the significant growth of higher education, and more specifically in doctoral education and doctorates awarded. High-participation systems of higher education, which are the norm across OECD, may have reached saturation levels in some countries. The massification of higher education responds to the demands for a skilled workforce in the knowledge economy, but is also driven by the search for social status and cultural capital (Marginson, 2016[21]). When participation becomes an almost universal obligation for middle class families, the rise of credentialism, i.e. the perception that a degree credential is needed to succeed in life, may extend to postgraduate levels of education, including the doctorate, as a form of maintaining elite status for some groups. The number of doctorates awarded, and those trying to join an academic research career, may end up being disproportionate to the availability of such positions in some countries (Larson, Ghaffarzadegan and Xue, 2013[22]).

On the other hand, many countries are deliberately promoting the further expansion of doctoral education as a strategy to promote scientific culture, and advanced knowledge and skills as resources to be used by different sectors of society, including the business enterprise sector, the government sector and the social sector. To be effective, this requires preparing doctorate holders for diverse careers beyond academic research that can make use of their advanced skills. In some systems, the non-academic sectors demand and absorb these doctorate holders, but that is not the case in all countries. This raises questions about the efficiency of training large numbers of people, many of whom end up in non-research occupations, where their advanced skills are not necessarily used (Stephan, 2012, pp. 230-231[23]).

Changes in research careers

The massification of higher education has resulted, in some systems, in the horizontal diversification of institutions with different institutional missions and profiles (e.g. research universities vs universities of applied sciences), and in many cases also in vertical differentiation, i.e. hierarchies based on prestige. Although, elite systems have virtually disappeared across OECD countries, the same is not true of elite institutions. Stratification tends to increase in high participation systems, as institutions compete with each other for status, in a context where rankings have become very important (Hazelkorn, 2015[24]), and where some governments concentrate funding, especially research funding, in a few “world-class universities”. One consequence for academic careers has been the decoupling of teaching and research activities in many countries. The tenured academic that combined teaching and research activity is now in the minority in some systems (Frølich et al., 2018[25]), as the long-term funding associated with core resource allocation has steadily been replaced by short-term project funding. Institutions tend to rest their research prowess on a few tenured star researchers that head teams populated by doctoral and postdoctoral researchers, who sustain the research endeavour.

The hyper-competitive environment faced by academic research organisations, and their high degree of autonomy from government control, has also incited the development of more entrepreneurial institutions in some systems. These are similar to market-facing institutions that need a cadre of professionals to procure project-based funding and manage complex research projects, which are often multi-national and multi-site. These professionals market their activities to potential funders, and deal with the pressures of accountability to funders, such as performance assessment exercises. In the higher education sector, there are more professional and managerial staff, and academic staff are now in the minority in some countries (Bossu and Brown, 2018[26]). The development of a cadre of specialist support services and management structures will likely mean these groups have an increasing voice relative to the academic research core, with the potential result of decreasing the capacity of researchers, especially early career

researchers, to bargain for better working conditions. On the other hand, doctorate holders are occupying some of these professional positions, which are a source of alternative employment to research within the realm of academia.

Another factor that strongly influences the appropriateness of different approaches to reducing the precarity of research careers is the historical legacy of university and academic career paths. There remains a cultural expectation within academic research that an academic career has certain stages and characteristics, embodied in the typical positions of doctoral student/ junior researcher, assistant professor/ researcher, associate professor/ senior researcher, full professor/ director of research. A traditional view of the academic career is that one needs to endure phases of uncertainty and hardship to prove one's devotion to the academic endeavour (Weber, 1946[27]). This perspective may no longer be aligned with what happens in practice, where the number of doctorates awarded has not been accompanied by a similar expansion in the number of academic positions, and where many doctorates will eventually find employment outside academic research. Whereas many of these individuals find successful and satisfying alternative careers, they often report challenges in making the transition associated with giving up long-held ambitions of an academic career and a loss of social identity (Vitae, 2016[28]). For those that stay, and with the rise of team science, some will remain in research supporting roles, as staff scientists (i.e. permanent researchers that are not PIs), and only a fraction will progress to achieve traditional research careers and PI status. One of the challenges is how to provide decent employment and working conditions for those in research supporting positions (Milojević, Radicchi and Walsh, 2018[29]).

Worsening of working conditions for researchers

The combination of the above factors is leading to the rapid worsening of the working conditions of postdoctoral researchers in many places. The postdoctoral "apprenticeship" stage between the awarding of the doctorate and finding a permanent position was meant to be transitional and a "defined period of advanced training and mentoring in research" (National Academies, 2014[30]). It has become longer and more arduous, as the bottleneck between non-permanent and permanent positions has become tighter. The continuous struggle to enter the academic research career, in an environment of heightened competition, leads to a regime of long hours, severe dependence on senior researchers, lack of visibility and recognition, stress caused by job insecurity and job dissatisfaction, constraints on academic freedom (which was the original rationale for the tenure system in the United States), and deterioration of physical and mental wellbeing.

A recent survey of doctorate graduates in the Netherlands concluded that their negative view of academic career opportunities does not cause a shortage of academic researchers, but quite possibly drives out some of the most capable researchers (Waaijer, 2017[31]). This is a major concern for science policy makers and academic leaders.

Effects of Covid-19

There is evidence that the Covid-19 crisis is compounding existing problems and having a detrimental effect on many early- and mid-career researchers. More than half of the scientists who had responded to the OECD Science Flash Survey 2020 by October 2020[2] expected the crisis to negatively affect their job security and career opportunities (OECD, 2021, pp. 23-24[32]). Research organisations have cancelled or postponed recruitment to open-ended positions. Covid-19 has limited the international mobility of researchers, and mobile researchers are afraid for their future when their visas expire and there are very few opportunities for transitioning to other jobs. Many cannot complete their lab or field work in order to obtain the necessary publications to access a research position. Some countries are enacting emergency policy initiatives to protect researchers on fixed-term employment that are at risk of losing their jobs and safeguard the research pipeline by pre-empting the loss of research talent. However, these measures are

generally time limited and their longer-term effectiveness will need to be carefully monitored to make sure that fears of a lost generation of researchers do not become reality.

Governance and the role of different actors

Policy environments

Academic research systems are embedded in specific national policy environments, with historically inherited values and philosophies of public management, which significantly affect their reaction to similar challenges and shape organisational responses. National conditions of path dependency are important and so convergence into one single narrative of policy reform for research careers is highly unlikely. National policy environments are likely to influence to different extents the management and governance of academic research systems, leading to considerable cross-national variation in terms of the specific policy instruments that will be most effective with regard to research careers. In some jurisdictions, national mandates and legislation can be used, whereas in others the focus will be on "softer" instruments, such as new funding incentives, concordats, or open provision of information.

Governance of academic research systems, i.e. the decision-making process and structures that steer the systems, are heavily influenced by the models of the role of the state vis-à-vis other stakeholders within national policy environments. A number of archetypes can be distinguished in relation to academic research: the Humboldtian model of academic self-government, the Napoleonic state-steered tradition, the Anglo-Saxon model with a stronger role for market or quasi-market steering mechanisms, and the Confucian model more prevalent in East Asia, characterised by strong state steering and control shaping research priorities, with high investment in applied research (Marginson, 2010[33]). In practice most national systems are hybrids of these models.

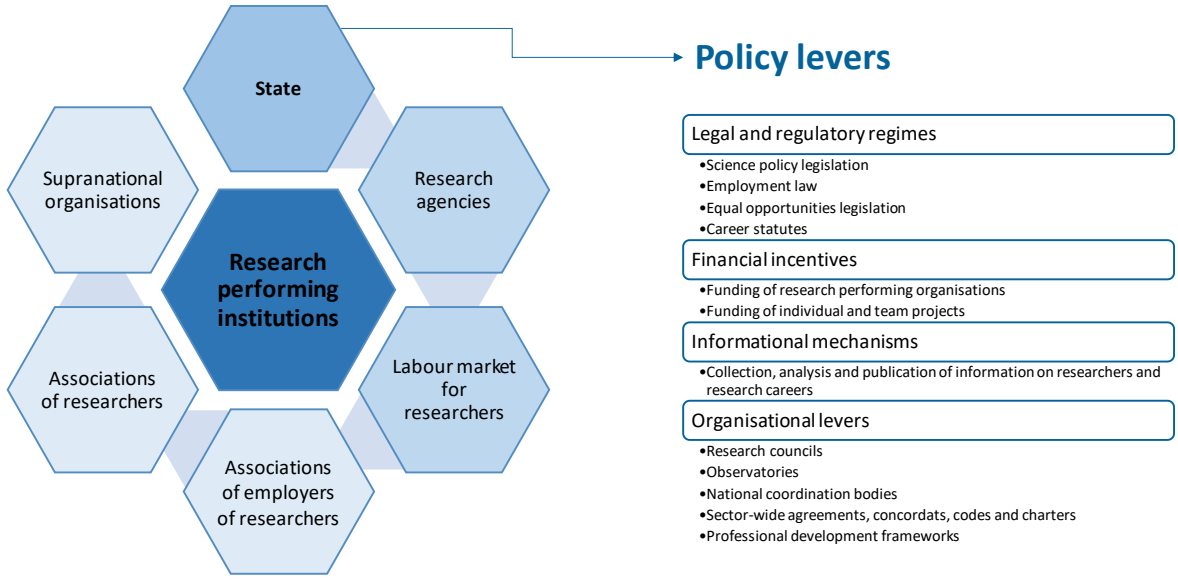
Multi-level governance

Academic research performing organisations tend to have a large degree of autonomy, including in staffing matters, but they operate within the constraints of government policies and their dependence, to a greater or lesser extent on government funds. Science policy is not just about direct government control, via legal and regulatory levers, but also involves financial, informational and organisational levers, within a landscape shaped by many other stakeholders, which steers the behaviour of, more or less autonomous, research performing institutions (see Figure 1).

Relevant stakeholders include: the research performing institutions, with prominence for large research organisations (e.g. CNRS in France) and Universities; national research agencies and quangos, such as research funding agencies, observatories and coordination bodies; researchers themselves and their representative associations (e.g. affiliates of Eurodoc in Europe), including trade unions; representative associations of employers; and supranational organisations (e.g. EuroScience). Federal states present complex governance environments with shared governance between central government and sub-national jurisdictions. In some instances, dedicated bodies support co-ordination across the multi-level stakeholder landscape (e.g. Swiss Conference of Universities).

Figure 1. Governance of research careers

Government policy levers within multi-level stakeholder governance



Government has an important role in the design, implementation and evaluation of science policy, in negotiation and collaboration with all relevant stakeholders. In fulfilling this role, it has several policy levers at its disposal: regulatory, financial, informational and organisational (Howlett, 2011[34]).

The main lever of government is direct **regulation** via laws. For research careers, relevant legislation may include general employment law, equal opportunities legislation, and national career statutes. Governments may also direct the system through indirect regulation via collective bargaining mechanisms.

A second, very important lever of government is **funding** for science, allocated to institutions or directly to research teams or individuals. The types of funding will have an impact on research careers, depending on the weight of basic core funding vs. competitive funding, and the existence, for instance, of targeted funding for early career researchers.

A third lever is **information**. In relation to research careers, it entails the collection, analysis and publication of information on researchers and research careers. It can be done via regular collection of administrative and registry data by statistical agencies, as well as national surveys of researchers (e.g. national surveys on the career of doctorate holders). The information can then be used to inform the design, implementation and evaluation of policy, as well as have a direct effect on the behaviour of institutions through publicising good practice.

A fourth lever relates to **organisational** mechanisms that coordinate the work of relevant stakeholders in science, including policy for research careers. These are implemented via a variety of agencies and quangos including research and funding agencies, observatories, agencies that promote researcher mobility, and coordinating bodies. They are often responsible for promoting sector-wide agreements, concordats, and national frameworks to which stakeholders collectively commit. Governments also use analytical units in ministries, and the establishment of government reviews, ad hoc task forces, commissions and public inquiries to look into research careers.

Finally, an important element in the governance of research careers is the level of competition in the labour market for researchers. This level depends on the autonomy granted by government to research performing organisations to decide on the number of research positions they make available, recruit research staff, and decide on remuneration, promotion, tenure, and cessation procedures. It also depends

on the openness of the labour market to international researchers, which can be constrained by policies on freedom of movement and migration or language (e.g. in some countries the working language has to be the national language, and there are constraints to the use of English).

Policy areas

From the scholarly and policy literature synthesised in the overview section above, a number of dimensions of policy analysis, or areas for policy intervention, emerge:

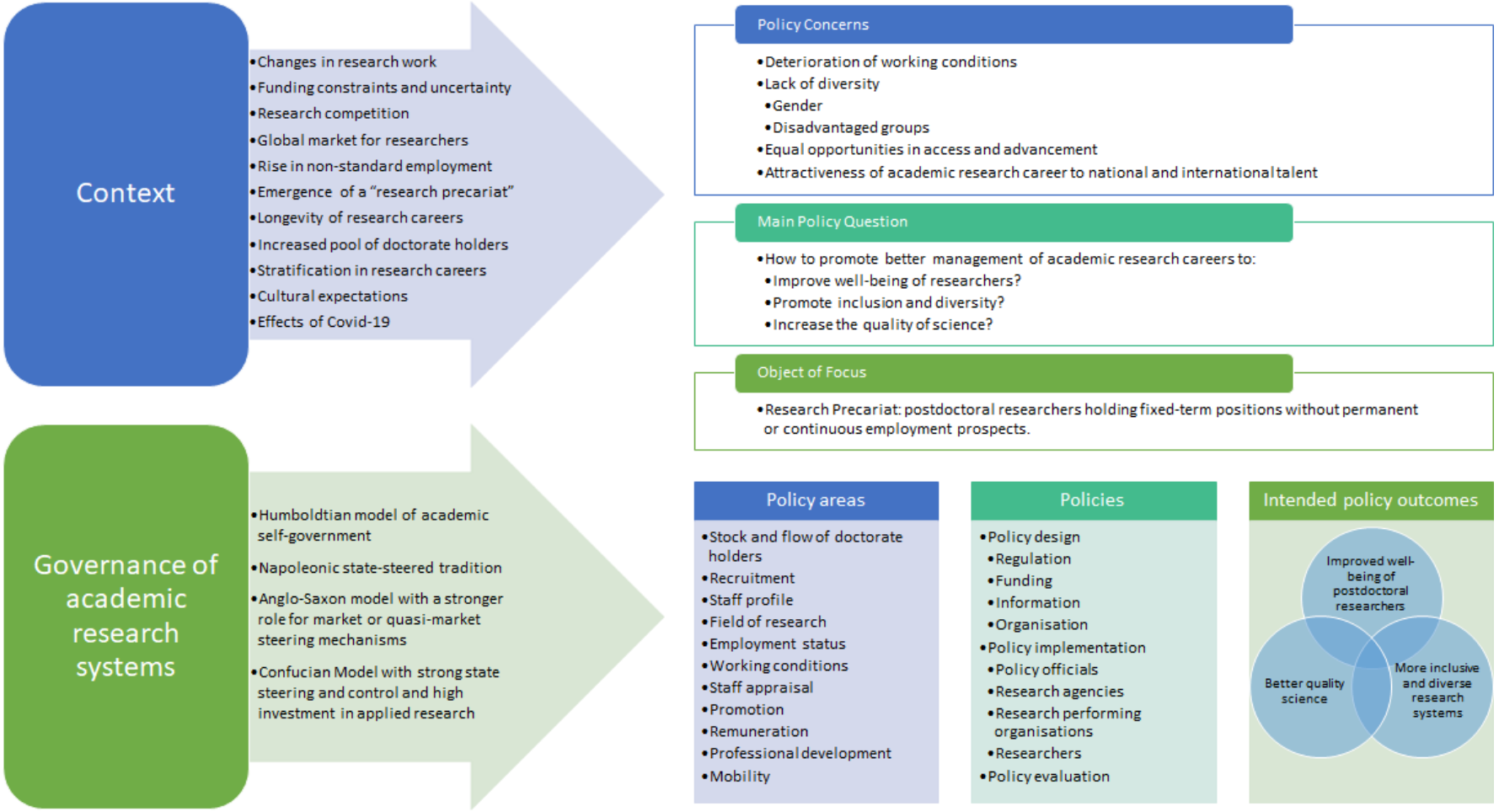
- managing the stock and flow of doctorate holders in relation to the needs of academia and other sectors
- ensuring open, fair and transparent recruitment processes
- staff profile in terms of distribution by age, seniority level, gender, geographic origin, and other characteristics of interest, such as socio-economic background, ethnicity, language, indigeneity, migrant status, and disability
- differences by field of research
- types of employment status available to researchers
- ensuring adequate working conditions and well-being of researchers
- staff appraisal criteria and procedures
- options for promotion and career advancement
- remuneration and welfare benefits
- professional development opportunities for researchers
- opportunities for intra-sectoral, inter-sectoral and international mobility of researchers

Framework of analysis

Figure 2 encapsulates the conceptual and analytical framework for the project. Science policy in relation to the precarity of postdoctoral researchers is developed in a context of changes to the funding, competition, and labour market for researchers. The role of government in defining policy in the area vis-à-vis other relevant stakeholders, the policy levers used, and the role of different stakeholders in the policy making process are dependent on the governance models of academic research systems. These have strong historical roots and vary considerably across countries and regions. Nonetheless, there are a number of shared policy concerns regarding: deterioration of working conditions for an increasing number of postdoctoral researchers; lack of diversity among the body of researchers; equal opportunities in recruitment and career advancement. All of these issues ultimately affect the attractiveness of the academic research career to national and international talent.

Countries are addressing these challenges by intervening in a number of policy areas, such as recruitment, employment status, working conditions, professional development and mobility. They do this by designing policies that use regulatory, funding, informational, and organisational policy levers, and that involve, to a different extent, policy officials, research agencies, research organisations and researchers to implement them. Ultimately, the merit of these policies will be evaluated by the effect they produce in terms of the improved well-being of postdoctoral researchers, more inclusive and diverse research systems, and higher quality science.

Figure 2: Framework of analysis for reducing the precarity of research careers



Methodology

This section explains the methodological approach in terms of the desk research on data analysis and synthesis of available policy information, and the collection of information from countries via country notes and policy interviews.

Existing data and policy information

The conceptual framework guided the gathering of relevant data and information. Available data from the OECD and other published sources were combined with de novo national information, and helped identify the main issues in different countries and research systems. The main international data sources were:

- Administrative and survey data:
  - OECD-Eurostat coordinated R&D data collection (RDS)
  - UNESCO-OECD-Eurostat data collection on education statistics (UOE)
  - OECD Survey on the career of doctorate holders (CDH)
  - OECD International survey of scientific authors (ISSA)
  - Survey on the mobility patterns and career paths of EU researchers (MORE)
- Policy information already provided by countries:
  - EC-OECD International database on STI policies (STIP compass)
- Scholarly and policy literature

As introduced above, different countries face different challenges and have instigated different policy initiatives to tackle the problem of the precarity of research careers. The Secretariat in conjunction with the Expert Group (EG) collected information from countries on recent, existing and planned policies and institutional practices addressing precarity. This was carried out using two instruments: a country note and policy interviews with relevant stakeholders.

Information on countries' policies and data was sourced from: i) the international database on STI policies – STIP Compass, ii) information provided by 15 countries specifically for this project (country notes), and iii) follow-up interviews with policy officials, funders, employers of researchers, and representatives of researchers, in 11 countries, at the European level and with the Trade Union Advisory Committee to the OECD (TUAC). The interviews involved circa 100 people (see Annex D for list of interviewees). The following countries took part, with an asterisk indicating those where interviews took place: Australia*, Belgium – French Community*, Czech Republic, Finland, France*, Germany*, Hungary*, Japan*, Korea*, Portugal*, South Africa, Spain*, Switzerland*, Netherlands, United Kingdom*.

Country notes

Participating countries were invited to prepare a brief country note summarising their national context and the challenges they are facing, and describing what is happening in the policy areas with highest priority in their country (see Annex B, Box 2 for the country note template). The development of the country note was coordinated by the EG member for each country, in collaboration with relevant national stakeholders, and using data, information and general evidence available in the country.

Policy interviews

In addition, in the majority of countries, the country note was followed up by policy interviews with panels of relevant stakeholders to explore further how they are addressing specific policy challenges (see Annex

B, Box 3 for the policy interview template). Countries were chosen to ensure a diversity of governance approaches, population sizes, geographical locations, and policy challenges faced. The interviews were performed by the OECD Secretariat with the support of the EG member for each country.

Respondents to the policy interviews were drawn from the following three stakeholder groups with roles in designing, implementing and evaluating policy in their countries:

- *Funders*: Government officials responsible for science policy or agencies responsible for science policy implementation and funding with direct impact on the employment and working conditions of postdoctoral researchers involved in academic research.
- *Employers*: Research performing organisations or representative associations of employers of researchers. Many of the individuals interviewed from this group are also senior academics/research leaders.
- *Researchers*: Representative associations of researchers, especially postdoctoral researchers.

Eurodoc, the European Council of Doctoral Candidates and Junior Researchers, which was represented in the EG, supported the Secretariat in surveying representative associations of postdoctoral researchers in Europe. TUAC, the Trade Union Advisory Committee to the OECD, which was also represented in the EG, nominated relevant representative associations of postdoctoral researchers in other countries.

Findings from internationally comparable data

This section is an analysis of relevant internationally comparable data that are useful to understand the phenomenon of the precarity of research careers. Following the guidance in the Frascati Manual, the following acronyms are used for the institutional sectors performing research: business enterprise (BE), government (GOV), higher education (HE), and the private not for profit (PNP) sector.

Doctorate holders

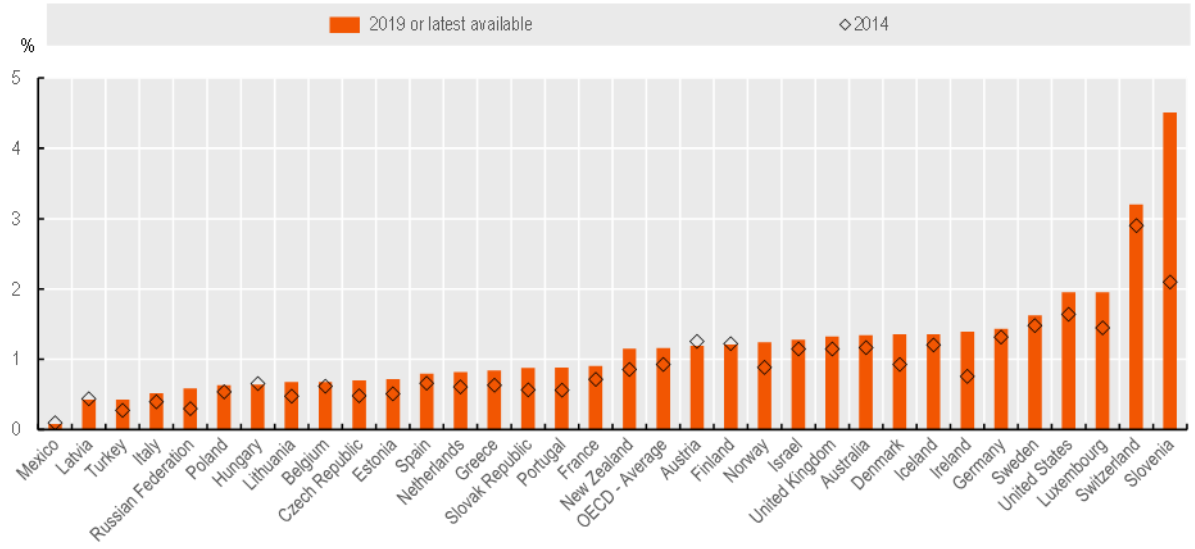
One of the factors driving the precarity of academic research careers is the increasing number of doctorate holders seeking academic research positions. The last report of the Careers of Doctorate Holders survey indicates a rise of 38% in the number of doctoral degrees awarded across the OECD between 2000 and 2009 (Auriol, Misu and Freeman, 2013[35]).

The UNESCO-OECD-Eurostat data collection on education statistics (UOE) is the main source of information for the annual flagship publication *Education at a Glance* (OECD, 2019[36]), which has some information on doctorate holders (across all fields of research classified in the Frascati Manual[3]), many of whom will go through a period of postdoctoral work. The publication in 2019, with a focus on tertiary education, incorporates indicators based on the survey on the Career of Doctorate Holders (CDH) undertaken in 2017. From 2008 to 2018, the percentage of 25-34 year-olds with tertiary education across the OECD went from 35% to 44%. In the case of women, tertiary education attainment reaches 51%. At the doctoral level, women are also on a parity in most fields, except for engineering, manufacturing and construction, where they represented around a third of doctoral graduates in 2017. The OECD average share of 25-64 year-olds with a doctorate is around 1%, but the share has been increasing, and if current trends continue, 2.3% of today's young adults will enter doctoral studies at some point in their life.

Figure 3 shows that the share of doctorate level attainment in the population aged 25-64 year olds in OECD countries has grown on average 25% across the OECD during the five-year period from 2014 to 2019.

Figure 3. Share of doctorate-level attainment in the population

25-64 years, 2014 and 2019 or latest year available



Note: The data for most countries are derived from national labour force surveys. It includes Short-cycle tertiary education (L5) for Switzerland 2014-2019. 2019 data for Russian Federation correspond to 2018 value.
Source: (OECD, 2020[37]), "Education at a glance: Educational attainment and labour-force status", OECD Education Statistics (database), https://doi.org/10.1787/889e8641-en (accessed on 22 September 2020).

StatLink https://doi.org/10.1787/888934223327

Doctorate holders (25-64 year-olds) have the highest employment rates, 92% on average across OECD countries. Doctorate holders, on average, especially those who work in the private sector, also enjoy an earnings premium relative to other graduates but this varies considerably across countries. Despite increasing levels of attainment at the doctoral level, younger doctorate holders (25-34 year-olds) in the majority of OECD countries for which data are available have higher rates of employment than other tertiary education graduates do. The relative advantage of doctorate holders over master's degree holders is more variable, especially in some fields. The higher education sector has been the traditional sector of employment for doctorate holders in most countries. However, there is evidence that, as many younger doctorate holders can no longer find a stable career position in academic research, they are increasingly pursuing alternative employment paths in the commercial sector, public services or in self-employment (OECD, 2019[38]).

In most OECD countries for which there are data women represent over 40% of academic staff in tertiary education, and the OECD average for women under 30 is over 50%. However, women tend to be over-represented in teaching-oriented institutions of short-cycle tertiary education, rather than research-oriented institutions. Opportunities depend greatly on field of study, and there are wide differences among countries in the distribution of doctoral graduates by field of study. Women are less represented in fields that are more market facing, such as engineering, manufacturing and construction, and thus may have fewer work opportunities outside the HE and GOV sectors, but the situation varies widely among countries.

The international mobility of doctorate holders is pervasive across the OECD. The OECD average share of international doctoral graduates is around a quarter, and English-speaking countries or those that use English in academia, tend to have larger shares of doctoral students. In many countries, the share of foreign-born and foreign citizen doctorate holders in the general population is substantial, representing more than half in Canada and Switzerland. Many countries have implemented policies to lower the barriers to migration of highly educated individuals, including postdoctoral researchers, and many support

incoming, outgoing and return mobility. However, women doctorate holders are less internationally mobile than men are.

In most countries, students can theoretically enrol in doctoral programmes from the age of 25, or even earlier. However, the median age of new entrants to doctoral studies across the OECD is 29, with 60% of entrants between the ages of 26 and 37, and there is wide variability between countries. It means that many people get their doctorate in their thirties, and that the postdoctoral period likely goes into late thirties and early forties, or even longer. Some countries consider early career researchers, including doctoral researchers, as employees. In others, they are funded on either grants or stipends and, in some cases, have no employment contracts with the organisation where they perform their research.

R&D expenditures, budgets and personnel

The Main Science and Technology Indicators (MSTI) is a biannual publication that provides indicators that reflect the level and structure of science and technology in OECD countries (OECD, 2019[39]; 2020[40]). It provides indicators on R&D expenditures, budgets and personnel derived from the OECD-Eurostat coordinated R&D data collection (RDS).

Total government budget allocations for R&D (GBARD) have grown by 44% since 2005 (OECD, 2019[39]), 80% of which is spent on civil R&D (OECD, 2020[40]). Government R&D budgets rose by 5.6% in real terms in 2018, bringing government allocations above their 2009 peak. HE R&D expenditure has increased by 27% compared to 2007 levels, below the 34% increase for BE, but well above GOV's increase of around 10%. Within these average patterns, there is wide variation among countries and some countries are still below the level before the 2007-2009 financial crisis (e.g. France, Italy and Spain) (OECD, 2020[41]).

Since 2005, the percentage of gross domestic expenditure on R&D (GERD) performed by the HE sector has been stable around 17%, and that performed by the GOV sector has steadily decreased from 12% to around 10% in 2018.

While the total number of researchers has grown by 37% in full-time equivalent (FTE), across the OECD, the gross domestic expenditure on R&D per capita has grown faster, by 68% between 2005 and 2018 (at current prices and PPP) (OECD, 2020[40]). In 2017, there were 8.6 researchers FTE per thousand employment, compared with 7.0 in 2005. HE researchers represented around 30% of the total number of researchers and GOV researchers represented around 7% in 2016. In 2017, women researchers were 35% of total researchers across the OECD, with a minimum of 16% for Japan, and a maximum of 52% for Latvia. The shares of women researchers are higher in the GOV sector (44%), and in the HE sector (43%).

One common assumption with potential implications for precarity is that research is becoming more expensive in terms of capital investment. However, from available data, there does not seem to be any particular trend among countries regarding capital expenditure in either the HE or GOV sectors. There seems to exist high volatility from one year to the next, both for HE and GOV.

Another common assumption is that core funding is diminishing relative to project-based funding. Public general university funds (GUF) are defined as R&D funding coming from general grants universities receive from the central government (federal) ministry of education or the corresponding provincial (state) or local (municipal) authorities in support of their overall research/teaching activities. Looking at the available data, the share of GBARD for general advancement of knowledge financed from GUF relative to other sources varies significantly by country, with no observable trend among countries. Additional OECD experimental data collection on the percentage of public project funding of GBARD shows a lot of diversity and no obvious trend between 2000 and 2011 (OECD, 2018[12]).

In terms of R&D personnel by sector and major field of R&D, there is no aggregate indicator for the OECD. It is thus not possible to assess how the rate of growth in the number of FTE researchers in the HE and GOV sectors compares to the rate of growth of doctorates awarded. There is no complete data for R&D

personnel by sector and formal qualification and R&D personnel by sector and function, which means that it is not possible to ascertain the evolution of R&D personnel with and without a doctorate over time, and the evolution of R&D personnel that are researchers relative to other research-related personnel. The statistics for R&D personnel are generally very incomplete, across countries and across time.

Academic staff

The results of the OECD feasibility survey on the classification of tertiary instruction personnel provides some relevant information on those working in academia [EDU/EDPC/INES/WP(2020)11]. Tertiary instruction personnel cover those that have teaching, research or both activities in tertiary education institutions (i.e. covering short-cycle tertiary education (ISCED 5) to doctoral education (ISCED 8)). It shows that personnel in higher education on non-standard employment are under-reported in official statistics. Only 10 out of 22 countries that responded report all casual and temporary personnel in the UNESCO OECD Eurostat education survey; five only do it partially, and seven do not report them at all.

Some countries emphasised the difficulty to report separately on staff with casual or temporary contracts. Some universities (for example in Estonia or Finland) do not consider personnel not on the academic career path as academic staff, and therefore do not report them in national registries. In other countries, the data are reported jointly with staff on the academic career track and cannot be distinguished. Most countries could not report the average duration of contracts for temporary staff. Only three countries reported an average contract duration: 12 months in Italy, 18.6 months in Estonia, and 24 months in Latvia. In Germany, while an average duration of contract was not specified, the maximum duration of a fixed-term contract for the purpose of qualification is capped at 6 years prior to being awarded the doctoral degree and six years (medicine: nine years) after being awarded the doctoral degree. There is little data available on academic staff by seniority level, salaries, and organisation of working time (full and part-time). The “Other” category of academic staff, i.e. casual or temporary staff with fixed-term employment and not on the academic career track, is significant in some countries, representing more than 40% in Australia, Germany, and Italy.

Survey of Scientific Authors

The OECD International Survey of Scientific Authors (ISSA) is a survey of corresponding authors who have published in peer-reviewed journals. It aims to collect information on their activities. It targets corresponding authors, a subset of researchers, and not necessarily representative of all postdoctoral researchers. Nonetheless, it contains relevant insights on researchers on fixed-term contracts (see findings and technical information in Bello and Galindo-Rueda (2020[42]; 2020[43])).

Working conditions of corresponding authors

ISSA2[4], conducted in 2018, has information on how the performance of researchers is assessed, and their working conditions. It provides information on differences between those on indefinite contracts and those on fixed term contracts, and between those that are classified as “professionals” and “associate professionals”, which includes researchers working under the supervision of a senior scholar, such as postdoctoral researchers. It sheds light on differences between employment in the public sector (e.g. academia and public research organisations) and the private sector, including salaries, and contractual status.

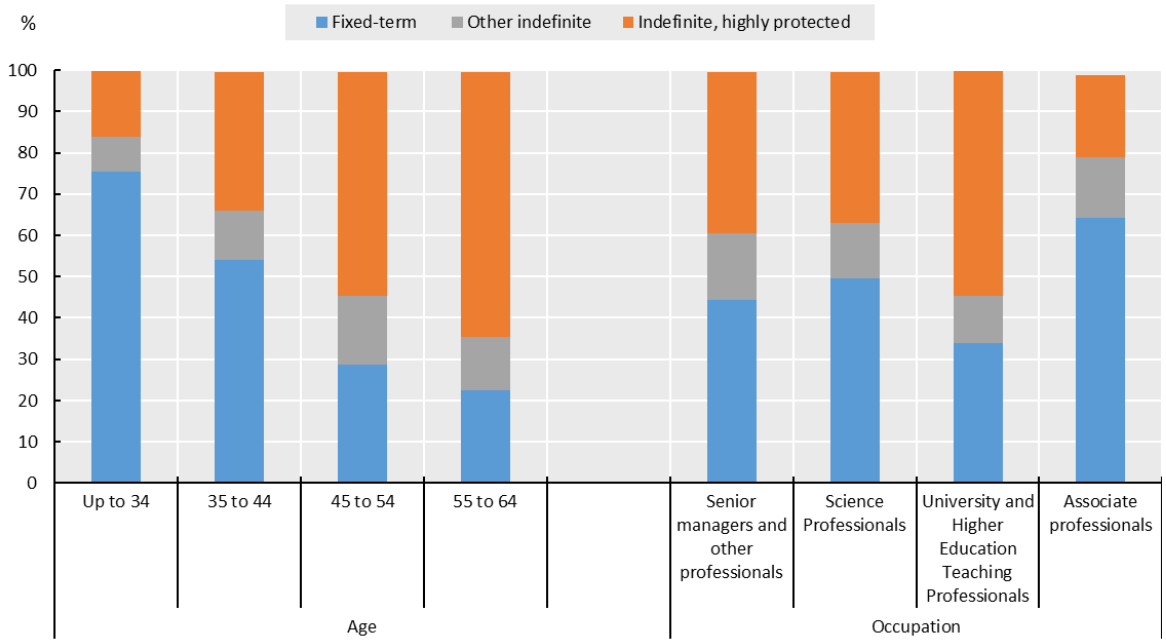
Almost three in four respondents work in the public sector, as expected of a survey of corresponding authors, as academic researchers have more of an incentive to publish than researchers in the private sector, and those in the private sector may not be able to publish if their work is commercially sensitive. Respondents state that many of the key decisions relating to research funding and careers are informed by the use of quantitative indicators of research output. They include the possibility of joining research

teams, the award of project funding, and hiring or job promotion. 65% of authors need to compete for resources within their organisation, and 71% need to compete for and secure funding from external organisations. The average working hours per week is above 40 for 78% of authors, and almost 1 in 5 work more than 55 hours per week. 28% of authors earn less than USD 30 000 per year. These working conditions give some indication of the pressure and (hyper-) competition that exists within research in academia.

Moreover, only 52% of corresponding authors hold an indefinite contract. Up to age 34, 75% of authors have a fixed term employment contract, and 51% still do in the age range 35-44 (Figure 4).

Figure 4. Job security of corresponding scientific authors, by author age and occupation

Percentage of corresponding authors



Notes: Calculations for the group of scientific corresponding authors under 65, who hold a doctoral degree and are employed in a non-profit organisation (public or private). Weighted estimates based on sampling weights adjusted for nonresponse. Indefinite highly protected contracts normally mean that the respondent can only be dismissed by their employer for gross misconduct. This level of protection is typically afforded by civil servant status or tenure. Other indefinite contracts are open-ended, as opposed to fixed-term positions that have a set duration.
Source: Calculations based on the OECD International Survey of Scientific Authors, 2018. http://oe.cd/issa, June 2020.

Corresponding authors are often mobile: the proportion of authors that are born in a country different from their country of residence is around 30%, whereas the average proportion of foreign-born in the general population across 34 OECD countries for which data are available is around 13% (OECD, 2020[44]).

There are significant differences between those on indefinite and fixed-term contracts

Corresponding authors on fixed-term contracts are more likely to earn less than those on indefinite contracts, after controlling for a number of personal and job characteristics[5]. This may indicate wage discrimination towards researchers on fixed-term contracts. Women corresponding authors also earn on average 6% less than their male colleagues, after controlling for relevant variables. This gender gap in

earnings persists in all science areas and it is wider in the physical sciences where the earning disadvantage of women reaches 11%.

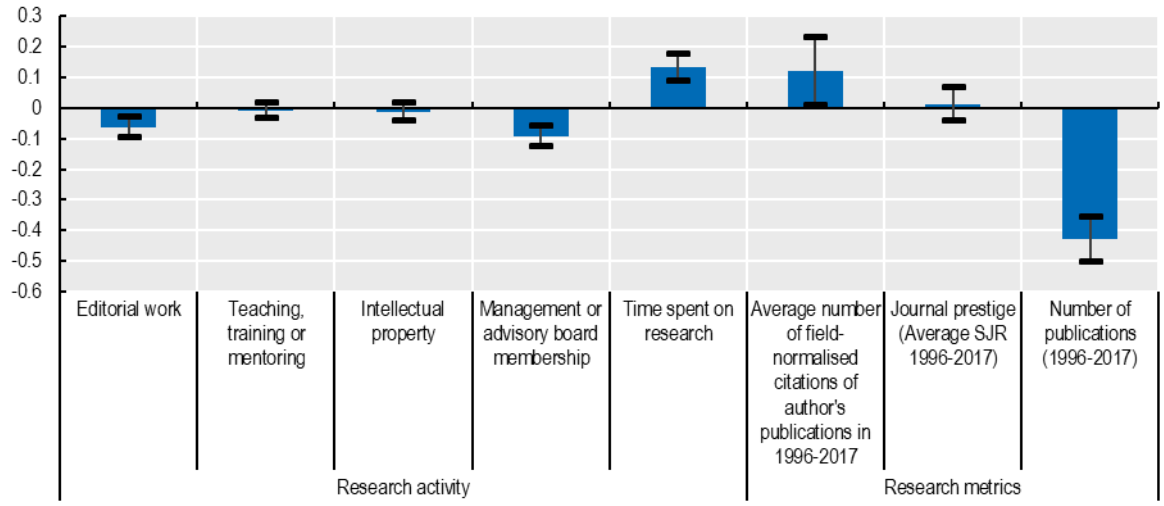
Those on fixed-term contracts and younger authors are more likely to hold multiple jobs, and, as expected, the likelihood of that decreases as the earnings of authors increase.

Quantitative indicators of research performance, such as journal prestige and citations, are more likely to be used for hiring, job promotion and retention decisions for authors on fixed-term contracts than for those on indefinite and highly protected contracts (i.e. civil servant status and tenure[6]).

Corresponding authors on fixed-term contracts spend a higher percentage of their time on research. During the period 1996-2017, they drew more citations and tended to publish in more prestigious journals than those on indefinite contracts (controlling for age, science field and gender) (see Figure 5).

Figure 5. Differences in research activity and research performance between authors on fixed-term and indefinite contracts

Least square regression coefficients and confidence intervals, controlling for author characteristics



Note: Calculations for the group of scientific corresponding authors under 65, who hold a doctoral degree and are employed in a non-profit organisation. The estimated coefficients report on the difference between authors with fixed terms contracts and those with indefinite contracts (including both highly protected and less protected contracts). All regressions control for author characteristics including age, gender, working hours, sector of employment, number of citations and number of publications, as well as country and science field-fixed effects.
Source: Calculations based on the OECD International Survey of Scientific Authors, 2018, http://oe.cd/issa, June 2020.

Corresponding authors on fixed-term contracts are more mobile. They are more likely to live in a country different from the one where they got their doctorate, and are three times more likely to be planning to move to another country in the future than authors on indefinite contracts. Whereas some will be moving out of choice, it is likely that many will be doing so as a necessary step to get their next contract.

Health, well-being, and the impact of Covid-19

The Nature postdoctoral-researcher survey shows that Covid-19 is significantly compounding the challenges faced by postdoctoral researchers on fixed-term contracts. It is worsening their career prospects, because institutions are cutting jobs or delaying recruitment. More immediately, around 1 in 4 postdocs feel unsupported by their senior researchers. 1 in 5 have sought help for anxiety or depression, and more than half have considered leaving research because of mental health problems. Many work abroad and fear they will not be able to stay in their hosting country (Woolston, 2020[45]; Nature, 2020[46]).

The OECD conducted a Science Flash Survey 2020 to better understand the impact of the Covid-19 crisis on science. Survey responses are consistent with those from the Nature exercise and confirm a detrimental effect of the pandemic on job security and career opportunities in science, research funding and time available for doing research. Women and younger researchers are more likely to be affected.

Key findings from the available data

The expansion of doctoral level attainment has been staggering. Many doctorate holders will no longer find a stable position in academic research and will pursue careers in other sectors. The international mobility of doctorate holders is pervasive across the OECD. R&D expenditure has been increasing in all research performing sectors, including academia, but there is wide variation among countries. There is little comparable international data on R&D personnel, especially those in non-standard employment, which makes it difficult to have a clear picture of the research workforce and research careers. Nonetheless, ISSA2 data give some relevant insights into the extent of precarity, especially among younger researchers, and the significant differences between those on indefinite and fixed-term contracts in terms of job security, earnings, multiple jobs, research activity, performance, and mobility. The impact of covid-19 is worsening the career prospects of postdoctoral researchers and having a detrimental effect on their wellbeing, with women and younger researchers being more likely to be affected.

Data gaps

The overview of available internationally comparable data shows that there are a number of important data gaps in relation to research personnel in general, which is more acute for those on fixed-term contracts in academic research. In particular, there are virtually no longitudinal data on:

- the evolution of those in precarious employment, such as growth rates in permanent positions versus fixed-term positions,
- the growth rate in postdoctoral positions versus the growth rate for positions at different seniority categories of the research career, and how they relate to the growth rate of doctorates awarded.

There is very little disaggregated data, beyond gender, on demographic characteristics such as socio-economic background, age (biological and academic), ethnicity, disability, indigeneity, etc. There is also a need for more systematic survey data across countries on the experiences of researchers, including important aspects of their health and well-being. In short, there is a need for valid, reliable and international comparable data, based on solid methodologies, on research careers, including on the precarity phenomenon.

There are some lessons to be learned from the OECD Careers of Doctorate Holders (CDH) initiative, which has sought to promote the implementation of a horizontal survey instrument targeting the full population of doctorate holders, rather than specific, recent cohorts, as well as covering all institutional sectors of employment. The CDH has sought to address challenges found in other sources (e.g. qualification attainment misreporting, timeliness in Census data and exhaustiveness in Labour Force surveys). Adoption is, however, limited and results have to be interpreted with caution as data submitted by countries are based on a combination of multiple data sources. The lack of good international comparable data reflects the lack of good information at national level, and the fact that, where data are collected, standardised methodological guidelines are often not well implemented within countries. Initiatives such as the International Survey of Scientific Authors (ISSA) can provide some pointers but cannot fully answer important questions relating to research careers and their precarity. Sustainable infrastructure and commitment at national level is required to support the development of internationally comparable data, which is of interest given the global nature of research careers and the phenomenon of precarity. From the experience of CDH a lot of interesting and useful findings for countries emerge from cross-country comparisons.

The CDH project developed a module of the core questionnaire that was specifically directed at postdoctoral researchers, defined as those in temporary research positions held shortly after completion of an advanced research qualification (Auriol, Schaaper and Felix, 2012, p. 45[47]). The module covers characteristics of the postdoctoral position, the titles used to refer to the postdoctorate, the field of science and research, duration of contract, possibility of extension of contract, reasons for taking the position, percentage of time in the position, and source of funding for the position. This work could be a point of departure for a more systematic data collection on postdoctoral researchers in the future.

Findings from national landscape analyses and interviews

As reviewed earlier, one of the challenges in analysing research precarity is the lack of good data. The evidence presented in this section was collected in the dedicated country notes and interviews (see the section on Methodology above and Annex B) that were conducted for this study. This information has been supplemented with references to public documents, where these are available.

Context for precarity

Over the past decade, R&D expenditure in academic research (HE and GOV) across the OECD has been increasing (albeit not in all countries). However, funding is increasingly awarded on a competitive basis, and increasingly comes from third party sources with short-term commitment and very limited discretion regarding its usage. This translates into an increasing number of postdoctoral researchers in many systems (e.g. postdoctoral researchers have increased by 144% in the last decade in Finland).

Many countries have seen the proportion of research-only staff in academia increase, as opposed to combined teaching and research positions. These are primarily positions for postdoctoral researchers on fixed-term contracts. Postdoctoral researchers (and doctoral and pre-doctoral researchers in some countries) represent the majority of the research workforce (e.g. in Australia, 56% of the human resources devoted to R&D are postgraduate students; in Switzerland, 64% of researchers are doctoral and postdoctoral researchers; in France doctoral and postdoctoral researchers are authors on 70% of scientific publications).

The share of permanent positions, either conferring civil servant status or tenure, and open-ended positions, is decreasing relative to the number of researchers on fixed-term contracts. In some countries, this is the result of restrictions on public employment. In others, it is the result of institutions not wanting to commit to long-term personnel expenditure in the face of funding uncertainty. This means that many postdoctoral researchers in academia remain on fixed-term contracts with limited prospects of advancing in their careers (e.g. in Germany, 77% of postdoctoral researchers in higher education institutions and 72% in non-university research institutions have a fixed-term contract; 80% of scientific staff in Swiss universities are on short-term contracts; in Finland, 70% of academics are on fixed-term contracts; in the French Community of Belgium 58% of those working in universities are on fixed-term contracts). This situation is sensitive to the macro-economic situation and the United States saw a large increase in doctorate holders taking postdoctoral positions during the recession of 2008-2010.

Countries have been expanding doctoral education, often rewarding universities for the number of doctorates awarded by using performance-based funding formulas. The increasing number of doctoral degrees awarded (e.g. in the United States, 37% growth since 2003; in the French Community of Belgium, 61% increase between year 2000 and 2017; in the Netherlands, 260% over 30 years; in France the ratio of doctorates awarded to the number of positions being opened at universities and public researcher organisations is around 10:1) means there is a constant supply of people to occupy an increasing number of short-term positions.

Postdoctoral researchers operate in a global market place (e.g. in the Netherlands, 51% of postdocs have an international background), which exacerbates competition for appointments to tenured positions. The deterioration of working conditions for early career researchers may already be affecting the attractiveness of academic careers in some countries, which have seen a decrease in the number of people pursuing doctoral education, especially in more market facing fields, such as engineering, where alternative careers are more attractive to university graduates.

In some countries, academic research is still the destination for the majority of doctorate holders (e.g. in Portugal, 83% work in HE), but there is a shift of employment towards the business enterprise sector, and to a lesser extent to public administration and the private non-profit sector (e.g. in the United Kingdom, 70% of all doctorate holders have left academia 3 years after graduation). Overall, there is no indication of serious concerns with unemployment rates for doctorate holders, with employment rates generally higher than for other graduates. However, there is a widespread stigma within academia towards postdoctoral researchers leaving academic employment.

There is no sign of action to control the number of doctorates awarded, but instead there are new initiatives in several countries to change the nature of doctoral education to better prepare doctorate holders for diverse careers and support economic and societal development (e.g. in the Netherlands, 69% of doctorate holders work outside academia, but only 13% of doctoral students feel sufficiently prepared for those positions). Whereas in many countries doctorate holders, who do take the decision to leave academia, can find jobs in other sectors, the demand for their skills is weaker in other countries (e.g. Czech Republic, Hungary, Portugal, Spain).

In some countries, recruitment for postdoctoral positions is at the discretion of senior researchers or follows informal recruitment procedures, with posts not being advertised publicly. This can result in “academic inbreeding” and raises issues of equal opportunities and diversity in the research workforce. In addition, there is often a proliferation of funding instruments targeting postdoctoral researchers, which means widely differing employment conditions for people doing similar work.

In some systems, the research workforce is ageing, retiring later (e.g. in the United Kingdom, the lifting of mandatory retirement age led to a doubling of those over the age of 65 in academia; in the United States full-time faculty aged 65-75 at research universities rose from 2% in 1973 to 12% in 2013), reducing the opportunities for younger researchers. This may also be accentuating power relations within institutions that value seniority.

In some countries, remuneration of postdoctoral researchers is low, and associated with fewer welfare benefits than alternative employment. In some cases, poor pay means that postdoctoral researchers need to hold multiple jobs, which detracts from full engagement with research. It is not surprising that postdoctoral positions are increasingly considered as unattractive to the best talent. This is especially the case in some fields, such as data analysis and artificial intelligence, where skilled individuals, with a doctorate, are much sought after by industry.

The research ecosystem includes central government, local government, industry, independent funding agencies, charitable funding sector, supra-national funding (e.g. EC), autonomous universities and research institutions, and principal investigators with high levels of autonomy within institutions. The complex shared governance arrangements of academic research mean that implementing policy initiatives and changing the conditions of postdoctoral researchers on fixed term contracts is difficult to coordinate and a slow process.

Effects of precarity

Well-being of researchers

In the United Kingdom, the Wellcome Trust recently surveyed online more than 4 000 researchers (24% of whom were not based in the United Kingdom) at all career stages about the culture that they work in (Wellcome, 2020[48]). Less than a third felt secure about pursuing a research career. More than three-quarters felt the high levels of competition have created unkind and aggressive working conditions. Nearly two-thirds have witnessed bullying or harassment, and around 40% had experienced it themselves. More than half of those surveyed have sought or have wanted to seek professional help for mental health issues. There is a mismatch between the perceptions of research leaders of their management skills and the practices perceived by the researchers they manage. While 80% of researchers say they have the knowledge and skills to manage a team, only 48% have actually been trained to do it. Only half of those being managed say they have received feedback on their performance or had a formal appraisal in the past year.

The Covid-19 pandemic is making things worse, especially for women. A report chaired by Australia´s Chief Scientist assessed the potential impact of Covid-19 on the national research workforce (Rapid Research Information Forum, 2020[49]). It concluded that the precarity of research careers, particularly for women, has increased and is likely to have additional impact on their well-being.

Attractiveness of the research career

A survey by the Academy of Young Researchers in Hungary involving 1 500 respondents found that two-thirds of those under 45 are thinking of leaving the research profession. Several studies in Finland also found that many academics and particularly early career researchers are increasingly looking outside of academia for careers (Kuoppakangas et al., 2019[50]; Aarnikoivu et al., 2019[51]; Kallio and Kallio, 2012[52]). The main problems identified were: 1. the pressure to secure external funding and produce high-quality publications as an early career researcher; 2. negative effect on motivation of the use of quantitative performance metrics; 3. the decreasing number of permanent positions available and high dissatisfaction with the selection process for permanent positions.

Quality of science

The Wellcome Trust survey found that the research system favours quantity over quality (Wellcome, 2020[48]), and 75% of researchers consider that creativity is being hindered. A fifth of junior researchers and students have felt pressured by their supervisors to produce a particular research finding. More than 40% of researchers believe their workplace emphasises metrics over research quality. Wang et al (2017[53]) suggest, based on analysis of 15 years of citation data, that the use of bibliometric indexes by funding agencies and hiring and promotion committees, reinforces risk aversion, biases decisions against researchers doing novel research, and adversely affects early-career researchers. The report commissioned by the government of Australia on the impact of Covid-19 (Rapid Research Information Forum, 2020[49]) identified that the precarity of research careers, particularly for women and other demographic groups facing additional barriers, reduces diversity in the research workforce and this in turn could impact the quality of science.

Interviewees for this report from several countries reported that their best graduates are no longer attracted to pursue doctoral education towards a research career, and that many positions are filled with what they consider as less able national students and/or international students. They are concerned that this will ultimately affect the quality of the research being produced.

Differences by gender and other demographic factors

Even in Finland, a country that scores highly on standard measures of gender equality, a number of studies show that the Finnish professoriate lacks diversity in terms of both gender and social background (Helin et al., 2019[54]). Lengthy mobility periods for women, especially early career researchers, are often ruled out, not because women are not interested in them but due to family commitments; and women are under-represented in tenure track positions, particularly when recruitment is based on invitations (Nokkala et al., 2020[55]). Although it generally attracts less attention than gender, parental background is an important determinant of access to a research career: doctorate holders whose parents have a master's or a doctoral degree themselves are more likely to obtain a professorship and at a younger age. This also means that historically established ethnic disparities in academia tend to be perpetuated.

Several countries are concerned about the lack of diversity in their research workforce and have introduced policies to address the issue (e.g. Aboriginal and Torres Strait Islander Researchers is an under-represented research group and there are specific initiatives in Australia to address this). However, there seems to be little data on social diversity beyond gender in national datasets, which limits analysis of differences between different societal groups by ethnicity, indigeneity, etc.

Policy initiatives to address precarity

This section describes the common challenges faced by countries with regard to the precarity of research careers and some of the initiatives that are being implemented to address them. The discussion of each challenge begins with quotes from the interviews that were carried out for this study. References to specific national experiences or initiatives have been extracted from the country notes that were prepared for this project and/or interviews. A more extensive synthesis of illustrative policy initiatives from the countries that participated in this report is provided at Annex C, which includes references and links to further information. For many of the funding programmes, more information can be found in the OECD STIP Compass.

The "permadoc" phenomenon

"'Permadoc' is a way for universities to get low cost labour" (funder)

"Postdocs are encouraged to continue to publish in the illusion of getting a tenured position" (employer)

"Limiting the number of fixed-term contracts has good intentions but does not work" (researcher)

"There is no shortage of contracts, but they are precarious" (employer)

"Some researchers survive on grants a whole career" (funder)

"One-year contracts have become common" (funder)

"Funding, both volume and share of core funding, determines the employment of researchers" (employer)

"there is a lack of flexibility in project funding to pool money and provide more long-term positions" (researcher)

"Researchers feel stressed because of their unstable grants" (researcher)

"Competitive funding increased but it is difficult to employ faculty who teach students with competitive funds. There is a shortage of young faculty" (researcher)

"Conditions for postdoctoral researchers have deteriorated, and there is a lot of competition" (researcher)

"Those on fixed-term contracts are earning less than those with permanent contracts for identical work" (researcher)

"Institutions are creating non-degree awarding courses to justify keeping people on grants instead of giving them employment contracts" (researcher)

"There is pressure on researchers to teach for free with the rationale that it will improve their chances of a higher education position" (researcher)

"Researchers should be able to plan their career and have some stability" (funder)

"All postdoctoral researchers should be in employment contracts (rather than stipends)" (researcher)

"Institutions find creative ways round limitation on fixed-term contracts" (researcher)

"Even systems with generous funding keep dual labour markets" (researcher)

"Whether postdocs are employees or contractors is a big issue" (researcher)

Many early-career researchers stay in the postdoctoral phase in a succession of fixed-term contracts, often of very short duration (see section above on data findings). Countries are trying to curb the duration of the postdoctoral phase (e.g. maximum of 6 years (9 years in medicine) in Germany), discouraging very short-term contracts (e.g. in Germany duration of contract must be in line with project duration), mandating

employment contracts instead of stipends (e.g. Portugal, Max Planck Society in Germany), creating new permanent positions in institutions for individuals who have had temporary contracts for several years and allowing those that occupy fixed-term positions to apply for a permanent position in a competitive process (e.g. the *stabilisation* process in Spain); and generally promoting the transition to other careers, with different degrees of success in implementation.

"More worrying is age at first permanent position" (policy official)

"Permanent positions are awarded mostly on publications, which discriminates against the young" (policy official)

"Very few retirements" (policy official)

"There is no labour market in companies for those that take time to transition from academia – it is often too late (employer)

"Companies will get the best, those that can manage projects" (employer)

"New positions are filled with researchers advanced in the career" (policy official)

"Precarity is in parallel with the ageing of university staff" (policy official)

Researchers are accessing an indefinite contract later in life. They often face multiple "super-human" requirements, and vague evaluation criteria to access an indefinite contract. If they do not make it in academia, they may find it rather late to move to other careers. In the Netherlands, it is estimated that, on average, it takes a doctorate holder more than a decade to attain the labour market remuneration of a master's holder. Recent analysis in the UK suggests that when you control for other factors, the earnings premium of a doctorate relative to an undergraduate degree disappears, even being negative in some disciplines (Britton et al., 2020[56]).

Tenure-track type systems[7] are being introduced to give more transparency and certainty for young career researchers, also with a view to inducing young researchers to make career choices within or beyond academia earlier in their lives. Germany introduced a tenure track programme in 2017 (after having established junior professorships in 2002), and France is introducing a new tenure-track programme (although limited to a small share of positions). Japan also has a programme to support the dissemination and adoption of a tenure-track system: 70 out of 90 national universities had done so by 2019.

Outdated career structures

"There are limited career opportunities for those researchers not seeking group leader positions" (researcher)

"Mismatch between doctorates awarded and number of positions at universities and PROs" (employer)

"Civil servant status may be a deterrent to open-ended contracts" (policy official)

"The introduction of the tenure-track was not particularly successful: universities are hesitant to give civil servant status to more people" (funder)

"There is a lack of stable positions between ECR and professorship" (funder)

"Tenure-track would improve transparency" (researcher)

"Diverse, messy and opaque career structures are a problem (…) inbreeding and lack of transparency" (researcher)

"The European four-stage career model does not happen in practice – second stage mixes postdoctoral on research contracts with assistant professors in the career" (researcher)

"There is a lack of differentiated career system beyond professoriate" (researcher)

Most career systems assume a linear progression from doctoral researcher to researcher (or assistant professor), senior researcher (or associate professor), and director of research (or full professor). In reality, career progression is contingent on early career researchers competing for very scarce positions, with an emphasis on publication record as the main criterion. Many will not progress through the ranks but will become staff scientists or assume other research supporting roles, working in teams led by a senior researcher, without that being formally acknowledged in the existing career systems. There is a need to create career pathways and more stable funding for staff scientists within academia. Short-term funding used for continuous and long-term research requirements induces employment strategies that result in precarity. Additional funds going into the research system should not be concentrated on doctoral education and short-term postdoctoral positions – as is currently the case in many countries – but instead be spread across all career stages.

Some countries are discussing a differentiated career system to recognise other roles, such as staff scientist (e.g. recommendation of the Federal Council to the Cantons in Switzerland in 2014, recommendation of the Council of Science and Humanities in Germany in 2014). The EU has recently launched an action to develop a framework for research careers, including the recognition of the research profession and the skills and competences associated with it, and a coherent framework for career development of researchers (EC, 2020[57]). It aims to have recognised standards across the EU, for instance the consistent use of tenure track, open and transparent recruitment, and diversification of research careers. Without neglecting scientific excellence and publications, this framework would embrace other aspects of research and innovation, and translating them into more inclusive research assessment systems.

There are concerns about the lack of employer flexibility associated with civil servant status and tenured positions, and dual labour markets are emerging as institutions avoid giving highly protected contracts to younger researchers. Some countries are moving instead to less protected open-ended contracts in order to provide a more unitary labour market for researchers (e.g. full tenure no longer exists in the United Kingdom and Australia, Austria is phasing out civil servant status, France is introducing open-ended contracts alongside civil servant status).

Unstructured postdoctoral phase

> *"Currently, there is too much investment in the PhD and not enough beyond the PhD" (researcher)*
>
> *"Postdocs are not a well-defined body of people like doctoral researchers" (employer)*
>
> *"Need to move from funding people to initiate structural change" (funder)*

Postdoctoral researchers are not a well-defined cohort of people unlike doctoral researchers. Doctoral education is highly structured in most countries, with doctoral schools, formal processes, duration and expectations. In contrast, the postdoctoral phase, which can last many years, does not have a defined duration, tends to be unstructured, not formally taken into account within research career structures, and the way it is managed is highly contingent on local conditions. There is variation in perception of what the postdoctoral phase is - a further training or apprenticeship phase or a job or a mix of both. Nevertheless, there is a growing consensus that the postdoctoral phase should explicitly include the continued development of generic skills acquired during doctoral education to enhance preparation for a wide range of careers; it should evolve from being a safety net for those waiting for an academic position to a period that proactively opens up other options.

Countries are discussing ways to better structure the postdoctoral phase (e.g. the recommendation of the Federal Council in Switzerland to the Cantons in 2014). This involves explicitly defining the postdoctoral position, including formal processes for performance appraisal, professional development, and career guidance. In France, the government supports the organisation of training and career development of doctoral and postdoctoral researchers to help guide their professional paths. Some institutions and research funders are supporting postdoctoral networks to give them a stronger collective voice. UK Research and Innovation (UKRI) has recently announced a pilot of a national early-career researcher forum, in response to the development of a national Concordat to Support the Career Development of Researchers.

Excessive dependency on senior researchers

"Lack of control and sense of agency leads to mental health problems" (researcher)

"Postdocs cannot apply to lead projects in most calls" (researcher)

"Lack of opportunity for autonomous research" (policy official)

"There is pressure to move from 'feudal' chair system to departmental organisations, with more independence for younger researchers" (policy official)

"Established professors do not have an incentive to change the system" (researcher)

"Need more funding for independent research by postdocs" (employer)

"'Feudal' system: the power exerted by professors relative to younger researchers" (researcher)

"Assessment is not transparent for junior professorships" (researcher)

"Senior researchers want you to concentrate on their research and do not promote further development" (researcher)

"Need to shift some money from professors to universities and postdocs directly" (policy official)

"Most postdocs continue researching where they have studied; dependence on senior researchers is high" (researcher)

"Academic inbreeding is a problem" (policy official)

"There are generational conflicts between those that have the power and an increasing large generation of younger researchers" (researcher)

"Need to change the mindset of PIs" (employer)

"Senior researchers have all the power – no institutional regulation" (researcher)

Some postdoctoral researchers have individual fellowships that afford them a level of independence to do their own research, but this is a small minority. Most do not have their own independent support and work in subordinate positions relative to senior researchers. Whereas this allows them to undertake research and gain experience to advance their careers, several interviewees reported that they had very limited ability to develop independent research in a "feudal system" that relies on extreme dependency of junior researchers relative to senior researchers for prolonged periods of time. There is evidence also of a disconnect between senior researchers' perception of their management skills and their abilities in practice (Wellcome, 2020[48]). Career development of postdoctoral researchers needs to be a core requirement for PIs, and researchers need to be given time for professional development, and to develop their research identity and broader leadership skills.

In many systems, postdoctoral researchers are not eligible to apply for funding as PIs, even if they have devised a research project of their own. As time goes by, postdoctoral researchers find it increasingly difficult to access funding that is designated for early-career researchers, as this often has limits relating to the time of the award of the doctorate. This makes these people even more dependent on senior researchers.

There is a general perception that current research systems favour quantity over quality and that PIs respond to those incentives. In the process, the collaborative aspect of research is lost, and creativity is often stifled. The postdoc experience needs reforming, and the way funders assess and fund research should be adjusted to have a positive impact on research culture and curb extreme individualism in research. The view is emerging that excellence in research should encompass not just ideas and publication outputs of research, but also how research is done. This includes factors such as the dissemination and communication of research outputs to public audiences, responsible research practices, and leadership (see for instance the proposed Résumé for Researchers from the UK Royal Society (2019[58])). There is a need to develop robust methodologies for assessing these aspects of the academic research endeavour.

In recognition of these issues, several countries have launched programmes to support individual postdoctoral researchers to pursue their own research agendas. Korea, where more than 40% of new doctorate holders in science and engineering begin their postdoctoral research career with their doctoral supervisor, has launched the KIURI initiative, which among other objectives, promotes the independence of postdoctoral researchers. Spain has the The Ramon y Cajal programme where the recipient of a five-year postdoctoral fellowship is able to negotiate conditions with a hosting institution of their choice. Japan is allowing young researchers employed on a research project to decide on their own research activities

for up to 20% of their time. Many countries are expanding their funding schemes to directly support young researchers (e.g. the French Community of Belgium plans to increase success rate for individual fellowships to around 30%). In Germany, some institutions are changing to departmental structures instead of organising themselves in the traditional hierarchy around professorial chairs.

Lack of diversity in the research workforce

> *"There are issues with indigenous researchers and those from low socio-economic backgrounds" (researcher)*
>
> *"Exemplary cascade policy: new positions must lead to the selection of a share of women at least equal to the share in the prior seniority level" (employer)*
>
> *"New positions, especially project-based, have limited advertisement" (researcher)*
>
> *"There is a lot of inbreeding for the majority of positions; meritocracy is only for 'strangers' and 'outsiders'" (researcher)*
>
> *"Women tend to switch more to stable careers and are then less represented in senior categories" (funder)*
>
> *"Recruitment processes are not transparent and fair; (…) reason for lack of diversity" (researcher)*
>
> *"More needs to be done to support women. Maternity is now accounted for, after a petition by women" (researcher)*

Precarity is pervasive among postdoctoral researchers, but women and minority groups tend to be more vulnerable to its negative effects. Socio-economic background appears to be an important factor in research careers and needs more thorough analysis across countries. The integration of foreign researchers into the national research workforce is often more difficult and a concern in several countries. The overlapping effects of class, ethnicity and gender are compounded by precarity. Disadvantaged and discriminated groups of the population can less afford to endure a long period of precarity before attaining secure employment in research. According to some interviewees, the lack of diversity is also the result of the often-discretionary recruitment practices for postdoctoral positions.

Institutions and funders are taking action on gender discrimination, but there is still a need for more systemic changes (OECD, 2018[59]). There is less evidence of measures to address the lack of representation of disadvantaged social groups. Funding agencies can play a role in improving diversity by attaching conditions to funding, by including diversity criteria, and by ensuring diversity in evaluation committees. Researchers from different groups can be supported through mentoring programs and career coaching at their institutions.

Some countries are mandating open standards in recruitment (e.g. Portugal). The United Kingdom has developed the Athena SWAN initiative to advance gender equality and this has been adopted now in several other countries. In the French Community of Belgium, universities have implemented Gender Action Plans, with at least one university implementing a 'cascade' measure guaranteeing progress in gender distribution in higher academic positions through recruitment processes. Spain mandates that selection panels need to reflect gender parity and no gender should have less than 40% representation. Australia has developed targeted initiatives to support gender equality and for Aboriginal and Torres Strait Islander researchers. In Canada, equity, diversity and inclusion (EDI) targets determined at the federal level are having an effect on recruitment into tenure-track, although there are no data on fixed-term contract staff, which include most postdoctoral researchers. The EU, through the Marie Skłodowska-Curie Actions (MSCA) for Researchers at Risk, is supporting refugee scientists.

There is already some availability of disaggregated data by gender in many countries, but there is very limited or no data on other demographic characteristics, such as socio-economic background, ethnicity, academic age, country of origin, and disability. There is a need for more systematic data collection to cover these variables.

Lack of inter-sectoral mobility

"There are not too many PhDs but universities need to prepare students for other careers and to come back to academia" (researcher)

"There is no problem of unemployment of PhDs, but one of career development" (policy official)

"Doctoral education needs to include more practical work, including in Arts, Humanities, and Social Sciences" (funder)

"Postdocs need to make decision about their career earlier on – they can get good jobs outside academia" (employer)

"PhDs in partnership with industry have greater ease in finding job outside of academia" (policy official)

"Stakeholders should make effort to let private companies understand the value of PhD holders" (researcher)

"Most postdocs prefer to work in higher education and the public research institutes but there are limited jobs there. It is important to promote opportunities in the private sector" (policy official)

"Further funding for postdocs does not solve precarity, it is better to support employment in industry" (policy official)

"Arts, Humanities, and Social Science postdocs have much grimmer prospects than those in STEM that can move to business" (researcher)

"There is a significant gap in opportunities between basic and applied research" (researcher)

"Those transitioning to industry cannot go back to academia due to assessment criteria" (policy official)

"There are not too many PhDs, but there needs to be better ways to transition to industry but also to public administration, with adequate pay" (policy official)

"There is generally very few positions for PhDs in industry and even less in public administration" (employer)

"Universities continue to produce PhDs to feed their scientific production, but there is no market outside of universities for all the PhDs being produced. Need more policies to integrate PhDs outside academia" (employer)

"There are no employment opportunities outside academia" (researcher)

"There is limited recruitment of PhDs by industry" (policy official)

""Supervisors are not interested in younger researchers developing broader skills for jobs outside academia" (researcher)"

"Leaving academia is perceived as a failure" (researcher)

"PhD training has largely focused on academic education" (employer)

"There has been a lack of recognition of industry experience, and transdisciplinarity" (researcher)

"Don't reduce PhD numbers: promote inter-sectoral and geographical mobility" (employer)

"Need to promote diversity in careers – teaching, research, research support..." (employer)

Many countries are concerned about the lack of inter-sectoral mobility of doctorate holders, not only because greater mobility could help ameliorate the precarity of research careers, but also because it is expected to promote economic and societal development. Whereas doctorate holders in several countries have better working conditions outside than inside academia, many do not feel motivated and/ or prepared to work outside academic research, and such a move is generally not encouraged by the academic research culture (Vitae, 2016[28]). Mobility back into academia is often almost impossible, given the focus of evaluation on publication records, and the very limited recognition of experience and expertise gained in other sectors. There is a need to make transitions into and out of academia, industry and other sectors easier.

The model of doctoral education and postdoctoral training should be changed to facilitate the employability of doctorate holders in a diversity of careers, not limited to academic research, but also in industry, government, the social sector, and self-employment or entrepreneurship. Postdoctoral researchers need support in career development to consider other options beyond academic research, and need to be provided with opportunities to spend time working in other sectors. Postdoctoral researchers also need to be encouraged to consider the option of leaving academia at an earlier stage, to make eventual transitions easier and more successful. There is a strong case that mobility benefits researchers' careers even if they remain in academia by giving them a broader perspective on research and innovation, enabling them to work across disciplines and in collaboration.

There is a need to counter the idea among early-career researchers that a move from academia to another sector is a failure, and communicate early on that other careers can be as, or more, rewarding. The culture among PIs that they have failed as supervisors if their students and staff do not continue in academia also needs to change. On the demand side, there is a need to better communicate to non-academic employers the value of the skills of doctorate holders and involve them more in doctoral education and postdoctoral training. Institutions need to have good professionalised career services that provide advice to doctoral and postdoctoral researchers, because senior academics are often not best placed to provide advice on

careers beyond academia. Researchers need to be encouraged to find a range of academic and non-academic mentors.

Countries are launching policy initiatives to facilitate the transition of doctorate holders and postdoctoral researchers to the business enterprise sector, public administration and the social sector, and making their skills, which may not be subject-specific (e.g. project management), more visible and valued beyond academia. Hungary has launched a new "cooperative" doctoral programme in collaboration with industry. Portugal has created collaborative laboratories with the private sector and given fiscal incentives for the employment of doctorate holders. Finland is offering additional tax deductions for R&D related research cooperation. France has initiatives to develop employment beyond public research, encourage the creation of businesses by doctorate holders, and facilitate their recruitment for non-research public service positions. In Korea, the KIURI programme provides postdoctoral researchers with opportunities to develop their research careers in industry.

Inter-sectoral mobility is not just about the transition of doctorate holders to careers beyond academia, but also circulation between sectors, leading to the flow of ideas, knowledge and experience. Those that have worked outside academia may find it difficult to enter or re-enter due to academic assessment criteria that discriminate against them if they have not been actively publishing. Even in a country like Australia with an even distribution of doctorate holders among sectors (46% of researchers in HE, 41% in BE), inter-sectoral mobility is low. Universities and funding agencies need to recognise the value of skills obtained in industry. The focus on publications as the major evaluation criteria in is a barrier to inter-sectoral mobility.

At the same time, the multi-functional researcher should not be the sole model in academia, and there should be space for different profiles, with implications in terms of incentives and assessment. There is also a need to consider the potential conflicts of interest and conflicting missions and values between academia and the business sector when promoting inter-sectoral mobility.

The United Kingdom has launched the Future Leaders Fellowships scheme, targeted at early career researchers, which is open to researchers from across business, universities and other organisations, to attract, develop and retain the most promising future leaders in research. It facilitates and encourages inter-disciplinary research, part-time and flexible working, and cross-sector working with businesses. Germany has removed obstacles- with regard to pension entitlement - for professors on civil servant contracts wishing to switch to the private sector. Canada's Mitacs programme provides funding for postdoctoral researchers of all disciplines to pursue opportunities in entrepreneurship or collaborative research-based projects with partner organisations. It also provides policy fellowships for those with an interest in public affairs.

Compatibility of family life and academic career

> *"Lack of stability at later age and pressure to publish hinders family formation and access to housing" (researcher)*
>
> *"Recent legislation focuses on balancing research and family life" (employer)*
>
> *"Overtime is endemic" (researcher)*
>
> *"Women have challenges when they have children. They cannot continue their research jobs because they need to care for their children" (employer)*
>
> *"Many female postdocs have difficulties to continue research careers after having children. (…) female postdocs postpone having children" (researcher)*

Young researchers, especially women with children or caring for elderly parents, find it harder to spend time on their research, and get the outputs that are considered necessary to access a permanent position. Women in academic research careers tend to delay parenthood and parents, especially women, find it very challenging to balance parenthood and a research career.

Many postdocs, and a disproportionate number of women move to part-time work, not necessarily of their own volition, and become "hidden researchers" in teaching-only positions, or drop out of a research career because of family commitments. Researchers need more support to reintegrate back into the system after

maternity and paternity leave. Many interviewees in several countries mentioned the incompatibility of family life and a research career, made worse recently by the effects of working from home during the Covid-19 pandemic (Gewin, 2020[60]). The precarity of early career researchers affects access to financial loans, housing and family formation.

The EC publishes regularly the *She Figures* to monitor the situation of women researchers and provide a benchmarking tool for countries to peer learn from each other. Several countries are beginning to take into account periods of maternal and parental leave when judging funding applications, and taking other actions to improve gender balance in science, although policy initiatives remain fragmented and a more strategic, long-term approach is required (OECD, 2018[59]).

Issues arising from international mobility

> *"There are issues with pension rights and loss of social connections affect recruitment chances" (researcher)*
>
> *"There is an influx of international researchers coming from even worse conditions" (researcher)*
>
> *"Many that go abroad do not return" (researcher)*
>
> *"Going abroad is valued, but there is an issue of brain drain" (researcher)*
>
> *"It is more attractive to remain for locals, because they expect to get a permanent position at some point" (researcher)*
>
> *"There is an imbalance North-South and East-West [in Europe]" (funder)*
>
> *"Emphasis on mobility shifts the risks of mobility to the individual" (researcher)*
>
> *"International staff are in worse conditions than national staff" (researcher)*
>
> *"International mobility poses severe problem to the individual" (researcher)*

Most countries have implemented reforms aiming to lower the barriers to migration of highly skilled individuals, and most countries operate competitive funding programmes to support inward, outward or return mobility for researchers. Bibliometric analyses indicates that researcher mobility is associated with higher citation rates for publications (OECD, 2017, p. 129[14]), although whether this mainly reflects impact or network effects is unclear.

Whereas there is a positive "brain circulation" discourse regarding the mobility of international researchers, countries experiencing brain drain (mostly from South to North and from East to West) still worry about the loss of talent. Several countries are trying to promote scientific employment within and beyond academia to retain researchers and/or attract back their research diaspora.

International mobility can widen researchers' opportunities but also be associated with precarity, and mobility is often not a choice but a necessity in order to have reasonable expectations to remain in academic employment in the long term. At the same time, a postdoctoral position and experience of living in another country can be an attractive proposition for many young researchers Unfortunately, many of those that do go abroad subsequently find out that it can be difficult to return to a desirable position in their home countries, because they have lost the social networks necessary to access such positions. This is especially the case for systems that have high levels of academic inbreeding (in Spain, for example, around three-quarters of researchers are affiliated with the university where they graduated (Cruz-Castro and Sanz-Menéndez, 2010[61])). In addition, conditions for international researchers are often worse, in relation to access to employment contracts, right to stay, and welfare benefits. Mobility, when accompanied by short-term contracts, can entail significant personal sacrifices, especially when early career researchers are considering starting a family and/or entering the housing market. Women doctorate holders are less internationally mobile than their male counterparts; especially at a time they are more likely to have young children. There is often a lack of support, such as childcare facilities and family housing provided by universities, for mobile families.

In Europe, there are a number of initiatives to facilitate the international mobility of researchers. The Scientific Visa Package facilitates the procedure of admitting researchers coming from non-European countries to Europe. RESAVER offers a pan-European pension fund for mobile researchers. In addition,

the mobility of researchers is directly funded through a number of actions: the Marie Skłodowska-Curie Actions, ERC grants, Erasmus+. Recently, the EC launched a new European Framework for Research Careers to make conditions more attractive and mobility easier among member countries (EC, 2020[57]).

Under-developed human resource management in institutions

"Funding levers are not enough – need to promote institutional strategies and monitor them" (funder)

"Funders want more evidence that institutions support the personal development and career guidance of their researchers" (funder)

"Traditionally the investment has been geared towards R&D, not human resource development" (researcher)

"(…) has issued strategic documents on how to improve the situation, but they are not binding, universities are autonomous; there is consultation and publication of recommendations, but no monitoring of the situation" (employer)

"HR issues don't seem to be valued or well addressed in institutions" (funder)

"Third-party funding is a problem, but lack of human resource policies is worse" (researcher)

"Strategic personnel development is key: 1) stay 2) move out 3) start own business" (employer)

"Institutions need to take more responsibility for ensuring transparency and fairness" (researcher)

"Assessment of postdocs is not adequate" (policy official)

"Precarity is more linked to research cultures and institutional practices than to project based funding" (funder)

"Hyper-competition is causing lots of well-being issues, but it is difficult to police the HR policies" (funder)

"It is difficult to get to the PIs, who are funded to do research" (researcher)

"Need more career planning" (researcher)

"Institutional practices are far away from European charter guidelines" (researcher)

"Third-party funding and project funding cannot be excuses for temporary employment – institutions need to learn how to use the skills of researchers across different projects" (researcher)

"There is a lack of sound HR policies at institutional level" (researcher)

There is the general concern, which was raised by many of the people who were interviewed for this project, that institutions do not have enough capacity in terms of human resource management (HRM), especially to deal with the increasing number of postdoctoral researchers outside the established academic and research careers. In many institutions, rules for advancement are unclear and vary among fields, teams, and departments. There is a climate of exacerbated competitiveness, with a focus on the short-term production of publications, and wide power asymmetry in relation to senior researchers. There are frequent reports of high levels of stress, dissatisfaction and mental health problems among postdoctoral researchers, which are seconded by the results of recent surveys (Wellcome, 2020[48]; Nature, 2020[46]).

There is a need to enact annual performance assessments of postdoctoral researchers and take them seriously. Supervisors should be required to conduct annual assessments that go beyond the research being performed and focus as well on the researcher and their development. Institutions, on the other hand, argue that they do not have the funding to support human resource initiatives, such as the professional development and career guidance of postdoctoral researchers, and the training of senior researchers to manage and lead teams of researchers, and mentoring skills.

Some countries are launching initiatives to improve the human resource strategies and practices of institutions. Germany required its universities to provide personnel development strategies for the entire academic workforce – including career paths that are not associated with professorships – as a requisite to apply for tenure-track professorship support under the Tenure Track Programme. Japan supports universities and research institutes that foster researchers strategically through the "Strategic Professional Development Program for Young Researchers". The United Kingdom has developed and recently reviewed a Concordat to support the career development of researchers to which institutions voluntarily sign up, which commits them to publicly report on their practices. The European Commission adopted and is currently reviewing the European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers. Institutions that commit to these can apply for the EC HR Excellence in Research Award via its implementation mechanism, the Human Resources strategy for Researchers, based on systematic

peer reviewed assessment . Commitment to the Charter and Code voluntary and not a requisite to be a recipient of EU funding.

Institutions can do a lot to improve human resource management practices, and often are highly autonomous in this regard, but the overarching legal frameworks within which they operate are important in many countries and these also need to be addressed.

The academic career is no longer attractive for some

> *"The job prospects for university graduates are not good, some chose to do master's and PhDs instead, not necessarily the best, as the research career is not that attractive" (researcher)*
>
> *"Difficulty in attracting excellent researchers" (employer)*
>
> *"Lots of media coverage on precarity" (policy official)*
>
> *"Academic research is becoming unattractive in fields where conditions are better in the private sector" (researcher)*
>
> *"Danger of brain drain to industry" (policy official)*
>
> *"Students feel that the situation is risky, so fewer students enter PhD programmes than before" (employer)*
>
> *"Fewer students want to enter PhD programmes" (researcher)*
>
> *"There are too many postdocs in some fields but a shortage in others" (policy official)*
>
> *"The country is attracting students from abroad, because professors want to keep their PhD student numbers; many are not well prepared and will return to their countries" (researcher)*
>
> *"Hard to survive as a postdoc, remuneration is low at universities" (researcher)*
>
> *"Young researchers are demotivated" (policy official)*

Researchers tend to be passionate and proud about their work but have increasing, and well justified, concerns about job security. Poor research culture is leading to excessive competition, bullying and harassment, and mental health issues (Wellcome, 2020[48]).

In some countries academic research is losing its competitiveness in relation to alternative employment. Several interviewees mentioned that in their countries, and especially for certain fields, the research career is no longer attractive, and either they see a decreased interest in people to pursue doctoral education, or those that do are no longer the best university graduates. In addition, the supply of foreign talent that some countries rely on is also decreasing, as the conditions for doing research in emerging scientific powers are improving.

In France, there is concern that low salaries – by international standards and relative to other professionals – may dissuade good students from choosing a research career, especially because the doctorate is not highly valued outside of research. As a response, new legislation is proposing to increase wages, increase recurrent funding, improve conditions for postdoctoral researchers, and create a tenure-track for the best young talent. The issue of low remuneration has also been raised in the UK in the recent Government R&D Roadmap (UK HM Government, 2020[62]).

Poor evidence base

> *"Limited information on the career of researchers" (policy official)*
>
> *"There is a lack of evidence-base to inform policy; only occasional surveys" (employer)*
>
> *"Lots of data, but little analysis on tracking researchers' career paths" (funder)*
>
> *"Need to address the question of how many researchers are needed" (funder)*
>
> *"Lack of good data on careers trajectories" (employer)*
>
> *"Need to evaluate (…) after some years. Are postdocs moving to industry, as intended?" (researcher)*
>
> *"The evidence base on research careers is fragmented and disjointed" (funder)*
>
> *"It is difficult to get career information on postdocs" (employer)*
>
> *"No good statistics on fixed-term researchers" (researcher)*

It is increasingly clear that precarity is an important issue, but due to a lack of empirical data, it is difficult to define the real extent of the problem either across the OECD as a whole or in individual countries. If

research systems want to make the case for more doctorate holders, or maintain the current level, then more evidence is needed on what is really happening with doctorate holders, particularly with the postdoctoral cohort. Countries often do not have a good understanding of the number of postdoctoral researchers, their working conditions, and their career trajectories. There is rarely a single national data collection point for research careers, and whilst funders and research institutions might have troves of data, that data is not systematically organised and analysed.

On the positive side, countries are launching initiatives to track the career of postdoctoral researchers and survey postdoctoral researchers on their working conditions. Mandated by the Swiss Federal Council, in 2018 the Swiss National Science Foundation began an on-going survey of its funding cohorts as a way to improve the information base to track career progression. The French Community of Belgium has recently created the Observatory of Research and Scientific Careers, and Portugal has created a Scientific Employment Observatory. Korea is building a comprehensive database of postdoctoral researchers. France surveys doctorate holders one and three years after graduating, targeting both those residing in the country and abroad. Japan has an ongoing survey of postdoctoral researchers that collects information on employment status, career path and mobility. The United States produces the survey of earned doctorates (SED), which is an annual census, conducted since 1957 of all individuals receiving a research doctorate. It collects information on the doctoral recipient's educational history, demographic characteristics, and post-graduation plans. Results are used to assess characteristics of the doctoral population and trends in doctoral education and degrees. The survey of doctorate recipients (SDR) is a survey of science (includes social science), engineering, and health doctorate recipients, sampled from SED. It collects data on the careers of these doctorate holders in terms of education and training, work experience, career development, and demographics. Nonetheless, even in the United Sates, there is the sentiment that there is not enough good reliable placement data for students to know their career prospects before going to graduate school (see the initiative by the Coalition for Next Generation of Life Scientists (NGLF, 2020[63])).

Institutions that employ academic researchers also have a responsibility to compile more data on their staff, including postdoctoral researchers, and be more transparent about their employment practices. In this regard, the European University Association has developed a project with member institutions to study systematic approaches to follow the career paths of doctorate holders (Leysinger, Hasgall and Peneoasu, 2020[64]).

Detrimental effects of Covid-19

"Emergence of 2-tier system – people doing Covid and people staying at home" (researcher)

"Huge drop in international students" (employer)

"Improvements on gender are likely to be affected by Covid-19" (employer)

"No initiatives in response to Covid directed towards postdocs, only for PhD students" (researcher)

"Covid-19 has diverted funds to some and left little opportunities to others" (researcher)

"Covid-19 means less money from industry" (policy official)

"Policies on gender have not been very effective, Covid is making matters worse" (funder)

"International collaboration is difficult after Covid-19" (employer)

"Women are juggling work and care" (employer)

"Big concerns about starting new projects" (researcher)

The Covid-19 pandemic induced a change in funding priorities, with additional funding potentially benefiting postdoctoral researchers working in those fields that relate to Covid-19, and reduced focus on other areas. Many postdoctoral researchers have had to cancel or postpone field and lab work, with consequent effects on publications, which is their main passport to a secure academic contract. In addition, many research institutions have either cancelled or postponed recruitment to open-ended research positions. Countries whose higher education systems are highly dependent on earned income from international students (e.g.

United Kingdom and Australia) are losing some of this, part of which is used to fund research. Budget cuts tend to impose, as a first step, a reduction on the number of those on fixed-term contracts.

Many mobile researchers could not take up their positions abroad, and others have had to return to their countries due to visas expiring. Postdoctoral researchers are thus experiencing further delays in the transition to an academic career, and may be forced to pursue other careers, not necessarily ones where they can use their advanced skills, as retraction in non-academic high-skill jobs is also being observed (Campello, Kankanhalli and Muthukrishnan, 2020[65]). In addition, industry job cuts may be pushing more doctoral candidates towards an academic career despite the already difficult situation (Grove, 2020[66]).

In the UK, a recent survey on the impact of lockdown on researchers found that women, part-time workers and those on fixed-term contracts were most concerned about their employment ending (Vitae, 2020[67]). Covid-19 is having a disproportionate negative effect on women researchers (Viglione, 2020[68]), particularly early-career researchers, and the pandemic is threatening the gender-equity gains of recent years (Gewin, 2020[60]). Covid-19 has further exposed systemic weaknesses and highlighted the need to change the traditional academic research career model. Respondents to the UK survey propose a number of practical suggestions to ameliorate the situation: increase access to research facilities by extending normal hours, encourage collaboration across research groups to make the most of limited equipment, extend projects and funding, recognise and make concessions for reduction in outputs, provide equipment and access to e-resources to work from home (Vitae, 2020[67]).

Countries have attempted to safeguard the research pipeline and pre-empt the loss of research talent in a number of ways. Measures include granting extensions to projects and individual grants (e.g. French Community of Belgium, France, Germany, Spain, UK), modifying time limits for those on tenure-track professorships (e.g. Germany), opening job retention schemes to research staff whose project has been suspended (e.g. United Kingdom), supporting researchers who need to change the scope of their projects and/or budgets (e.g. Australia), and make up for loss income from student fees (e.g. Australia, UK).

Effectiveness of the policy process to address precarity

"Complex governance of research and research careers" (policy official)

"Better on policy than on implementation" (employer)

"The main policy lever has to be requirements attached to funding in relation to PIs and institutions" (researcher)

"Postdoctoral researchers are invisible in governance structures" (researcher)

"Most policies are about research rather than researchers" (researcher)

"Research labour market issues are not considered central in research policy debates" (researcher)

"No tradition of unionisation among researchers on fixed-term contracts" (policy official)

"(…) but universities are autonomous" (employer)

"Change to departmental structures is opposed by the professors" (employer)

"Complexity of governance system is a problem" (researcher)

"Academics on fixed-term contracts are less likely to join a union to defend their interests" (researcher)

"Lack of systematic policy analysis in this area; need more up to date data" (researcher)

"Limited institutional autonomy on finance and recruitment" (employer)

"Precarity has not been on the agenda [in Europe]" (employer)

"Postdocs have less voice (…) those that are heard are the small elite that stays: the superstar model" (researcher)

Interviewees in most countries report that the relevant stakeholders, i.e. funders, research performing organisations, and representatives of researchers, do participate and have a say in the development of policy with a bearing on research careers and the situation of postdoctoral researchers. Nonetheless, the fact that postdoctoral researchers are not a well-defined body within institutions makes it harder for their voice and the issues of precarity to be a priority in institutional and national policy agendas, and for them to be a social partner in policies that affect them.

Several networks and associations of postdoctoral researchers have emerged that are contributing to change the lack of representation, and some are actively being supported at institutional and national levels, for instance as sub-committees of national academies. Some of these initiatives have had a concrete effect on policy reforms and changes in institutional practices.

There are problems with the implementation of recommendations and sector-wide agreements, and general monitoring of the effectiveness of policies by government and funding agencies. This is perhaps not surprising in a context where there are high levels of institutional autonomy for research performing organisations, and a general lack of good systematic evidence on the experience and situation of postdoctoral researchers.

Some funders are changing their criteria to make a more explicit link to policy goals, and requiring more accountability reporting from institutions and principal investigators (PIs) linked to those goals. They are having to report on issues such as continuity of employment, research environment, professional development, equity, diversity and inclusion practices, and level of independence of postdoctoral researchers. In some instances, non-compliance results in loss of access to funding.

Barriers and enablers for effective policy action

"Need for a cultural change" (policy official)

"Institutions need more stable funding to address precarity" (employer)

"Money to institutions comes with too few strings attached" (researcher)

"Another major obstacle is the complexity of the governance, different stakeholders have different priorities – different levels of government and highly autonomous institutions" (funder)

"A barrier to change is how researchers are assessed. The DORA declaration has been signed but not implemented" (employer)

"Need to look at making sustainability a criterion for funding" (funder)

"The move from core funding to project funding went too far" (funder)

"Lack of sustainable basic funding" (researcher)

"Institutions circumvent the law" (researcher)

"System relies on allocating competitive money to far too many people" (researcher)

"If universities could pool a part of competitive funds for years, they would be able to hire more permanent researchers" (employer)

"Difficulty to reduce precarity in a context of funding instability and underfunding" (employer)

"No clear rationale for allocating funding for postdoctoral training in different fields of study" (employer)

"Instruments tend to be based on project funding, rather than funding to pay ongoing salaries" (funder)

"Third-party funding is good, as it brings more resources, but needs to be managed to support structured careers" (researcher)

"Resources are not everything; change in culture is needed" (employer)

"Need to change assessment criteria beyond bibliometrics" (employer)

"Any strategies for change need to be at PI level – they have the money to deliver a project" (researcher)

"One barrier is communication [among stakeholders]" (researcher)

"The European Charter & Code for Researchers is not mandatory" (funder)

"Increased funding is not the solution: it postpones the bottleneck" (employer)

"Core funding is mostly for teaching; research is mostly funded by project money" (researcher)

"Research assessment is too quantitative and competitive – demands are superhuman" (researcher)

"There are too many PhDs" (researcher)

"Precarity is more about research culture than funding" (researcher)

"There is an oversupply of PhDs, and the companies do not want them all" (researcher)

The precarity of research careers is not a new problem and numerous policy initiatives have been developed by countries to address it. However, even if individual policies are sound, they are not always well integrated with other policy initiatives and implementation is often problematic. The survey of countries identified a number of barriers and enablers for effective policy action.

Several barriers can be identified that hinder progress towards reducing the precarity of research careers. First, a research culture overly focussed on rankings, competition and quantitative metrics that puts pressure on PIs, who employ postdoctoral researchers, to focus on short-term publications: this cascades through the system, and drives institutional and individual behaviours. Second, the uncertainty of research

funding, which makes it difficult for institutions to manage their financial and human resources. Third, a lack of good evidence base on which to design sound policy and practices in the management of postdoctoral researchers on fixed-term contracts, and research careers in general.

Likewise, several enablers have been identified that promote the implementation and effectiveness of policies to improve the working conditions of postdoctoral researchers on fixed-term contracts. First, active involvement and consultation of relevant stakeholders including of postdoctoral researchers in relevant governance structures and processes. Second, the development of sector-wide agreements for academic research that bind all actors, with requirements for reporting and monitoring of progress. Third, research funding arrangements more tightly aligned with policy objectives relating to the working conditions of researchers.

Annex C presents a synthesis of illustrative policy initiatives from the countries that participated in this report including links to more in depth information.

Concluding remarks and a policy toolkit

The precarity of research careers is a widespread phenomenon across OECD countries and across different research systems. As in many other sectors, the Covid-19 pandemic threatens to make the situation even worse. But even prior to the pandemic, precarity in research careers had already become an issue of public debate, and a major concern for science policy in many countries. One of the notable findings of this report is the level of consensus among stakeholders on the need to reduce the precarity of research careers and on what needs to be done to achieve this.

Doctorate level attainment in the population of OECD countries is rising fast. Many doctorate holders who privilege a career in academic research will find themselves in a long period of postdoctoral work on fixed-term, and often short-term, contracts. The precarity experienced by early-career researchers is having detrimental effects on their well-being. There is evidence that high levels of competition and lack of recognition have created unkind and aggressive working conditions. In addition, precarious working conditions and a lack of long term prospects have implications for these researchers´ personal lives, for instance in terms of family formation and access to housing. It is not surprising that an academic research career is no longer attractive for many talented young scientists. The precarity of research careers also undermines attempts to increase diversity in academia. Only those from privileged backgrounds can afford prolonged precarity. Women are disproportionately affected, especially in the transition from early to mid-career, when they are also considering having children. Ultimately, the quality of the science produced is at stake, in a culture of “publish or perish” that values quantity over quality, where risk aversion hinders novel research, and research integrity is under threat from excessive competition. Assuring and improving the quality of science should be a strong motivation to reduce the precarity of academic research careers.

> *“Precarity makes postdocs to play it safe; it affects the quality of science” (funder)*
>
> *“Permanent researchers can implement challenging and original research. Fixed-term researchers need to create short-term outcomes to apply for the next position” (employer)*
>
> *“Competition is pushing away criticism” (researcher)*

This project has gathered data and information from countries on how they are addressing precarity in research careers. It synthesises the lessons learned and proposes nine overall policy recommendations to countries. For each recommendation, there are a number of policy options that are more or less appropriate in different national or institutional contexts. Many of these options are already being deployed to some degree in the countries that participated in this study and they are bought together in a policy toolkit that is presented below in Table 1. Annex C provides a synthesis of the specific policy initiatives that inspired these policy options.

Table 1. Policy toolkit

Policy options for countries to implement recommendations

Recommendations	Policy Options
1. Improve the working conditions and offer more transparent, predictable and flexible career prospects for postdoctoral researchers	• Make employment contracts the norm for all postdoctoral researchers and limit the use of stipends. • Include postdoctoral researchers on fixed-term contracts, including those on stipends, in established research career frameworks and reward structures, providing comparable salaries and the same access to welfare benefits (health, social security, pension) as more permanent academic staff. • Offer transparency for future prospects and ensure predictability by supporting professional progress within the established research career frameworks (e.g. tenure-track) • Ensure that postdoctoral researchers on fixed term contracts, including those on stipends, have a minimum degree of continuity to avoid periods without salary (e.g. minimum 3-year contracts). • Create diversified open-ended positions to replace fixed-term contracts for positions that fulfil long-term needs (including for positions such as staff scientists, data stewards and software engineers). • Implement effective labour inspections of research performing organisations to ensure compliance with existing labour legislation. • Monitor working conditions and wellbeing through regular surveys of postdoctoral researchers and act on findings. • Monitor employment status of postdoctoral researchers and age profile (including academic age) along seniority levels through registry data and act on findings. • Monitor the effects of significant global events such as the Covid-19 pandemic on postdoctoral researchers through survey and registry data, and use this information to actively inform policies to mitigate the potential negative effects on this vulnerable group over the following months and years.
2. Offer broad professional development during postdoctoral training	• Offer professional development opportunities to postdoctoral researchers to prepare them for diverse careers within and beyond academia: training beyond specialised disciplinary research skills, mentoring, coaching, career guidance, placements in business, public administration, and the social sector, and international exchanges. • Give postdoctoral researchers time for professional development, and to develop their research identity and broader leadership skills. • Support the regular appraisal of career opportunities for individual postdoctoral researchers, guaranteeing that they consider a diverse set of career options early on in their career. • Adopt a national researcher development framework as a guide to develop professional researchers for academic research and for other careers.

3. Promote equal opportunities, diversity and inclusion in research careers by identifying and addressing existing biases and challenges	• Enact transparent and open recruitment procedures including for postdoctoral positions.
	• Enact transparent processes for promotion to:
	  ○ Permanent contract by competition (e.g. civil servant status)
	  ○ Tenure for those meeting a pre-determined set of criteria within a specified time (e.g. tenure track)
	  ○ Open-ended contracts
	• Consider the value of using anonymised processes in recruitment and promotion procedures to address biases.
	• Promote diversity through changes in institutional policies, processes and culture to address barriers faced by under-represented groups in research and development including (but not exhaustive list) women, those with caring responsibilities, those from disadvantaged backgrounds, researchers who are disabled or have additional support needs, those who work part-time, and minorities.
	• Analyse and publish detailed research workforce data, ensuring that all postdocs are included. This should be disaggregated by:
	  ○ Specific population groups (e.g. gender, socio-economic status, ethnicity, etc.):
	  ○ Type of contract (standard and non-standard contracts)
	  ○ Seniority levels
	  ○ Field of research

Recommendations	Policy Options

4. Establish better links between research assessment and funding, and human resource management policy objectives	• Adopt evaluation criteria for research funding allocation that go beyond routine quantitative performance metrics based on publication records, as recommended, for instance, by the DORA Declaration (2013[69]) and the Leiden Manifesto (2015[70]).
	• Attach conditions to awards that promote good human resource management. For instance:
	  ○ Expect implementation of sector-wide agreement on the career development of researchers (e.g. European Charter for Researchers and Code of Conduct for the Recruitment of Researchers, UK Concordat to Support the Career Development of Researchers)
	  ○ Include evaluation criteria related to the quality of the research environment and how it supports the career development of postdoctoral researchers
	  ○ Include evaluation criteria related to equity, diversity and inclusion strategies and practices
	• Examine and monitor the balance between core basic funding and project-based funding and their impact on precarity. Short-term, project-based funding should not be routinely used for continuous, long-term research support requirements.
	• Take into account the supply and demand for doctorate holders, in different fields of research and development, and for different sectors of employment. Balance push funding strategies that support supply of doctorate holders for long-term societal needs with pull strategies based on shorter-term demand for doctorate holders.

5. Improve institutional practices regarding human resource management in research	• Promote and support the development of better HRM practices in institutions in relation to postdoctoral researchers, including: recruitment, promotion to open-ended or permanent positions, performance assessment, professional development, and career guidance. • Externally review HRM strategies and practices in institutions, including those relating to equality, diversity and inclusion, and act on findings (e.g. by introducing criteria for funding, prizes and awards). • Publish disaggregated registry and survey data by institution in order to monitor the results of institutional strategies and practices. • Review workforce policies to ensure opportunities for continuing research after normal retirement age are balanced with those provided for early-career researchers seeking a permanent position. • Promote better management of project-based funding to support structured careers with open-ended contracts (e.g. pooling of funding streams to ensure more flexibility and sustainability in personnel management). • Include up-to-date information about the labour market outcomes and career paths of doctorate holders in various fields on the websites of doctorate granting institutions to help manage expectations and promote diverse postdoctoral career paths.
6. Promote the inter-sectoral mobility of researchers	• Offer work-based learning opportunities during doctoral education and postdoctoral training, including for fields that are less market facing (e.g. researchers who are engaged in basic rather than applied research, and arts, humanities and social sciences). • Remove barriers to inter-sectoral mobility (e.g. enable portability of pension rights). • Recognise professional experience and skills acquired in other sectors in recruitment and promotion processes in academic research.. • Counter perceptions of failure associated with transition out of academic research by publishing evidence on labour market outcomes of doctorate holders, their career satisfaction, and the value and use of their skills in different sectors. • Monitor distribution of doctorate holders in the business enterprise (BE), higher education (HE), government (GOV), and private non-profit sectors (PNP), through registry data, and use this information to inform policy and evaluate impact.
7. Support the international mobility of researchers	• Support the international mobility of postdoctoral researchers (e.g. study visits, academic exchanges). • Remove barriers to returning postdoctoral researchers. • Remove barriers for international postdoctoral researchers (e.g. recognition of qualifications, national language proficiency, immigration rules, portability of pension rights). • Ensure that international researchers have, as a minimum, the same conditions as the equivalent locally recruited researchers, including welfare benefits (e.g. health, social security, pensions, etc., after any required qualification periods). • Monitor incoming, outgoing and returnee postdoctoral researchers, and act on findings.

Recommendations	Policy Options
8. Develop the evidence base on research careers	• Collect, analyse and publish registry data on all researchers, including those on fixed-term contracts and other forms of non-standard employment[1] via offices for national statistics. • Follow the guidelines of the Frascati Manual[2] to make statistics comparable across countries (OECD, 2015[1]). • Track the career trajectories of doctorate holders through regular surveys (e.g. use the Career of Doctorate Holders (CDH) survey already developed by the OECD Working Party of National Experts on Science and Technology Indicators (NESTI)). • Implement regular surveys on the experience of postdoctoral researchers (e.g. use the module on early-career researchers of CDH (Auriol, Schaaper and Felix, 2012[2]), which will allow for international comparisons). • Evaluate the effectiveness of policy implementation regularly using the developed evidence base (e.g. implement 5-year cyclical reviews with recommendations for the next cycle).
9. Include all relevant stakeholders in the governance and coordination of research careers and ensure concerted, systemic action	• Promote sector-wide agreements on academic research careers with the involvement of all stakeholders, including, as appropriate: central and regional policy makers, research funders, employers (institutions and PIs), trade unions, and researchers. These might be in the form of legally binding collective bargaining agreements or less formalised concordats depending on the national and/or local context. • Give voice to postdoctoral researchers in the governance structures of research performing institutions and the policy-making processes affecting them (e.g. acknowledge and promote institutional and national postdoc networks).

Notes: 1. Variables of interest include: Sector of employment (BE, HE, GOV, PNP), Employment status, Remuneration, Field of research, Age (biological and academic age), Sex, Seniority level, Mobility as measured by geographic origin (nationality, citizenship, country of birth, country of previous residence, country of study at highest level), Groups of interest (social economic background, ethnicity, indigeneity, etc.), Personnel flows, Personnel stock. 2. The Frascati Manual provides an internationally recognised methodology for collecting and using R&D statistics, including those relating to research personnel.

At the macro-level, there are common concerns among countries, but at a micro-level, there are important contextual differences. The extensive information collected for this study revealed a lot of commonality but also diversity and heterogeneity between countries and among different stakeholders. The priority attached to each of the nine recommendations will differ from country to country, as will the feasibility of the different policy options for implementing each recommendation. Who should engage and lead on each recommendation is also very much context dependent.

The report presents nine recommendations and a number of policy options for each one. This reflects the fact that the precarity of research careers is a complex and multi-dimensional problem. It cannot be solved by piecemeal initiatives but needs a coherent integrated set of policy measures. Tackling precarity calls for systemic changes in the way academic research is structured and supported (OECD, 2021[71]).

Funding constraints and variability are important drivers of precarity, but so is the current research culture, in terms of assessment processes, power relations between senior and junior academics, and individual and institutional incentives. To effect change, all relevant stakeholders, including postdoctoral researchers, need to be involved to some extent in policy reform and in changing practices on the ground, which ultimately will lead to the necessary change in academic research culture.

The absence of dedicated and up-to-date data is a significant barrier to change. Disaggregated data by socio-demographic characteristics are very scarce and this hinders progress to promote diversity in the research workforce. Data are also essential, not just to inform policy reform but to monitor and follow-up on implementation efforts. Precarity of research careers is a perennial problem with many worthy efforts having already been made to address it. However, it is not enough to negotiate charters and codes of conduct and develop action plans, there is a need to monitor implementation and act on findings, to continuously evaluate the effectiveness of policy initiatives. Good, publically available, data on career outcomes are also important for individuals to make informed choices regarding doctoral education and postdoctoral training. At the same time, collection of data must be balanced against creating further

administrative burden on research institutions and researchers themselves. Data collection frameworks and processes need to build on what already exists and be carefully planned, with a long-term perspective and corresponding investment in the necessary infrastructure.

There are some positive signs of change in all the countries surveyed during this project, and these provide a valuable point of departure for addressing recommendations that are laid out in this report. Things are starting to move in the right direction, as the ongoing policy initiatives in countries listed in Annex C showcase, even if there is still a long way to go before precarity in research careers becomes a thing of the past.

Endnotes

[1] In this report, the distinction is made between doctoral 'education', defined as a recognised level of educational attainment, corresponding to an internationally recognised advanced research qualification (OECD, 2015[72]), and postdoctoral 'training', which corresponds to skill development while having a work position. It is recognised that some doctoral researchers in some countries have employee status and both those with and without a contract may engage in training activities as well, beyond working on their doctoral level qualification.

[2] Based on responses from nearly 1 300 researchers to the OECD Science Flash Survey, launched in April 2020 to the question "As a result of the current crisis, have you personally experienced or do you expect to experience a change in your job security and career opportunities?" Calculations based on the results available at https://oecdsciencesurveys.github.io/2020flashsciencecovid/ (accessed 1 October 2020).

[3] According to the Frascati Manual, research and development can be classified into different fields, the first level of classification comprising six fields: natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, humanities and the arts.

[4] Approximately 12 000 responses from scientific authors were obtained. Although the survey response rate was only 7.55%, the study's quality checks suggest that the results can be considered representative of the target population for the majority of countries and economies covered.

[55] The regressions undertaken include the following variables: Gender dummy, Age, Average number of working hours per week (in log), Percentage of weekly working time spent on research, Number of publications (in log), Average field-normalised citations per document (1996-2017), Fixed-term contract holding (dummy variable equal to 1 if the author holds a fixed-term contract, 0 otherwise), Sector-, country of residence-, and science field- fixed effects. In addition to these variables, the regressions on salary also include a mobility dummy that is equal to 1 if the author's country of education is different from the country of residence, and 0 otherwise.

[6] Tenure is an indefinite academic appointment that can be terminated only under extraordinary circumstances.

[7] The tenure-track type system is a pathway by which an academic on a fixed-term contract has prospects of accessing permanent (tenure) or continuous employment, subject to positive performance appraisal at the end of a pre-determined period.

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Country/ Organisation	Name	Affiliation
Australia	Carolyn Shrives	Assistant Secretary, Research Policy and Programs Branch, Australian Department of Education, Skills and Employment
Australia	Linda Arnold	Director, Research Strategy and Analysis, Research Funding and Policy Branch, Research and Economic Division, Australian Government Department of Education, Skills and Employment
Belgium	Neda Bebiroglu	Scientific advisor, Observatory of Research and Scientific Careers, F.R.S-FNRS
Chile	Juan Asenjo	Chilean Academy of Sciences
Czech Republic	Markéta Sedmíková	Vice-dean for science, research and doctoral study, Czech University of Life Sciences Prague
Finland	Charles Mathies	Academy of Finland Research Fellow in the Finnish Institute for Educational Research at the University of Jyväskylä
France	Marie-Hélène Prieur	Ministry of Research, Human resources strategy
Germany	Jan-Christoph Rogge	BMBF - Federal Ministry of Education and Research
Hungary	Valéria Csépe	Professor, Centre for Natural Sciences of the Hungarian Academy of Science Brain Imaging Centre
Japan	Toshiyuki (Max) Misu	Professor, Hiroshima University, Global Career Design Center
Japan	Shin Okuno	Director, Human Resources Policy Division, MEXT
Korea	Inkyoung Sun	Head, Office of Development Cooperation Research, Science and Technology Policy Institute (STEPI)
Korea	Sun Kun Oh	Emeritus Professor, Konkuk University, and Vice Chairman of GSF (OECD)
Netherlands	Christine Teelken	Associate Professor, VU University Amsterdam
Portugal	Daniel Ferreira	FCT – Fundação para a Ciência e a Tecnologia
South Africa	Roseanne Diab	Director GenderInsite
Spain	Luis Sanz Menéndez	Research Professor, CSIC Institute of Public Goods and Policies (IPP), Ministry of Science and Innovation
Switzerland	Verity Elston	Head of Careers Advice for Doctoral and Postdoctoral Researchers, Université de Lausanne
Switzerland	Mélanie Bosson	Deputy to the Vice-Rector, Graduate Campus, Université de Lausanne
Switzerland	Benjamin Rudaz	Deputy to the Vice-Rector, Graduate Campus, Université de Lausanne
United Kingdom	Sue Carver	Head of Skills, Arts and Humanities Research Council, UK Research and Innovation
United Kingdom	Alasdair Taylor	Senior Strategy Advisor (Talent), Strategy Directorate, UK Research and Innovation
United Kingdom	Tony Whitney	Head of Public Engagement with Research, Department for Business, Energy & Industrial Strategy
United States	Paula Stephan	Research Associate NBER, Professor Emerita Georgia State University
Eurodoc	Filomena Parada	Member of the Eurodoc Employment and Career Development Working Group and University of Helsinki
TUAC	Sonja Bolenius	Head of Unit for University and Science Policy, DGB-BVV GERMAN TRADE UNION CONFEDERATION

Note: Other experts participated in some videoconference meetings of the project. The United States joined the project in June 2020 and did not contribute a dedicated country note.

Annex B. Templates for country notes and policy interviews

Box 2. Country note template

National context

- Brief description of the national context with a bearing on the precarity of research careers
  - Budgetary pressures
  - Research funding models
  - Labour market for researchers
  - Relevant national and administrative or survey data on the precarity of research careers
  - Differences between the higher education, government and private non-profit sectors, where relevant
- Brief description of any recent policy initiatives to improve the working conditions and career prospects of postdoctoral researchers.
- Brief description of any policy initiatives to deal with emerging issues resulting from the Covid-19 pandemic.

National policy concerns

- Brief description of main policy concerns regarding the policy areas relevant to the main policy question of the precarity of research careers. When relevant, distinguish between the higher education, government and private non-profit sectors.

Available national evidence

- Brief synthesis of any scholarly or policy analysis studies on how the precarity of postdoctoral researchers is affecting the following outcomes in your country [Please provide references, if available.]
  - Quality of science
  - Attractiveness of the research career
  - Well-being of researchers
- Evidence of differences between groups
  - By gender
  - By other groups of interest in the country

Box 3. Policy interview template

Information on recent, existing, and planned policies

Departing from the country note, the Secretariat inquire respondents about:

- Purpose of the policies
- Content of the policies
- Policy levers used
- Inclusion of measurable targets
- Impact of Covid-19 on existing and planned policies

Information on the policy process

For each policy initiative discussed:

- At what stage is the policy process?
  - Design
  - Implementation
  - Evaluation
- Which stakeholders have been involved in the different policy stages?

Observed effects of the policy

For each policy initiative:

- Describe impact on
  - Opportunity for alternative careers outside the academic research career for some doctorate holders
  - Opportunities for professional development of postdoctoral researchers
  - Improvement of working conditions of postdoctoral researchers
  - Improvement in the well-being of postdoctoral researchers
  - Improvement in equal opportunities to access and advance in the research career
    - Gender
    - Other groups of interest
  - Improvement in the diversity of those in research careers
    - Gender
    - Other groups of interest
  - Improvement in the attractiveness of the research career to national and international talent
  - Improvement in the quality of science produced
- No evidence of impact

Factors influencing impact

- Enablers:
  - What factors have promoted the enactment of the policy, its implementation and its effectiveness?
- Barriers
  - What factors have hindered the enactment of the policy, its implementation and its effectiveness?

Annex C. Illustrative initiatives to address the precarity of academic research careers

Issue	Illustrative initiatives
Working conditions	• ARC Early Career Research Statement of Support: articulates the ARC's commitment to early career researchers to support a strong, viable and diverse Australian research workforce [AUS] • Wallonia-Brussels Partnership for Researchers: contribution to the implementation of the European Charter for Researchers, the European Code of Conduct, the European Commission Partnership for Researchers, the recommendations of the Helsinki Group on Women and Science and the human resources strategy of the key initiative "Innovation Union" of the European Union [BEL-WAL, policy makers, funders, employers] • Transformation of fixed-term into permanent contract for those in similar functions for at least 6 years in the same public research organisations (Sauvadet Law, 2012) [FRA, employers, researchers] • Creation of postdoctoral contract in public and private law no later than 3 years after graduation, for a minimum duration of one and maximum duration of four years (Research Programming Law, 2020) [FRA, employers, researchers] • Creation of "junior chair" of maximum duration of 6 years: creates an additional career path towards permanent position in academic research (Research Programming Law, 2020) [FRA, employers, researchers] • Tenure-Track Programme: aims to make the journey towards a lifelong professorship more transparent and predictable for many young academic by establishing and consolidating an additional career path that leads to a professorship [DEU, policy makers] • The reform of the Academic Fixed-Term Contract Act (Wissenschaftszeitvertragsgesetz): to encourage better handling of the provisions concerning fixed-term contracts and to prevent the improper use of short-term contracts in particular [DEU, policy makers] • The contract on good employment conditions at universities and scientific institutions in North Rhine-Westphalia [DEU] • Herrschinger Code: The Education and Science Union (GEW) recommends that the institutions commit themselves to stable employment conditions and predictable career paths for scientists by means of this code. [DEU, trade union, employers] • Infrastructural development of higher education institutions and performance based salary of researchers at the Eötvös Loránd Research Network [HUN, policy makers, funders, employers] • Program to Disseminate Tenure-Track System (2011-2020) [JPN, policy makers, funders, employer] • Leading Initiative for Excellent Young Researchers (LEADER) [JPN, policy makers, funders, employers, PIs] • Issuance of guidelines for employment and training of postdoctoral researchers (2020) [JPN, policy makers, employers, PIs] • "Sejong Fellowship" Program (2021): aims to provide the research precariat with stable income and independent research funding of up to five years along with freedom to choose the research institutions for the fellowship period [KOR, policy makers, funders, employers, researchers] • Scientific Employment Stimulus: legal framework to stimulate scientific employment and decrease the precarity of researchers [PRT, policy makers, funders, employers] • The New Generation of Academics Programme: successful applicants are appointed into permanent posts [ZAF] • Ramón y Cajal Contract Aids: promote the employment of national and foreign researchers with an outstanding career in R&D centres through grants for their recruitment and grants for the creation of permanent jobs by research performing organisations [ESP, funders] • I3 Programme: provides financial incentives to universities and PROs to create a permanent position for researchers accredited with the I3 certificate after a successful evaluation of their Ramon y Cajal 5-year contract [ESP, funders, employers] • "Stabilisation of public employment agreement" of those that have been on fixed-term contracts for some time [ESP, policy makers] • ICREA Research Positions: The selection of candidates is based on peer evaluation and has scientific excellence and leadership as its sole criteria. Does not rely on quantitative measures of academic output and fully adheres to the San Francisco Declaration on Research Assessment (SFDORA) [ESP, funder] • University of Lausanne: Rectorate requires all faculties to put into place a plan for the academic research career, published on their individual websites [CHE, employer] • Single UK Higher Education pay scale [GBR, policy makers, employers, unions] • Recognition that post-docs on successive fixed term contracts at one institution should be treated as permanent employees [GBR, employers, unions] • UKRI policy and UK Concordat on Research Integrity [GBR, policy makers, funders] • European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers [EUR] • MSCA grants can only be awarded up to 6 years after the PhD to counter "permadoc" phenomenon [EUR]

Issue	Illustrative initiatives
Professional development	• Research Training Implementation Plan in 2017: designed to strengthen the quality of Australia's research training system, and ensure Higher Degree by Research graduates have the skills they need to thrive in both academic and professional contexts [AUS, policy makers, employers]. • Doctoral Seminars: to improve the mutual understanding between PhD students and the business sector, and professionalise the doctorate [FRA, employers, doctoral schools] • Tenure-Track Programme: aims to encourage the enhancement of HR structures for the entire academic workforce at German universities – including career paths that are not associated with professorships [DEU, policy makers] • The Excellence Strategy: includes a broad range of career opportunities for postdoctoral researchers [DEU, funders, policymakers] • Excellence programs including a broad range of postdoctoral scholarships and research grants [HUN, policy makers, funders, employers, PIs, researchers] • Strategic Development Program for Young Researchers [JPN, policy makers, funders, employers] • Inter- and intra-university initiatives to provide professional development programmes to doctoral candidates and (in some) postdocs. Some financial incentive provided by swissuniversities.[CHE, funders, employers] • UKRI Future Leaders Fellowship programme [GBR, funders, employers, researchers] • European Framework for Research Careers [EUR] • EURAXESS website for jobs, funding, career development, partnering and information, including gateway to refugee researchers [EUR]
Equal opportunities, diversity and inclusion	• Support for Aboriginal and Torres Strait Islander researchers: the scheme provides dedicated funding each year to Australian universities to support research that is led by an Aboriginal and Torres Strait Islander researcher [AUS] • ARC Research Opportunity and Performance Evidence (ROPE) Statement: aims to ensure the assessment processes accurately evaluate an Investigator's career history relative to their current career stage, and considers whether their productivity and contribution is commensurate with the opportunities that have been available to them [AUS] • Science in Australia Gender Equity (SAGE): supports gender diversity and improve the attraction, retention and progression of women, trans and gender diverse people in Australian higher education and research [AUS] • Decree establishing the Committee on Women in Science, « Décret instituant le Comité Femmes et Sciences » [BEL-WAL, policy makers, funders, employers, researchers] • ULB Cascade initiative: ensures that the gender balance among promoted staff members is at least equal to that observed at the lower level of career progression [BEL-WAL, employers] • Tri-Agency Statement on Equity, Diversity and Inclusion [CAN*, funders] • Programme for Women Professors of the Federal Government and the Länder [DEU, policy makers] • Research-Oriented Standards on Gender Equality by the DFG [DEU, funders] • Initiative for Realizing Diversity in the Research Environment [JPN, policy makers, funders, employers] • Special program designed for female scientists and engineers who wish to return to research after parental leave. [KOR, policy makers, funders, employers, researchers] • Gender@UC promotes gender equality in knowledge production at the University of Coimbra [PRT, employers, researchers] • Thuthuka Funding Programme: aims to improve the research capacities of researchers from designated groups, including black and female, to redress historical imbalances [ZAF] • Selection panels in all recruitment processes have to reflect gender parity [ESP, policy makers] • Fix the Leaky Pipeline @ Swiss institutes of technology EPFL and ETHZ: coaching, training and mentoring programmes for women researchers in STEM [CHE, policy makers, employers] • UKRI policy and linked activity on Equality, Diversity and Inclusion [GBR, policy makers, funders] • Athena Swan Charter on gender equality [GBR, employers, PIs, researchers, Advance HE] • Daphne Jackson Trust - supporting returners to research careers [GBR, funders, employers, researchers, Daphne Jackson Trust] • Race Equality Charter [GBR, employers, Advance HE]

Issue	Illustrative initiatives
Link between funding and HRM policies	• The Future Fellowships scheme for mid-career researchers has incorporated elements within the scheme addressing continuity of employment [AUS, funders, policy makers]. • Tenure-Track Programme: As a prerequisite for funding universities must present an HR development concept containing information about standards, the level of institutional embedment and the implementation status of this HR concept [DEU, policy makers] • The evaluation and institutional funding to Associate Laboratories in Portugal has as its main evaluation criteria the "Capacity to develop own scientific and technical careers for doctorates with permanent or open- ended employment contracts" [PRT, funders, employers] • UKRI Forum and position statement on bullying and harassment [GBR, policy makers, funders, employers, PIs, researchers] • Wellcome Trust Bullying and Harassment policy [GBR, policy makers, funders, employers, PIs, researchers] • Résumé for Researchers [GBR, policy makers, funders, employers, PIs, researchers] • Royal Society of Chemistry Bullying and Harassment support line [GBR, employers, PIs, researchers, Royal Society of Chemistry]
HRM practices	• "HR Excellence in Research" logo obtained by French-speaking universities. [BEL-WAL, policy makers, employers, researchers] • "HR Excellence in Research" logo obtained by some universities and main public research organizations [FRA, employers, researchers] • Pact for Research and Innovation [DEU, policy makers, funders] • Personnel concepts in HEI and RI [DEU, employers] • HR Excellence in Research Award [GBR, employers, Vitae, EC] • HR Excellence in Research and the Human Resources Strategy for Researchers (HRS4R) [EUR]
Inter-sectoral mobility	• Discovery Early Career Research Award (DECRA) scheme: supports mobility for early career researchers by providing focused research support for both teaching and research, and research-only positions [AUS, funders, policy makers]. • First Entreprise Docteur program allows companies to hire PhD holders to conduct research within an academic unit through an internship. [BEL-WAL, policy makers, funders, employers, PIs, researchers] • Mitacs programme provides postdoctoral researchers of all disciplines funding for opportunities in entrepreneurship, collaborative research-based projects with a partner organisation, and policy fellowships to inform public affairs [CAN*, universities, companies, federal and provincial governments] • Introduction of fixed-term additional tax deduction for R&D related research cooperation 2021-2025 [FIN, policy makers, employers in industry, PIs] • Registration in 2019 of the doctorate in the National Directory of Professional Certification with 22 fields divided according to the classification of professional activities and a single reference system in 6 blocks of skills: aims to help the HR departments of companies to better understand the common and specific skills of doctorate holders [FRA, employers, researchers] • "i-PhD": innovation competition that encourages young doctorate holders to develop their innovation project and create companies [FRA, policy makers, funders, employers, researchers] • Adaptation of competitions or creation of competitions reserved for doctorate holders to enter the public service (high level category and senior civil service) since 2014 [FRA, policy makers, funders, employers, researchers] • Cooperative PhD program launched in 2020 [HUN, policy makers, funders, employers, PIs, researchers] • Building of Consortia for the Development of Human resources in Science and Technology [JPN, policy makers, funders, employers, PIs] • "KIURI" Program [KOR, policy makers, funders, employers, Pis, researchers] • Collaborative Laboratories (CoLabs) to foster and sustain collaboration of skilled employment with the productive, social and cultural sectors [PRT, policy makers, funders, employers] • SIFIDE - indirect support via fiscal incentives for the employment of doctorate holders in the business sector [PRT, policy makers] • The NRF Industry Partnership Strategy: placement opportunities for postdoctoral fellows in industry, NGOs and government departments (3-6 months) [ZAF] • Torres Quevedo Contract Aids: Aid of three years' duration for companies, technology centres, technological innovation support centres, business associations and science and technology parks for the employment of doctorate holders. [ESP, funders] • UKRI Innovation Scholars, industrial CASE studentships, policy internships; Royal Society Industry Fellowships; Royal Academy of Engineering Industrial Fellowships [GBR, funders, researchers, employers in BUS and GOV]

Issue	Illustrative initiatives
International mobility	• MISU funding supports highly-qualified Belgian or foreign researchers, who do not hold a Fond National de la Recherche fellowship when submitting the application and who currently have a scientific career abroad, to come and pursue their career in a French-speaking university in Belgium. [BEL-WAL, funders, researchers] • Programmes of the German Academic Exchange Service [DEU, policy makers] • Top up funding of EU mobility programs given to Hungarian doctoral students and postdocs, and additional scholarship (Stipendium Hungaricum) to foreign students. [HUN, policy makers, funders, PIs, researchers] • Overseas Research Fellowships [JPN, policy makers, funders, employers] • "Study and Research in Portugal" a single entry point for students and researchers who wish to pursue their higher education and scientific career in Portugal [PRT, policy makers] • National call to Promote Scientific Employment is open to individual applications, including from foreign researchers, and has allocated circa 20% of the contracts to foreigners, on the basis of the evaluation by international assessment panels [PRT, funders] • Global Knowledge Partnerships (GKP) programme: opportunities for postdoctoral fellows, and early career researchers to spend 6 to 18 months abroad [ZAF] • Global Talent Visa [GBR, policy makers, funders, employers] • Opening up international eligibility to UKRI funded studentships [GBR, funders, employers] • Scientific Visa Package [EUR] • RESAVER for pensions and social security of mobile researchers [EUR] • Mobility funding: The Marie Sklodowska-Curie Actions, ERC grants, Erasmus+ [EUR]
Evidence base	• 2020 Reports chaired by Australia's Chief Scientist: Impact of COVID-19 in research workforce and women in science [AUS, policy makers]. • 2016 ACOLA Review of research training system [AUS] • Peak body the Group of 8 launched a survey that looks at career paths [AUS] • Australian Bureau of Statistics collects data that is able to be utilised to determine the research workforce by sector within Australia [AUS, policy makers]. • Creation of the Observatory of Research and Scientific Careers with a sustainalbe public funding commitment, « Décret portant diverses mesures relatives à l'Enseignement supérieur et à la Recherche » [BEL-WAL, policy makers] • Large and up-to-date database on Finnish education and R&D: vipunen.fi from the ministry. [FIN, policy makers] • Updated (2020) platform for online information on research in Finland including human resources: research.fi. [FIN, policy makers, employers] • IPDoc: biennial survey of the career of doctorate holders one, three, and five years after graduation [FRA, policy makers, doctoral schools] • National Report on Junior Scholars: published at least once every legislative session to report on the situation of junior scholars in Germany, focusing each time on different aspects [DEU, policymakers, researchers] • Reform of the university statistics act (Hochschulstatistikgesetz) [DEU, policy makers] • National Report on Junior Scholars [DEU] • Survey of postdoctoral researchers by Academy of Young Researchers [HUN, funders] • Survey on the employment and careers of postdoctoral fellows [JPN, policy makers] • Korean CDH, New census of postgraduate students and postdocs modelled on the US Survey of Graduate Students and Postdoctorates in Science and Engineering, and an early career survey of doctorate holders modelled on the US Survey of Earned Doctorates and Survey of Doctorate Recipients, to be launched in 2021 [KOR] • Observatory of Scientific Employment to monitor flows, CDH Surveys, Independent Assessment of Scientific Employment Policies [PRT, policy makers] • University of Lausanne: career survey of doctoral alumni (2007 to 2017) conducted on a low-cost basis from 2018 to 2020, leading to ongoing initiatives in data gathering, career support and alumni integration. Quantitative and qualitative data produced. [CHE, employers] • HESA data which includes Graduate Outcomes [GBR, employers, researchers, HESA] • Careers in Research Online Survey and Principal Investigators and Research Leaders Survey (to be replaced in 2021 by Culture, Employment and Development in Academic Research Survey) and What do researchers do next? surveys [GBR, PIs, researchers, Vitae] • Survey of earned doctorates (SED): an annual census, conducted since 1957 of all individuals receiving a research doctorate [USA*, policy makers, funders] • Survey of doctorate recipients (SDR): a survey of science (includes social science), engineering, and health doctorate recipients, sampled from SED [USA*, policy makers, funders] • MORE surveys on mobility patterns and career paths of European researchers [EUR] • SHE Figures for women in research [EUR]

Issue	Illustrative initiatives
Governance and coordination	• Alumni Network [BEL-WAL, funders, researchers] • Working group on doctoral education and research careers to report in 2021 [FIN, employers, PIs, researchers] • Associations and unions of researchers have been set up and are highly active in national science policy: ABIC, ANICT, SNESup, Fenprof/Superior [PRT, researchers] • South African Post-Doctoral Research Forum: provides a meeting place for post-doctoral researchers to share ideas on how to tackle the challenges presented in their career paths [ZAF] • Young Academy of Spain: provides a space for young researchers to participate in the governance of R&D and innovation [ESP. policy makers] • Swiss Academy of Natural Sciences (SCNAT): We Scientists 2035 - an inclusive, action-oriented workshop to develop visions for the future of research culture, rolling out to all Swiss universities through academic networks. [CHE, employers, Pis, reserchers, network of academics] • Better Science Initiative: a bottom-up approach on multiple levels to change practice in science. Originating out of the University of Bern and extended to all Swiss universities.[CHE, employers, Pis, reserchers, network of academics] • UKRI Early Career Researcher Forum, linked to Concordat Action Plan [GBR, funders, researchers] • The Concordat to Support the Career Development of Researchers [GBR, policy makers, funders, employers, PIs, researchers, Vitae]

Notes:* Canada and the United States did not participate in the project with country notes, but examples from these countries have arisen during the project.

Annex D. Interviewees

Name	Affiliation	Country/ Jurisdiction
Akihiro Kishimura	Associate Professor, Kyushu University, Young Academy of Japan in Science Council of Japan	JPN
Alastair McEwan	Convenor of the Australian Council of Graduate Research and Dean of the Graduate School at the University of Queensland	AUS
Alexander Hasgall	Head, Council for Doctoral Education, European University Association	EUR
Alexey Evstratov	Actionuni	CHE
Andreas Keller	Vice-President of the German Trade Union for Education and Research (Gewerkschaft Erziehung und Wissenschaft - GEW)	DEU
Ângela Noiva	Deputy Director, Directorate-General for Higher Education (DGES-MCTES)	PRT
Anjali Shah	Researcher Developer, People and Organisational Development, University of Oxford	GBR
Anjana Buckow	Programme Director Research Careers, German Research Foundation (DFG)	DEU
Anne K. Krüger	Scientific Coordinator Universities in Change (postdoc from Humboldt University Berlin)	DEU
Anne Kelso	CEO, National Health and Medical Research Council (NHMRC), Australia	AUS
Anne-Marie Coriat	Head of Research Landscape, Wellcome Trust, UK	GBR
Antje Tepperwien	Head of Team Persons and Structures, Volkswagen Foundation	DEU
Anton Muscatelli	Chair of Russell Group	GBR
Bodo Richter	Deputy Head of Unit, European Commission - Directorate General for Education, Youth, Sport and Culture Directorate C – Innovation, International cooperation and Sport	EUR
Carlos Hermenegildo	Vicerector d'Investigació, Universidad de Valencia, Spain	ESP
Carmen Castresana	Director General of Research Planning at the Ministry of Science and Innovation (DGPI)	ESP
Carmen Faso	Actionuni	CHE
Carole Chapin	Association Nationale des Docteurs (ANDès), France	EUR - Eurodoc
Christina Helbig	PostDocNL, PhD Candidates Network of the Netherlands (Recommended by Eurodoc member PNN, which represents doctoral researchers)	EUR - Eurodoc
Christophe Desmet	ULG, spokesperson of the Interuniversity Contact Committee of FNRS researchers (Biomedical Sciences)	BEL
Colienne Lejeune de Schiervel	Deputy Chief of Staff at the Cabinet of the Minister of Higher Education, Scientific Research, Youth and Sports of the Wallonia-Brussels Federation- Valéry Glatigny	BEL
Eduardo Maldonado	Chairman of the Board of ANI (Innovation National Agency)	PRT
Eduardo Oliver	Investigador CNIC (Spanish National Center for Cardiovascular Research), and Spanish Researchers in the UK (SRUK/CERU), Spain	ESP
Elena Carretón	Eurodoc member organization: FJI-Precarios, Federacion the Jovenes Investigadores	EUR - Eurodoc
Elisabeth Ewen	HR Director at Fraunhofer-Gesellschaft	DEU
Emilio Criado Herrero	Researcher CSIC. Representative of Union (CCOO) in National Advisory Board for Science and Technology, Spain	ESP
Enric Banda	Barcelona Supercomputing Center, Chair, Advisory Board on Science, Technology and Innovation (CACTI), Spain	ESP
Enrique Playán	National Research Funding Agency (AEI), Director General, Spain	ESP
Gergely Toldy	Academy of Young Researchers (AYR) – member of the AYR's presidency, member of the Global Young Academy, Hungary	HUN
Gonçalo Velho	President SNESUP (National Union of Higher Education)	PRT
Haruka Ono	Toyohashi University of Technology, Young Academy of Japan in Science Council of Japan	JPN
Helena Pereira	President FCT (Foundation for Science and Technology – research funding council)	PRT
Henning Rockmann	German University Rectors' Conference	DEU
Ilka Schießler-Gäbler	Senior consultant, Programmes and Networks Unit, Department for Human Resources Development & Opportunities, Max Planck Society	DEU
Imelda Whelehan	Executive Committee Member ACGR and Dean of the Graduate Research School, The University of Western Australia	AUS
In KIM	Post-doc researcher, Korea Institute of Science and Technology Information (KISTI)	KOR
Inês Almeida	Eurodoc member organization: ABIC, Portuguese Association of grant-holding researchers	EUR - Eurodoc
István Szabó	Vice President, National Office of Research, Development and Innovation, Hungary	HUN
Jan-Christoph Rogge	Universities Department, BMBF - Federal Ministry for Education and Research	DEU

Name	Affiliation	Country/ Jurisdiction
Javier Garcia Martinez	Professor at Universidad de Alicante, Nanotechnology Molecular Laboratory, President of the Youth Academy of Spain, and co-founder and Chief Scientist of Rive Technology Inc (Boston, MA), a VC-funded MIT spin-off	ESP
Jean-Christophe Renauld	Chair of the Council of Vice-Rectors for Research, UCLouvain	BEL
Jeong Soo LEE	Deputy director, Ministry of Science, Technology, and ICT	KOR
Jessica Delmasso	Confédération des Jeunes Chercheurs (CJC)	FRA
Jorunn Dahl Norgård	Head of Department, Trade union policy section, Norwegian Association of Researchers (NAR)	NOR - TUAC
José Manuel González Sancho	Vicerrector de Investigación, Univesidad Autonoma de Madrid (UAM) (Profesor Titular de Bioquímica y Biología Molecular en la Facultad de Medicina), Spain	ESP
José Manuel Mendonça	Chairman of the Board and CEO of INESC TEC (Associate Laboratory)	PRT
Julia Buckingham	President UUK	GBR
Katalin Solymosi	Founding member of the Hungarian Young Academy and the Young Academy of Europe	HUN
Kévin Bonnot	General Secretary Confédération des Jeunes Chercheurs (CJC)	FRA
Kibeom PARK	Senior Research Fellow, Science and Technology Policy (STEPI)	KOR
Kisung KO	Professor, Chung-Ang University, and visiting professor, Harvard University	KOR
Krisztian Baranyai	Policy Analyst, Research and Innovation, Universities Australia	AUS
Kylie Emery	Branch Manager, Policy and Strategy, Australian Research Council (ARC)	AUS
Kyunghwan Choi	Post-doc researcher, Korea Advanced Institute of Science and Technology (KAIST)	KOR
Laura Fernández de Mosteyrín	Departamento de Sociología III de la Facultad de Cc. Políticas y Sociología, Universidad Nacional de Educación a Distancia (UNED)	ESP
Lidia Borrell-Damián	Secretary General at Science Europe	EUR
Liz Eedle	Policy Director, Research and Innovation; Universities Australia	AUS
Maarten Hermans	Postdoc at KU Leuven (recommended by Eurodoc member organization: Focus Research)	EUR - Eurodoc
Manuel Gonzalez Bedia	Adviser to the Ministry of Universities, Professor, Univ Zaragoza, Spain	ESP
Marc Vanholsbeeck	Director at Directorate for Scientific Research, Ministry of Wallonia-Brussels Federation	BEL
Marcel Kullin	Division Careers, Swiss National Science Foundation	CHE
Marijtje Jongsma	Chief executive of scientific education, Algemene Onderwijsbond (Aob) (General Union of Educational Personnel), The Netherlands	NLD - TUAC
Marine Jaeken	Responsible for Career Support of PhD holders, Objectif Recherche NGO	BEL
Mathias Schroijen	Eurodoc Board, Cellule Doctorat, ULB	BEL
Matt Bawn	Researcher at Quadram Institute Bioscience and Earlham Institute	GBR
Miia Ijäs-Idrobo	Eurodoc member organization: FUURT, Finnish Union of University Researchers and Teachers	EUR - Eurodoc
Moises Gulias	Prof. Contratado, Center for Research in Biological Chemistry and Molecular Materials (CiQUS), Universidad Santiago de Compostela, Spain	ESP
Nicholas Wardle	Research Fellow, Imperial College London	GBR
Nuno Cerca	President ANICT (National Association of Science and Technology Researchers)	PRT
Nuno Peixinho	President ABIC (Portuguese Association of the grant-holding researchers)	PRT
Pam Foster	Director, Research & Political Action, Canadian Association of University Teachers (CAUT)	CAN - TUAC
Paulo Baptista	Eurodoc member organization: ABIC, Portuguese Association of grant-holding researchers	EUR - Eurodoc
Pedro Dominguinhos	President, CCISP (The Portuguese Polytechnics Coordinating Council)	PRT
Peter Ullrich	Senior Researcher, Centre for Technology and Society, Technische Universität Berlin, Network for Decent Labour in Academia (NGAWiss)	DEU
Pierre Coural	Chef de service des personnels enseignants de l'enseignement supérieur et de la recherche au Ministère de l'enseignement supérieur, de la recherche et de l'innovation (MESRI)	FRA
Quentin Rodriguez	Eurodoc member organization: CJC, Confédération des Jeunes Chercheurs, France	EUR - Eurodoc
Rashmi Rai-Rawat	Eurodoc member organization: actionuni der Schweizer Mittelbau	EUR - Eurodoc
René Krempkow	Eurodoc member organization: THESIS – The Interdisciplinary Network for Doctoral Candidates and Early Stage Researchers in Germany	EUR - Eurodoc
Rory Duncan	UKRI Director, Talent & Skills	GBR
Rui Vieira de Castro	Rector, University of Minho, Council of Rectors of Portuguese Universities	PRT
Shinichi Kobayashi	Vice-president, Hiroshima University	JPN

Name	Affiliation	Country/ Jurisdiction
Shinsuke Kawagucci	Reseacher, Japan Agency for Marine-Earth Science and Technology, Young Academy of Japan in Science Council of Japan	JPN
Stacey Pelika	Director of Research, National Education Association (NEA)	USA - TUAC
Sue Berners-Price	Immediate Past Convenor of ACGR and Dean of the Graduate Research School, Griffith University	AUS
Sun Kun OH	Emeritus professor, Konkuk University, and vice chairman of GSF	KOR
Suzanne M. Monnier	Scientific advisor Higher Education, State Secretariat for Education, Research and Innovation SERI	CHE
Svenja Gertheiss	German University Rectors' Conference	DEU
Sylvie Pommier	Université Paris Saclay and Réseau national des collèges doctoraux	FRA
Tania Jenkins	Scientific Officer, Swiss Academy of Sciences (SCNAT)	CHE
Tibor Gulyás	Deputy minister of State, Ministry of Innovation and Technology, Hungary	HUN
Tristan Flury	Research Associate, Promotion of young talent, Swissuniversities	CHE
Vanessa Cuthill	British Academy, Director of Research	GBR
Véronique Halloin	Secretary General of F.R.S.-FNRS	BEL
Viktória Pató	Eurodoc member organization: DOSZ, Association of Hungarian PhD and DLA Students, Hungary	EUR - Eurodoc
Vinciane Gaillard	Deputy Director for Research and Innovation (Acting) at European University Association	EUR
Violeta Duran	Federacione Jovenes Investigadores (FJI)/ Precarios, investigadora predoctoral, Universidad Complutense de Madrid (UCM), Spain	ESP
Wataru Iwasaki	Associate Professor, University of Tokyo, Young Academy of Japan in Science Council of Japan	JPN
Yolanda Benito	CIEMAT, Environment Department Director, Spain	ESP
Youjung SHIN	Research Professor, Graduate School of Science, Technology, and Policy, Korea Advanced Institute of Science and Technology (KAIST)	KOR