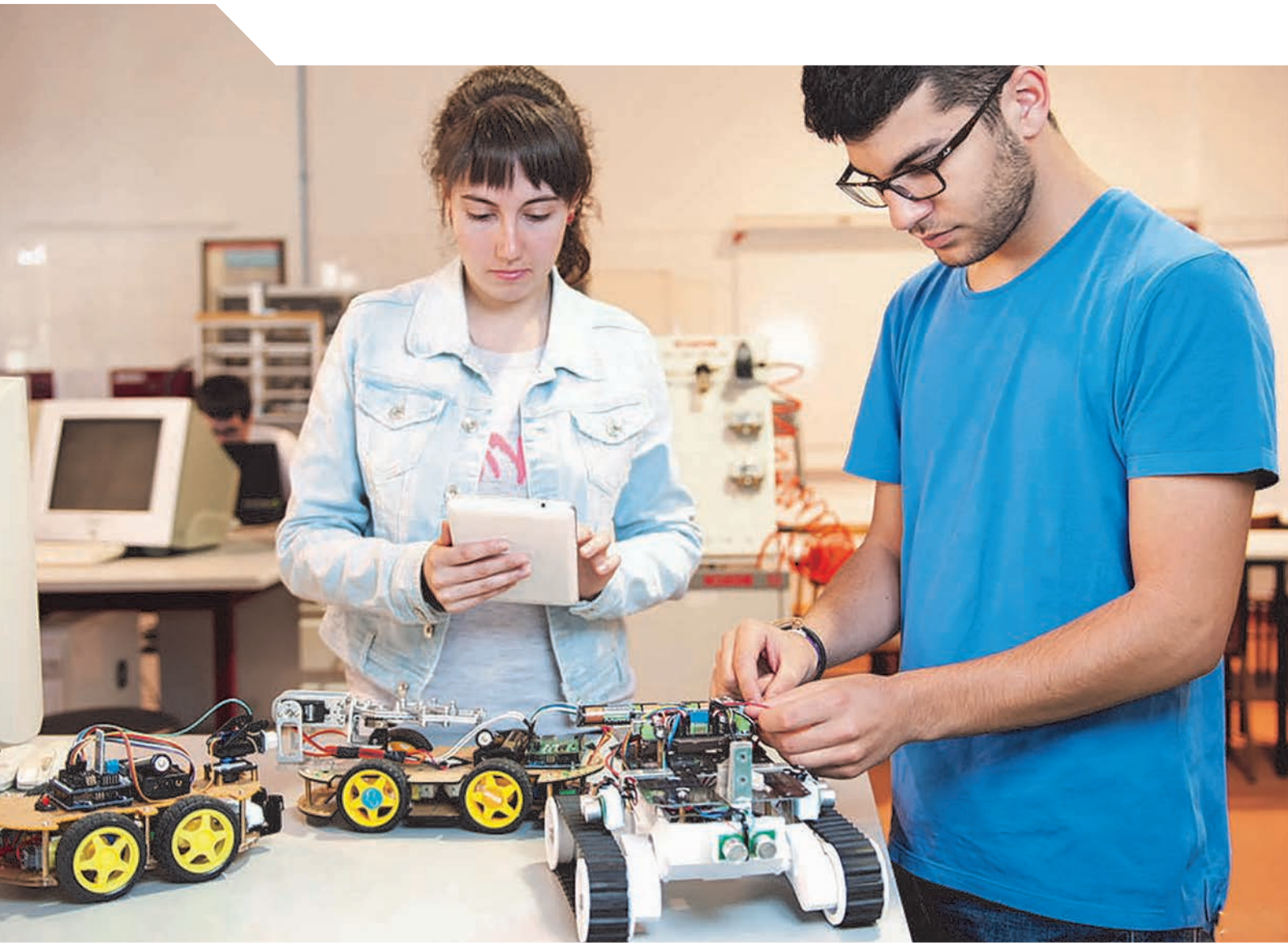
OECD Review of Higher Education, Research and Innovation: Portugal



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Foreword

The OECD Review of Portugal's higher education, research and innovation system is the result of the joint endeavour by the OECD Directorates for Education and Skills and for Science, Technology and Innovation (STI). The review was requested by the Ministry for Science, Technology and Higher Education (*Ministério da Ciência, Tecnologia e Ensino Superior*, MCTES), conducted under the auspices of the Committee for Scientific and Technological Policy (CSTP) and the Education Policy Committee (EDPC).

The purpose of this review is to provide a comprehensive understanding of the key elements, relationships and dynamics that drive Portugal's higher education, research and Innovation system and the opportunities to enhance it through government policy. More specifically, the review:

- provides an independent and comparative assessment of the overall performance of Portugal's higher education, research and innovation system;
- recommends where improvements can be made in the system; and
- formulates recommendations on how government policies can contribute to such improvements, drawing on the experience of OECD and non-OECD countries and evidence on relevant processes, systems and policies.

The review is relevant to a wide range of stakeholders in Portugal, including government officials; agencies which are part of the governance of the higher education, research and innovation system; senior management in higher education and research institutions; entrepreneurs; business leaders and researchers; as well as the general public.

The review team, comprised of OECD analysts and international experts, carried out four fact-finding missions in Portugal during 2017. In November 2017 it presented preliminary results during a week of consultations. These consultations included key stakeholders convened in locations across Portugal, and a full day workshop with the Ministry's Coordinating Council on Higher Education. Key results from the review were presented to the Education Policy Committee on November 15, 2017, and a draft version of the "Overall Assessment and Recommendations" was presented for peer review to the Working Party for Innovation and Technology Policy (TIP) of the CSTP on December 12, 2017. The Ministry of Science, Technology, and Higher Education convened a pre-launch event in Lisbon on February 9, 2018, in which the Minister of Science, Technology, and Higher Education, the Minister of the Economy, members of Parliament, and a wide range of stakeholders from the higher education, research, and innovation organisations participated.

The findings in the report reflect policies and practices as of end of 2017. Changes to policy adopted after that date, apart from the 2018-2030 Innovation Strategy (adopted March 2018), were not examined in the review.

The review was led by Dominique Guellec (Head of the Science and Technology Policy Division, STI, OECD) and Thomas Weko (Senior Policy Analyst, EDU, OECD). The report was authored by Thomas Weko, Simon Roy (Policy Analyst, EDU, OECD) and Philippe Larrue (Policy Analyst, STI, OECD). A team of international experts provided valuable contributions: from the Laura Cruz-Castro, Catalina Martinez, and Luis Sanz-Menendez (Spanish National Research Council, Institute of Public Goods and Policies,

Spain); Jon File (Center for Higher Education Policy Studies, University of Twente, Netherlands); Paula Stephan (Georgia State University, United States), and Matthias Weber (Austrian Institute of Technology, Austria).

Key analytical support for the project was provided by Anna Pons (Analyst, EDU, OECD), Manuela Fitzpatrick (Consultant, EDU, OECD), Blandine Serve (Statistician, STI, OECD) Johannes Weber (STI, OECD), and Cynthia Lavison (CFE, OECD). Administrative support was provided by Jonathan Wright (Assistant, EDU, OECD), Célia Braga-Schich (Assistant, EDU, OECD) and Chrystyna Harpluk (Assistant, STI, OECD). . The review team is grateful for the feedback and support received from Andrew W. Wyckoff (Director, OECD Directorate for Science, Technology and Innovation, OECD), Andreas Schleicher (Director, Directorate for Education and Skills, OECD) and Paulo Santiago (Division Head, Policy Advice and Implementation Division, EDU, OECD).

The review draws heavily on the results of interviews with a wide range of major stakeholders of the Portugal's higher education, research and innovation system during several fact-finding missions, including higher education administration, researchers, students, business and community leaders and government officials. The review team is grateful for their time and valuable input.

The review owes much to the support of government officials of the Republic of Portugal, in particular Manuel Heitor (Minister, MCTES), Paulo Ferrão (*Presidente, Fundação para a Ciência e a Tecnologia*, FCT) and José Carlos Caldeira (*Presidente, Agência Nacional de Inovação*, ANI). The contributions of Pedro Barrias and Roque Teixeira (Advisors to the Minister), Tiago Santos Pereira (Head, Studies and Strategy Office, FCT) were particularly valuable, and ensured thorough and expert consultation between the OECD review team and relevant national authorities.

The review benefited from discussions with analysts leading various OECD reviews and initiatives in support of Portugal, including Patricia Mangeol of the OECD Skills Strategy for Portugal (EDU, OECD) and David Liebowitz and Gonçalo Lima, of the OECD Review of School Resources (EDU, OECD).

While the OECD review team benefited greatly from many discussions with a wide range of Portuguese stakeholders, as well as documents, data, and a Country Background report provided by MCTES, any errors or misinterpretations in this report are the responsibility of the OECD.

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Acronyms and abbreviations

A3ES	Agency for Assessment and Accreditation of Higher Education (*Agência de Avaliação e Acreditação do Ensino Superior)*
AICEP	Portugal Global – Trade & Investment Agency (*Agência para o Investimento e Comércio Externo de Portugal*
ANI	National Innovation Agency (*Agência Nacional de Inovação*)
APESP	Association of Private Higher Education (*Associação Portuguesa de Ensino Superior Privado*)
BERD	Business expenditures for research and development
BPD	FCT post-doctoral fellowships (*Bolsas de Pós-Doutoramento*)
CASE	*Industrial Co-operative Awards in Science & Technology*
CCHE/CCES	Co-ordinating Council for Higher Education (*Conselho Coordenador do Ensino Superior*)
CCISP	The Council of Polytechnics (*Conselho Coordenador dos Institutos Superiores Politécnicos*)
CDH	Careers of Doctoral Holders
CDT	Centres for Doctoral Training
CIC	Commission for the co-ordination of the Partnership Agreement (*Comissão Interministerial de Coordenação do Acordo de Parceria*)
CNE	National Council on Education *(Conselho Nacional de educação)*
CNEI	National Council for Entrepreneurship and Innovation (*Conselho Nacional de Empreendedorismo e Inovação*)

CNCT	National Council for Science and Technology (*Conselho Nacional de Ciência e Tecnologia*)
CoLABs	Collaborative Laboratories
CRUP	Council of University Rectors (*Conselho de Reitores das Universidades Portuguesas*)
CTeSP	Technical Professional Higher Education Courses (*Cursos Técnicos Superiores Profissionais*)
DBA	Professional doctorates in business administration
DGES	Directorate-General of Higher Education (*Direcção Geral do Ensino Superior*)
DNP	Doctor of nursing practice
DPT	Doctor of physical therapy
DTP	Doctoral Training Partnerships
Ed.D	Professional doctorate in education
EFICE	Industrial Development Strategy for Growth and Employment (*Estratégia de Fomento Industrial Para o Crescimento e o Emprego*) 2014-2020
EIB	European Investment Bank
EIF	European Investment Fund
ENEI	National Strategy for Smart Specialisation (*Estratégia de Investigação e Inovação para uma Especialização Inteligente*)
EPO	European Patent Office
ERC	European Research Council
ERCEA	European Research Council Executive Agency
ESIF	European Structural and Investment Funds
EURIRS	Euro Interest Rate Swap
FCCN	Foundation for the National Scientific Computing (*Fundação para a Computação Científica Nacional*)

FCT	Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*)
FDI	Foreign Direct Investment
FTE	Full-time Equivalent
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GII	Global Innovation Index
GBARD	Government budget appropriations for R&D
GOP	Major Options of the Plan (*Grandes Opções do Plano*)
GOVERD	Government expenditures on research and development
GPEARI	Planning, Evaluation, Strategy and International Relations Office (*Gabinete de Planeamento, Estratégia, Avaliação e Relações Internacionais*)
H2020	Horizon 2020
HERD	Higher Education Research and Development Expenditure
HERI	Higher Education, Research and Innovation
IAPMEI	Competitiveness and Innovation Agency (for the support of SMEs) (*Agência para a Competitividade e Inovação*)
ICT	Information and communication technology
INESC TEC	Institute for Systems and Computer Engineering, Technology and Science
INIAV	National Institute of Agrarian and Veterinary Research (*Instituto Nacional de Investigaçao Agraria e Veterinaria*)
ITN	Innovation Transfer Network
IP	Intellectual Property
IPA	Institute for Programming Research Algorithmics

JNCT	National Board of Scientific and Technological Research (Junta Nacional de Investigação Científica e Tecnológica)
JPO	Japan Patent Office
LTP	Long-term plan for Higher Education and Research 2015-2024
MCTES	Ministry of Science, Technology and Higher Education (*Ministério da Ciência, Tecnologia e Ensino Superior*)
MEC	Ministry for Education and Science (*Ministério da Educação e Ciência*)
MFP	Multi Factor Productivity
MIT	Massachusetts Institute of Technology
MNE	Multinational enterprise
NCN	National Science Centre
NRP	National Reform Programme
OECD	Organisation for Economic Co-operation and Development
PD	Professional doctorates
PhD	Doctor of Philosophy
PMR	Product Market Regulation
POCH	Human Capital Operational Programmes
PREMAC	Plan to Reduce and Improve Central Administration (*Plano de Redução e Melhoria da Administração Central)*
PRI	Public Research Institute
PT2020	Portugal 2020
PVCi	Portugal Venture Capital Initiative
R&D	Research and development
RGA	General access regime (*Regime Geral de Acesso*)

RJIES	Legal regime for higher education institutions (*Regime Jurídico das Instituições de Ensino Superior)*
RO	Research organisations
SATT	Sociétés d'Accélération du Transfert de Technologies
SENSE	Research School for Socio Economic and Natural Sciences of the Environment
SIFIDE	System of Fiscal Incentive for Business R&I (*Sistema de Incentivos Fiscais à I&D Empresarial*)
SMEs	Small and medium enterprises
S&T	Science and Technology
STEM	Science, technology, engineering, and mathematics
TEA	Total early-stage Entrepreneurial Activity
TTA	Technology Transfer Alliance
TTO	Technology Transfer Office
UTN	University Technology Enterprise Network
UMIC	Agency for the Knowledge Society
USPTO	United States Patent and Trademark Office

Executive summary

Portugal aims to ensure that its higher education and public research system contributes to the growth of a more innovative and productive economy. Progress towards this goal, achieved through growing investment and research performance, was halted by the global recession. As a consequence of the 2011-14 Economic Adjustment Programme for Portugal, sharp reductions were made to public investments in knowledge and innovation. Private investment fell as well. With the resumption of sustained economic growth, Portugal has set its sights on further development of the nation's higher education, research and innovation system as a catalyst for economic growth and social inclusion. Further public investment in higher education, research, and innovation can be most effectively used with attention to the following challenges:

Governance, strategy, and funding in the higher education, research, and innovation system

Portugal needs a comprehensive and coherent national strategy to guide public higher education, research, and innovation in the mid- to long-term

Portugal has a crowded and fragmented strategic policy framework that limits the effectiveness and efficiency of public investment in research and innovation activities, and does not assist in building critical mass in areas where the country can excel. Portugal should adopt an overarching national strategy that provides clear mid- to long- term guidance to public bodies that fund and steer higher education, research and innovation.

Improved co-ordination across government is needed to support the development of a comprehensive policy strategy and priorities

Horizontal co-ordination mechanisms within government are not sufficient to ensure that departments and policies for higher education are coherently linked to research and innovation policies, or that both are suitably linked to broader economic, social and regional development policies. Establishing a high-level task force at the inter-ministerial level could support high-level, strategic, cross-ministerial co-ordination, planning or decision-making. Such a body could also lead the development of an overarching and coherent national strategy for higher education, research, and innovation.

The future of State Laboratories within Portugal's research system is unclear

The prominence of State Laboratories as research institutions has been reduced over the last 20 years. However, they continue to obtain a significant investment of public resources. The absence of an overall strategy and limited interministerial co-ordination hinder the State Laboratories' work, limiting their engagement with important new scientific and social challenges, such as climate change, an ageing population, and food security. As part of its national knowledge strategy, Portugal should consider defining the future role of the State Laboratories, and identify how they can best contribute to these new challenges.

The resources allocated to higher education, research and innovation are not aligned to an overall strategy, or to policy goals guiding the work of government

The ambitious European convergence goals set by the government in 2018 – reaching 3% of R&D intensity by 2030 – will require that public R&D expenditures double, and that private R&D expenditures quadruple. Although expenditure on research and development has rebounded after the financial crisis of 2008, achieving these goals requires a rate of growth in spending that Portugal has not previously achieved, even prior to the financial crisis. Experience shows that R&D intensity targets must be credible and widely embraced if they are to be implemented by policymakers. Moreover, growth in spending needs to be complemented by reforms that support the capacity of firms to engage in knowledge-based innovation, and reforms in the governance of the public research sector. It is also important for Portugal to ensure sufficient stability in the levels and methods of public funding, while reducing the administrative burden for firms to obtain funding.

Funding allocation processes at agency level limit the implementation of national priorities

The Portuguese Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*) (FCT) is the leading public funder of research at the institutional, project and individual researcher levels. Its follows a bottom-up approach to research funding, without *ex-ante* prioritisation of research domains and disciplines. This results in the dispersion of research resources and limits the alignment of the higher education, research, and innovation system to national development goals. Addressing these issues will require a reform of the FCT, increasing its capacity to effectively balance national research priorities and the priorities of the nation's scientific research communities.

The missions, profiles and use of resources of higher education institutions

The profiles and missions of Portugal's public higher education institutions, viewed as a system, are not well aligned to national and regional needs

There is scope for improving Portugal's higher education system to ensure that the nation has a diversified network of institutions, the missions of which are well-aligned to national and regional needs. Better balance can be achieved with a strategically guided process of review and approval of new educational programmes to ensure they are well-aligned to the mission of institutions in each sector, and to the institution's own strategic profile. Further, the legal basis for polytechnic institutions could be revised to permit the carefully controlled award of doctoral degrees by polytechnics. This could be permitted in applied research fields where institutions have a clearly demonstrated capacity to provide doctoral training, and where there is a strong economic rationale for the offer of doctoral awards.

Higher education institutional autonomy and responsibility have expanded, but remain insufficient

Portuguese universities and polytechnics enjoy a moderate level of institutional autonomy in organising their internal management and structures. However, national legislation governing public sector employment, public procurement and financial management are burdensome, and limit the ability of institutions to plan and manage their operations efficiently and effectively. Foundation status for universities was expected to widen the scope of institutional autonomy; however, the take-up of foundation status has been limited, and its effects more restricted than anticipated. Full implementation of the foundation status

for all well-managed public higher education institutions should be the aim of policymakers, and a series of reforms to public accounting and budgeting provisions should be adopted to expand flexibility in financial management and procurement for public higher education institutions.

Public spending is provided in a way that hampers sound financial management by higher education institutions

Multi-annual and performance-based funding of higher education institutions has been proposed or adopted in the past, but not successfully implemented. Institutions receive public funding for operations on an historical basis, and may be subject to mid-year budget reductions in budgets to balance public accounts. Portugal should aim to develop a higher education funding regime with multi-year commitments, and deliver balanced institutional funding. Its institutional funding scheme should predictably fund the core activities of institutions, reward institutions for performance in a way that is recognised to be fair, and provide incentives for the development of forward-looking institutional profiles. Portuguese authorities should aim for the development of a funding methodology that allocates approximately 80%-15%-5% of institution resources across activity, outputs, and future profiles, respectively.

Funding and steering policies do not encourage institutional profiling and division of labour

The Portuguese government does not require nor encourage higher education institutions to develop profiles in line with their respective strengths and weaknesses, and to situate those within a clear national policy framework. This leads to a lack of specialisation, inefficient duplications, missed opportunities for collaboration and weak alignment of activities with national priorities. Dedicated institutional funding should be linked to institutional profiles, and should assist public higher education institutions in strengthening the professional and administrative capacities of needed establish strategic profiles. Further, public research funding should be delivered in a way that supports the capacity of institutional leaders to set and implement a co-ordinated research profile.

Higher education provision, access and support mechanisms

Differentiation and flexibility in modes of provision and pedagogical approaches remain limited, jeopardising Portugal's attainment goals

Portugal hAs a binary system of higher education, and has endeavoured to create greater diversity in higher education offerings. However, flexible and innovative study programmes that are adapted to the needs of non-traditional students are not frequently offered. Further improving the diversity of the educational offer and provision will be particularly important to cater to a more diverse student population. The on-going reform of the quality assurance system, based upon institution-level review, could be an opportunity to encourage greater diversification and innovation in the development of new types of programme, instruction methods, curriculum and delivery modes.

Pathways from secondary to higher education limit further widening and social diversification of higher education access

The current entry regime for higher education is transparent and cost-efficient, but unnecessarily hampers wider access to higher education. The national competition for higher education entry is based upon the curriculum of scientific-humanistic upper secondary programme, rather than the upper secondary education professional education curriculum. Widening entry to higher education will require revising the higher education entrance examination system to ensure it is appropriately adapted to students from upper secondary professional education.

Financial and academic support for students needs improvement to achieve attainment goals

Portugal aims to raise higher education attainment by encouraging enrolment among young adults who completed upper secondary education and directly entered the labour market, or enrolled in higher education but left prior to completion. However, eligibility requirements for student support are not adapted to this population. Moreover, academic support and guidance services that can help student persist in their studies are not extensively developed by its higher education institutions. Improvement in both higher education entry and completion can be achieved through the re-design of student financial support policies, and support for academic and social support delivered by institutions.

Doctoral training

The funding and delivery of doctoral training is not well configured to prepare doctoral graduates for today's research roles

Portugal has succeeded in greatly expanding its capacity to train doctoral candidates in the last two decades. However, FCT's demand-driven allocation of PhD scholarships does not allow the prioritisation of fields based on institutions' missions and areas of strength, and in line with national priorities. The considerable instability and unpredictability in the volume and the type of instruments used to allocate funding, compounded by decreasing success rates for applications, has also made it harder for institutions to plan post-graduate training in a strategic way. The concentration of public funding and decision-making responsibility in the FCT also contrasts with the current international patterns, where greater responsibility is typically granted to universities in selecting candidates and attributing scholarships. There is room to direct more public funding for PhDs to higher education institutions through reformed support for doctoral programmes.

More needs to be done to create quality employment opportunities for doctoral graduates in Portugal

PhD graduates in Portugal face a difficult situation, as the academic sector often offers precarious, grant-based post-doctoral positions and the private sector, populated largely by micro enterprises in low and medium-technology sectors, still has limited demand for highly-trained workers. Although recent initiatives aim to alleviate these problems, the significant 'brain drain' experienced by Portugal, in particular since the financial crisis might persist if the availability and attractiveness of career opportunities in Portugal in the academic and private sectors is not made a core element of future research and innovation policy initiatives. To create quality employment opportunities for doctoral graduates, Portugal should develop tailored selection and quality criteria for doctoral training

programmes in the business or wider public sectors. There is scope for strengthening and expanding the practice of awarding 'mixed' and professional PhD scholarships, to allow doctoral candidates to gain practical experience abroad and in Portugal. To inform effective policy-making, it is important to improve data collection about the career paths of doctoral candidates and graduates, including those who move abroad.

Academic Careers

Problems of queuing and in-breeding in academic careers are extensive

The increasingly difficult access to academic careers in Portugal has resulted in an increase in the number of doctoral graduates moving through a succession of precarious post-doctoral positions. The recent initiative to offer formal employment contracts to post-doctoral fellows may perpetuate unrealistic expectations about the likelihood of obtaining a permanent academic post and could divert individuals from exploring job opportunities outside academia. It will be key to improve information and guidance to prospective academic staff and ensure that post-doctoral positions allow post-docs to gain skills and experience that can be exploited outside academia. Moreover, the high level of 'in-breeding' in the system, whereby students go on to work in the universities where they study, risks undermining academic excellence and innovation.

The structure of careers is marked by weak differentiation and limited performance-based rewards

The comparatively detailed national legal and regulatory frameworks that structure academic careers creates rigidities in the system, in particular in relation to the way staff use their time and profile themselves. Portugal must ensure institutions and academic staff have flexibility to allocate staff time efficiently and to follow distinct career profiles. Moreover, policies should encourage institutions to implement transparent and merit-based procedures for staff performance review that are aligned to institutional mission, and support differentiation in pay and rewards.

Low career mobility and late retirement hinder innovation and diversity

The limited mobility of academic staff reduces the range of experience gained by individuals and the innovation and development benefits of diversity for institutions. Moreover, older staff often remain in post beyond pensionable retirement age, limiting opportunities for career progression for younger staff. Inbreeding and the comparatively static nature of academic careers in Portugal also contribute to the comparatively low level of internationalisation among academic staff in the country. To address this challenge, Portugal should promote near-term measures to increase inter-institutional mobility and timely retirement, while, in the long-term, adopting reforms that increase domestic and international mobility.

High-skilled employment, co-operation with HEIs and innovation in the business sector

There is a need to support low and mid-tech businesses to develop their internal innovation capacity

The innovation capacity and output of Portuguese businesses have remained at a low level in international comparison, partly due to the dominance of SMEs and the weight of traditional sectors in the economy. Although more could be done to promote engagement with industry among academic institutions and staff, at present, there are only a limited number of companies with sufficient 'absorption capacity' to collaborate effectively with academic partners. It is therefore important to support more low and mid-tech businesses that do not yet innovate significantly and serve mainly regional markets to develop their internal innovation capacity and exploit the opportunities offered by co-operation with the academic sector. This could be done through 'regional innovation platforms' that provide domestic SMEs easy access to resources such as information, expertise, and equipment that allow them to upgrade their innovation capabilities.

Mismatches between the supply and demand for qualified staff may be hampering innovation

Although Portugal has improved the level of qualification of its population over recent decades, some mismatches between graduate qualifications and industry needs persist. Specifically, there appears to be an over-emphasis on academically-oriented PhDs in comparison to more professionally-oriented PhDs. There is still room to upgrade polytechnics and regionally-profiled universities, supporting their capacity to engage in 'practice-based knowledge-intensive institutions' dedicated to local development.

Further support for intermediary organisations in low technology industry and service sectors is needed

The government has progressively created a diversified system of intermediary organisations to fulfil a wide range of business knowledge transfer and service needs, including those related to science-based, incremental and problem-solving innovation. However, most of these organisations operate with fragile business models without systematic public support. The institutional funding planned in the recently launched Interface Programme, if maintained over a period of several years and subject to regular evaluation, could have a significant effect on the upgrading of domestic firms' innovation capacity.

The knowledge transfer infrastructure should be strengthened

Technology transfer offices and science and technology parks often have limited financial and human resources, which hinder their ability to support SMEs upgrade their innovation capacity and collaborate with academia. New approaches such as technology transfer alliances could help strengthen knowledge transfer institutions and reach critical mass and higher quality of services.

Chapter 1. Assessment and recommendations

1.1. Introduction

Portugal aims to develop a more innovative and productive economy, and to ensure that the benefits of these developments are widely distributed across society and the regions of Portugal. This vision is reflected in a range of national documents including the Government Program of the 21st Constitutional Government, 2015-2019 (*Programa do XXI Governo Constitucional – 2015-2019)*. Key aspects of this vision rely upon investment in higher education, research and innovation to achieve two main goals:

1. **Rising prosperity**. Portugal seeks to improve the provision of higher education and accelerate innovation in its commercial life to raise the productivity of its economy. Innovation should occur through the knowledge-based modernisation of traditional industries, permitting businesses to move up the global value chain and export more effectively; in the further development of newer industries with high growth potential (such as IT or renewable energies); and in public services and civic life, permitting increased effectiveness in governance and greater capacity to address contemporary problems, such as environmental challenges and sustainability. Innovation is to be nurtured by raising the skills of Portugal's population through higher education and life-long learning, and by widening internationalisation – by making Portugal more attractive to knowledge-intensive foreign direct investment, highly-skilled immigrants and the Portuguese diaspora.
2. **Inclusiveness and equity**. Portugal seeks to ensure that the benefits of increased innovation and productivity are experienced by all sections of society and all regions of the country, metropolitan and rural.

Portugal made progress toward these goals prior to the 2008 crisis, which resulted in severe reductions to public and private investments in knowledge and innovation. The country's ability to achieve fully this vision depends upon many factors. Among these are cultural, regulatory and fiscal environments that promote and reward creativity, and investment in the development and application of new knowledge and skills. Equally important is the performance of innovative, productive, internationally oriented businesses, higher education institutions and research units, which operate and are connected through effective networks and supported by sound governance and funding mechanisms and structures.

This second element – which encapsulates the higher education, research and innovation 'system' – is the focus of this OECD Review. The key objective of the Review is to assess the extent to which Portugal's higher education, research and innovation system is well-configured to help Portugal achieve the vision of inclusive innovation, and to identify which policy options might help it achieve its goals.

The review focuses on the structure and operation of higher education, research centres and innovation-related bodies that form a core part of the higher education, research and innovation system, as well as direct public support for research and innovation in the

business sector and public services. While the broader legal, regulatory and fiscal environment – such as immigration or intellectual property rights policies – also influence the capacity of firms and public services to invest and innovate to promote economic and societal development, these are outside the scope of this review.

1.2. What does an effective HERI system look like?

Different national economic and social contexts mean that what works in higher education, research and innovation in one country may not work in another. There is no single recipe for success that can be applied internationally. However, in order to provide a meaningful assessment of the performance of the Portuguese HERI system – a view of what is working well and less well – and to formulate appropriate recommendations, some criteria against which to judge performance are required. We therefore draw on knowledge of effective HERI systems worldwide and the many insights gained through the research and fieldwork in Portugal to develop a set of broad features that would characterise an effective HERI system in the Portuguese context. These core characteristics, which frame the assessment, can be summarised as follows:

1. **Opportunities and incentives for engagement and co-operation across the system**. In successful systems, a wide and appropriate range of people with relevant knowledge and interests are involved in formulating and agreeing objectives, implementing activities and adjusting strategy and implementation to changing circumstances. Successful systems are characterised by strong co-operation across institutional and organisational boundaries. This includes effective co-ordination and co-operation between different parts and levels of government (horizontally between different ministries and agencies, and vertically between national and regional authorities), and between public authorities, higher education and research institutions, businesses and civil society.
2. **Clarity of objectives and steadiness of rules and policy**. Successful research, innovation and higher education systems are guided by a clear and shared vision of overall objectives and characterised by a stability and predictability – by steadiness – in the main strategic, regulatory and financial frameworks in which organisations and individuals operate. This enhances the level of trust between the different actors of the system and permits them to set and act upon medium to long-term plans – for hiring, investing, co-operating – with confidence. Operational entities within the system – such as research units or higher education institutions – also establish broad strategies to provide additional clarity about their specific missions and goals and help frame the work of their staff.
3. **Internationalisation**. Successful systems are open and attractive to the world. This means not only that there is strong co-operation between players in the national system and partners in other countries, but that the system is able to both attract talented researchers, teachers, innovators and entrepreneurs from abroad and ensure the international mobility of their domestic counterparts. Internationalisation is seen as a particularly important characteristic in Portugal, given the country's comparatively small size, tradition of openness and dependency on international trade.
4. **Adequate and stable resources, joined up to incentives for good performance and accountability for results**. Organisations and individuals in successful systems have access to adequate and predictable financial, human and knowledge

resources to allow them to undertake their activities effectively; where and when public intervention is justified, they are supported and incentivised to achieve good performance against agreed goals; and held accountable for the results they achieve.

5. **Flexibility, adaptiveness, and differentiation**. Within the stable and predictable frameworks highlighted above, successful education and research systems allow organisations and individuals act with flexibility, differentiating their institutional profiles, teaching, research and innovation-related activities to respond to the needs of their target populations, community, region, or global knowledge partners. Adequate flexibility and differentiation are particularly important for achieving objectives related to social and territorial cohesion, as teaching, research and innovation need to be adapted to the needs of particular individuals and particular places. The legal, regulatory, and funding frameworks within which organisations and businesses operate permit them to work with agility and are responsive when individuals and organisations need to adapt their activities to changing circumstances.

The strengths and weaknesses of Portugal's higher education, research and innovation system were examined in light of this framework,[1] with chapters focusing on six inter-related aspects of the system:

- *Chapter 3 - Governance, Strategy and funding in the HERI System*: examines the overall strategy that has been agreed at system level, the structures in place that allow strategy to be agreed, implemented and amended over time, and the availability and allocation of public resources for investment to support achievement of the overall strategy.
- *Chapter 4 - Missions, profiles and resource use in :* examines missions and strategies of higher education and research institutions and the ability of institutions and staff to effectively design and implement activities that respond to the needs of the population groups and regions they work with and contribute to institutional and national goals.
- *Chapter 5 - Higher education provision, access and support mechanisms:* effective undergraduate and Master's level education is crucial for supplying the large body of skilled people needed by modern economies.
- *Chapter 6 - Doctoral training:* the quality and relevance of training for PhD candidates and the ability of doctoral graduates to access quality jobs where they exploit their skills. The availability of trained researchers and specialists may be seen as a factor in further developing national research capacity and stimulating innovation.
- *Chapter 7 - Academic carreers*: examines the extent to which the conditions and the organisation of employment in higher education and public research institutions contribute to the effective deployment of skilled people and allow staff to pursue fulfilling and productive careers.
- *Chapter 8 - High-skilled employment, co-operation with HEIs and innovation in the business sector*: examines activities designed to support the development of innovation and the kinds of high-skill employment that support innovation in the wider economy in Portugal, in the business sector and public services.

1.3. Governance, strategy and funding in the HERI system

The ability of individuals, teams and institutions engaged in education, research and innovation activities to perform their roles effectively is influenced to a considerable extent by the strategy and funding environment in which they operate. Effective governance arrangements and practices are essential to ensure strategic and policy decisions are made with adequate co-ordination between different parts and levels of government.

These should result in a clear mid- to long-term vision, concretised in ambitious and realistic objectives and plans to inspire and guide higher education, research and innovation activities. The latter, along with a broad set of stakeholders, should be involved with policy makers in the development of this strategy. Its effective implementation depends in great part in the country's capacity to set up a stable and efficient framework for allocating resources to tertiary education, research and innovation actors based on the collectively established national priorities and monitoring of their execution and effects.

Policy Issue 3.1. There is no overarching and coherent national strategy to guide the system in the mid to long term

The formalisation of the governance structure of the higher education, research and innovation system in Portugal started later than in other European Union (EU) countries, following Portugal's accession to the European Economic Community in 1986. This process, driven in large part by the requirements set by the European Commission to steer and manage the different generations of Structural Funds, resulted in a multiplicity of strategic plans and priorities. Several strategic documents coexist, at different levels and covering various components of the system (research, innovation, specific sectors). This contrasts with other OECD countries, such as Germany and Norway, which have developed authoritative, if not unique, national research and innovation strategies. There is a clear divide between strategies related to research and innovation, reflecting the silos in which the ministries in charge of these policy fields operate, and each ministry has only limited monitoring, evaluation and foresight capacity to support the development of these strategies.

This crowded and fragmented strategic landscape has several harmful consequences. First, there is no clear, overarching and shared national strategy in place to provide a vision and guide the higher education, research and innovation system in line with national priorities. The coexistence of several distinct strategies has led to multiple, sometimes inconsistent, messages and goals. Second, this makes it difficult to prioritise and target resources to create critical mass in areas where the country's research and higher education systems can excel. Finally, these many strategic initiatives, which accumulate with no action plan and little monitoring, fail to provide a stable mid-term financial framework that allows research organisations to operate and invest confidently in ambitious research, innovation, and higher education activities.

The 2018-2030 Innovation Strategy adopted by the Council of Ministers in March 2018 is a positive development as it covers the research and innovation policy fields and sets economic development targets, although not always precise. However, the document is very short and broad, only available as an annex to a resolution of the Council of Ministers. Apart from referring to already existing programmes and initiatives, it does not provide information on actions and resources. These features make it unlikely that the Innovation Strategy will provide either the overall vision or the roadmaps of future actions. It could

however, if implemented and monitored, be useful as an inter-ministerial co-ordination tool.

National policymakers have taken strategies initially developed to guide the allocation of Structural Funds and used them to support key performance indicators (KPIs), as well as monitoring and evaluation. This is done, for example, in the "Research and Innovation Strategy for Smart Specialisation" adopted in November 2014. The result is a document in which strategies are too procedural and centered on implementation issues to provide a comprehensive and aspirational vision for the development of the national higher education, research and innovations system.

International experience shows that the benefit of a strategy often stems as much from the process of creating it as from its results. Strategies are not the result of a top-down approach that imposes priorities; they should engage a broad range of stakeholders, from the research community, funding agencies, business, and civil society to regional and local governments in policy making and implementation. Portugal has made recent progress on this regard. Although it is too early to assess these initiatives, the participatory approach adopted to develop the 2014 Smart Specialisation Strategy, along some recent national initiatives, mark a shift in policymaking style toward a greater participation of stakeholders in higher education, research and innovation policy.

Recommendation on establishing an overarching national strategy

3.1. Adopt an overarching National Strategy for Knowledge and Innovation covering and providing clear guidance to higher education, research and innovation funding and steering organisations

Based on an appropriate bottom-up consultation and engagement process, a dedicated high-level task force should oversee preparation of a formalised National Strategy for Knowledge and Innovation for Portugal. This strategy should not only make it possible to set priorities in line with socially desirable goals, but also set a predictable and stable funding framework (see recommendation 4 below) and improve the co-ordination and communication among the main government bodies. This document should include:

- A vision of how the Government wishes to see the Portuguese economy develop through innovation in the next decade, including identification of sectors with greatest growth and innovation potential.
- An assessment of the broad skills and education attainment profiles, research capabilities and collaboration with firms and non-profit organisations that will be needed to support the development trajectory the government wishes to see.
- An account of the regional and social dimensions of education, research, innovation, and on the prospects for the benefits of increased productivity and innovation to be shared.
- An assessment of the capacity of Portugal's higher education, research and innovation actors to support the nation's innovation policy goals.
- Identification of the overall funding levels that the nation's higher education, research, and innovation actors are likely to need to achieve. The initial timeframe for the actions could be four years, with a broad multi-annual budget allocation attached.
- Specification of procedures for monitoring progress against the goals for the strategy and for periodic revision of both global objectives and specific actions (after the initial four-year timeframe).

The national Knowledge and Innovation Strategy should provide a clear framework to guide the internal strategies of implementing bodies and funding agencies under the MCTES and Ministry of Economy (such as the FCT and ANI), while leaving these bodies adequate room to devise the best policy tools and precise prioritisation of actions to achieve the overall goals. The Ministry of Planning and Infrastructures should also be involved to establish effective linkages with EU Cohesion Policy.

The timing of the Strategy should make it possible to set long-term orientations as well as actions required in the short- and medium term. Following the example of the Norwegian Long-term plan for research and higher education, a national strategy could have an eight to ten-year time horizon, with a rolling cycle of revision every four years. Another option, similar to the Spanish National strategy for research and innovation, would be to have an overarching strategy with an eight to ten year time horizon, with four-year research and innovation implementation plans providing more detail on specific objectives, defining the instruments, and funding, etc.

The timing of the Strategy should also be properly aligned with the ESIF programmes. The main orientations included in the new Knowledge and Innovation Strategy should be the basis for the development of the content of the next generation of Operational Programmes for EU Structural Funding for the period 2021-2028, in particular in the 'competitiveness' and 'human capital' areas.

Policy Issue 3.2. The capacity to develop an overarching strategy and set priorities is hindered by insufficient co-ordination across government

The absence of an overarching national strategy and weak priority-setting results, in part, from a lack of horizontal policy co-ordination. Mechanisms that ensure coherence of decisions between the government departments and policies dealing with higher education, research and innovation and between these departments and those responsible for broader economic, social and regional development policies are not sufficiently developed. As in many countries, the divide is particularly prominent between the research and innovation policies.

This appears clearly in the co-existence of three distinct advisory councils, the Co-ordinating Council for Higher Education (*Conselho Coordenador do Ensino Superior*) (CCES), the National Council for Science and Technology (*Conselho Nacional de Ciência e Tecnologia*) (CNCT) and the National Council for Entrepreneurship and Innovation (*Conselho Nacional de Empreendedorismo e Inovação*) (CNEI) in charge respectively of higher education, research and innovation. In practice, under the current government, the two latter councils have met infrequently and the CCES has become *de facto* the only active advisory council to the MCTES, touching on subjects that go beyond the theme of teaching and learning. It however lacks the clear mandate and sufficient resources to act as an independent advisory body which combines higher education, research and innovation. Similar silos exist at ministry levels. At funding agency level, the participation of the MCTES, via its research agency FCT, in the joint board overseeing the National Agency for Innovation (*Agência Nacional de Inovação*) (ANI) theoretically allows for some co-ordination between the two ministries in the area of innovation. Interviews conducted among agency staff and members of its governing bodies tend to show that this "hybrid" governance of ANI has had little effect on bridging the gap between research and innovation policies.

Portugal stands out due to its absence of clear formal institutional arrangements that can support high-level, cross-ministerial co-ordination, planning or decision-making. While administrative and policy silos exist in many countries, the latter have often set high level advisory and co-ordination bodies with a broad remit. Co-ordinating bodies in Portugal cover only part of the higher education, research and innovation system. These bodies are often linked to a particular government and have a limited longevity that does not allow them to establish firmly their legitimacy.

Another divide results from the fact that some other ministries have direct competence in the area of R&D, in particular via the State Laboratories under their direct control. However, some State Laboratories are jointly co-ordinated with the MCTES and the sector has been significantly reduced in recent years, limiting the impact of this divide.

The considerable volume of resources from European Structural and Investment Funds (ESIF) in Portugal dedicated to higher education, research and innovation means that the strategic and operational bodies to administer these funds are important actors in the strategic governance and implementation of policies in these fields. This specific structure of governance has improved in response to repeated criticisms regarding the lack of co-ordination between the related Programmes (Competitiveness, Human Potential, etc.). However, the governance structure put in place for Structural Funds is primarily ensuring effective disbursement of funds in line with Operational Programmes, which have been agreed with the European Commission.

Recommendations to strengthen national co-ordination

3.2. Establish a high-level task force at inter-ministerial level to take political responsibility for development of the shared national knowledge strategy, taking into account stakeholder input

Establish a task force at the inter-ministerial level bringing together, at a minimum, the Ministers for Science, Technology and Higher Education; Economy; and Planning and Infrastructure, to take responsibility for the development of the new national Knowledge and Innovation Strategy. Direct involvement of the Minister of Finance would be beneficial, providing the body with input with respect to macroeconomic and fiscal constraints.

The high-level task force with the initial task of developing and adopting the Strategy should be established for a fixed length, meeting formally every few months. A secretariat of policy and analytical staff drawn from respective ministries should support the task force.

While principally responsible for the development of the Strategy, the task force could be a first step toward a permanent inter-ministerial co-ordination council that would provide orientations of the higher education, research and innovation policies in a horizontal setting.

For a national knowledge and innovation strategy to be effective, it must be informed by the expertise and perspectives of those working directly in knowledge-intensive sectors of the economy and those who carry out research and education, taking into account the views of a wider range of relevant stakeholders.

To engage knowledge and expertise in the country – and to ensure a future knowledge strategy has wide support – the high-level ministerial task force should organise a wide-ranging consultation and engagement exercise, going beyond the sectoral consultations so far undertaken on elements of current strategy. Existing sectoral advisory groups, including the Co-ordinating Council for Higher Education can play a key role in convening stakeholders and providing input to this process. The secretariat supporting the task force should prepare a consultation document – equivalent to a green paper – outlining initial proposals and options for the priorities and action lines for a national knowledge strategy, to which stakeholders can react. The consultation exercise could involve a combination of moderated discussion events and written submissions. The process of preparing the consultation document, undertaking the consultation and collating input is likely to take at least 12 months.

3.3. Strengthen analysis, foresight and management capacity in government

The development and monitoring of a national strategy should be informed by accurate information on what is happening in innovation, research, and education, and by foresight on developments in the international economy and technology. To meet these needs, an analytic unit drawn from ministries responsible for the strategy's development and implementation should be established. This unit should provide ministers a detailed report every two years. These reports should inform the process of periodic revision of the national knowledge and innovation strategy, every four years, for example. The monitoring of public expenditure related to the strategy would be facilitated by the creation of a specific budget category in national accounting protocols, consolidating spending on Higher Education, R&D and Innovation.

Policy Issue 3.3. The future role of State Laboratories in Portugal's research system is unclear

Over the last 20 years, the importance of State Laboratories in the Portuguese research system has been reduced, as staff numbers and budgets have fallen. Despite these changes, State Labs still represent a significant investment of public resources. However, there is no overall strategy guiding the work and future development of State Labs and limited co-operation between them. Rigid staff regulations also hinder their ability to respond rapidly to changing requirements.

As in most countries, the ability of the government to steer these research institutions, mainly through competitive funding incentives, is limited, especially when it comes to enhancing their contribution to addressing the mounting societal challenges. Several countries have reformed their government sector to better address the challenges related to climate change, aging, food security, etc.

Recommendation to ensure the contribution of state Laboratories to the national strategy in HERI

3.4. As part of the renewed national knowledge strategy, define the future role of the state laboratories with a view to maximising their contribution to Portugal's development and addressing societal challenges.

The development of the new national knowledge strategy (Recommendation 1) should include a comprehensive review of the role of the State Laboratories and the formulation of a clear development strategy for these bodies. Portugal can seek inspiration from other OECD countries in its efforts to steer and modernise its public research sector. In Spain, for example, state laboratories have been brought under the direct supervision of the ministry in charge of research and the researchers were integrated into a single research professional group in order to favour inter-organisational mobility. In Sweden, government research institutes have been transformed into non-profit companies and all their shares transferred to a common umbrella body, itself a non-profit company (RISE – Research Institutes Sweden). The role of the umbrella body is to maintain a dialogue with business and the co-owners, steer the RISE institutes, allocate strategic development funding, represent the institute sector in various contexts, lead the branding effort in Sweden and internationally and to evaluate the benefits and impacts of the state's investment in RISE. Another option would be to established performance contracts for all the state laboratories.

Policy Issue 3.4. The resources allocated to higher education, research and innovation are not aligned to an overall strategy or the level of ambition of the government

Once an overarching strategic framework has been set, policy implementation comes down to the commitment of financial resources that are commensurate with the level of ambition and in line with the strategy in place.

The financial crisis of 2008 put a halt to the strong and unprecedented increase of public and private R&D investment during the period 2000-09. Gross expenditure on research and development from all public and private sources has fallen drastically, before picking up in the last two years. However, these funding increases appear far from sufficient to meet the very ambitious objectives related to European convergence recently set by the government in 2018. This goal would require multiplying public R&D expenditures by two and, even

more challenging given the structure of industry and the nature of the labour force, private R&D expenditures by four. This represents a level of growth of funding over a duration that Portugal has not previously achieved, even prior to the crisis. Experience shows that setting R&D intensity targets that engage actors is a delicate process, where ambition and realism must be balanced so that they are deemed credible and can become a shared national goal. Moreover, such growth would not consistently contribute to innovation and productivity growth if made using existing governing mechanisms and allocation processes. Major reforms will be required to change the structure of industry and services, as well as to reform the governance of the public research sector.

Of equal importance is the stability of the funding being allocated, so that HERI actors can plan their activities in confidence. Not only have funding levels in Portugal proved unpredictable, but funding methodologies and criteria change frequently, complicating planning and access to finance for research organisations and firms.

Finally, funding schemes should be accessible without disproportionate costs and administrative efforts, which is not the case in Portugal where the complexity of the management of the R&D funding programmes and the administrative burden for the applicants has increased significantly. The increased efforts needed to participate in competitive schemes combined with decreasing success rates act as a deterrent to participation in public support programmes.

Policy Issue 3.5. Funding allocation processes at agency level are not adequate to implement national priorities

To have an effect, the research and innovation priorities set at the system level – by government in consultation with stakeholders – need to be translated into relevant activities on the ground. One key 'transmission belt' of these priorities is the funding allocated by agencies. In Portugal, the FCT has been an influential actor from the very early years of the development of the system, well before the agencification process that most OECD countries have experienced in the last two decades. It is by far the main actor for the competitive funding of research at institutional, project and individual researchers levels.

The dominant funding approach, in the system as a whole and within FCT more specifically, has been 'bottom-up'. Research proposals are selected based primarily on merit, without any *ex-ante* prioritisation of research domains and disciplines. Although selection based on excellence is a feature of the most efficient research system around the world, the lack of explicit allocation criteria for the resources among thematic areas results in a scattering of resources and does not allow the government to support the transformation of the HERI system in line with national development goals.

FCT effectiveness is also hindered by the types of linkages established, upward, with its line ministry (MCTES) and, downward, with the research communities. This configuration results in a low level of effective autonomy of the agency vis-à-vis both its 'principal' and its 'beneficiaries':

- There is no formal process for the ministry to convey strategic orientations and targets to its research agency and the head of FCT is also responsible for serving as the Director General for Research at MCTES. In many OECD countries, agencies are separate from their line ministry, and are governed by performance contracts negotiated between the agency and the ministry.
- The independence of the FCT from the scientific communities represented in its Scientific Councils is undermined by the agency's internal governance

arrangements. These are characterised by fragmentation between disciplines and the absence of strong power at the strategic management level of the agency.

Recommendation to ensure predictable and strategic funding environment for the HERI system

3.5. Use the Portugal Knowledge and Innovation Strategy to set a predictable funding environment for the nation's higher education, research, and innovation system.

The analysis and advice of task force – based upon wide engagement across relevant Ministries within government and careful wide public consultation – should provide government, with the endorsement of Parliament, with an opportunity to establish a high-level, multi-year commitment of public funding in support of higher education and research. With this funding framework agreed, MCTES can deliver multi-year research funding through FCT and educational funding through its institutional subsidies in ways that predictable, aligned to national priorities, and at a level adequate to achieve needed reforms identified in the review.

While the Knowledge and Innovation Strategy would have a long-term time horizon, the funding framework linked to it would be for a shorter duration, such as four or five years. In Norway or Spain, for example, a national strategy contains a long-term perspective for and a mid-term rolling plan with financial commitments. The strategy is revised every four years for instance, adapting the long-term orientations as needed, and agreeing upon a new funding framework for the four years to come.

3.6. Reform the FCT, increasing its capacity to effectively balance national research priorities and the priorities of the nation's scientific research communities.

The institutional arrangements between FCT and MCTES should allow the ministry to provide clear guidance and associated resources to the agency on a multi-annual basis and monitor the performance of the agency in implementing these orientations. Such arrangements could take the form, for instance, of multi-annual letters of assignment or performance contracts negotiated between FCT and MCTES, setting out clear objectives and planned resources in line with the national knowledge strategy.

The independence of FCT in the fulfilment of these objectives should be strengthened by institutional reforms such as the dissociation of the roles of Director General for Research Planning and President of FCT. More radical reforms could also be considered, including a change of the current 'Public Institute' status of FCT, which provides only limited administrative and financial autonomy, into a public Foundation status. The latter option would also increase its operational flexibility.

The capacity of FCT to put in place the necessary measures to fulfil the objectives assigned to it should be also strengthened by changes of its internal organisational structure to ensure increased autonomy vis-à-vis the scientific communities it funds. A key condition of this autonomy is a clear separation between the "scientific evaluation" bodies and the "decision making" bodies that assign the indicative allocations of resources per areas, instruments. Potential options include notably the creation of an FCT "General Advisory Council", with a broader scope and stronger role than the current *Conselho Consultivo*, and changes to strengthen the FCT "Governing Board" (*Conselho Directivo*) with the appointment of additional members.

Wider autonomy vis-à-vis funded scientific communities should be complemented by a review of its scientific panel structure, to ensure that the FCT is capable of responding effectively to new knowledge needs, and to a range of research communities that are applied, clinical, or transdisciplinary.

1.4. Missions, profiles and resource use in HEIs

High-performing research and innovation systems have higher education institutions that have profiled themselves in areas of activity where they are strong – or have clear potential to be strong – and differentiated from other institutions with like missions in the system. Further, their HEIs engage with external partners at regional, national or international level in ways that are aligned to their mission and profile.

Well-profiled higher education institutions result from well-designed public policies. Specifically, they arise from legal, regulatory and financial frameworks that provide clarity about the missions of HEIs, establish institutional autonomy sufficient to permit institutions to set their profile, support leadership and management capacity to implement these strategies, and allocate resources in a way that is stable, sufficient, and linked to good performance and accountability.

Systems that function in this way benefit society. They do this by ensuring adequate diversity in the types of education provided, by responding effectively to the distinctive needs of their localities and regions, by avoiding unnecessary duplication in teaching and research to increase efficient use of resources, and by encouraging the concentration of activities to create internationally competitive centres of excellence in research and innovation.

Policy Issue 4.1 Portugal's balance of higher education institutional missions is imperfectly aligned to its national and regional needs

Higher education systems that have a network of higher education institutions with strategically differentiated missions are best able to meet a wide range of national needs, including diversified educational provision, high quality research activity, and regional engagement.

Portugal's modern higher education system was planned to have a clear binary line, organized by areas of conceptual knowledge (universities) and professional knowledge (polytechnics). However, in the decades since the inception of its binary system the missions of Portugal's higher education institutions have become overlapping, and less differentiated than is possible. Its public higher education institutions tend to attempt a wide range of disciplines in their educational offering at the first degree (undergraduate) level, rather than specialising, and to offer instruction across a range of study levels, rather than concentrating on one part of the study cycle. This is driven, in part, by pressure to maximise enrolment and the fee income that comes with each enrolled student, and by a desire on the part of institutions to shape and enhance their reputation. It also results from the limited use of ministerial steering to maintain and shape the nation's binary divide. The funding methodology used to support the core operations of higher education institutions does not take account of institutional teaching and research profiles, and the ministry does not have a process by which its reviews and approves new programmes in public higher education institutions with a view to their alignment to institutional mission and profile.

While Portugal has a growing research output led by its universities, many of the nation's 14 public universities have modest research profiles, and award few doctoral degrees in a limited number of fields. Conversely, some programmes or schools within polytechnics have significant research programmes, host or participate in R&D centres, and collaborate in training or hosting doctoral students from Spanish or Portuguese universities.

Growing relationships between universities and polytechnics in the training and hosting of PhD students and the widening participation polytechnic researchers in R&D Centres and Associated Laboratories together point to emergent model (or models) of doctoral education for polytechnic institutions. For example, one model would be to authorise doctoral awarding authority for selected polytechnic programmes or colleges. This authority might award a programme or college when conditions satisfies certain conditions of excellence and relevance. These first of these conditions could include participation in a multi-institutional doctoral programme with a public research university; hosting an FCT R&D Centre evaluated as very good or excellent, or participation in an Associated Laboratory. The second condition might be assured by having external stakeholders evaluate the proposed programme to ensure that it is distinctively professional or practice-focused in its profile.

Recommendations on modernising the diversification of institutional missions

4.1. Rebalance the missions of Portugal's higher education institutions to ensure that nation has a diversified network of institutions, the missions of which are well-aligned to national and regional needs.

Continue lines of policy from the past decade that have been effective in developing diverse capacities, including establishing a PhD requirement for polytechnic academic careers, supporting applied research through the Polytechnic Modernisation and Valorisation Programme, and awarding R&D centre designations to leading polytechnic research groups. International experience with initiatives such as the Modernisation and Valorisation Programme suggests that about five years of support are required to achieving substantial and lasting change through targeted grant making.

Develop a regulatory capacity in MCTES to systematically review and approve new educational programmes at the bachelor level and integrated master degree levels to ensure they are well-aligned to the mission of institutions in each sector, and to the institution's own strategic profile. This process should be clearly differentiated from (though complementary to) external or internal quality assurance procedures, and operate with clear and simple rules that permit institutions to take forward new programme proposals with confidence that alignment to mission and profile will result in swift approval. Alternatively, MCTES could continue rely upon the annual allocation of additional study places to public higher education institutions through the despacho orientador to ensure that programmes offerings are aligned to national policies. It could make this a more effective instrument of steering by providing public and prior guidance to institutions about its allocation priorities, and grounding these priorities in the nation's education, research, and innovation policy framework.

Modify, as necessary, the legal basis of accreditation and quality assurance processes administered by A3ES to ensure that its reviews adequately differentiate between theoretically-oriented university study programmes and practice-oriented professional education.

Review the organisation of postgraduate and its relationship to the knowledge and innovation needs of the country. Reassess responsibility for the conducting postgraduate education, for its funding, and for the assurance of its quality.

As part of this review, consider revising the legal basis for polytechnics, permitting the carefully controlled award of doctoral degrees by polytechnics. This should be permitted in applied research fields where institutions have a clearly demonstrated capacity to do so, and where there is a strong economic rationale for the offer of doctoral awards. Where there is a close connection between the work of polytechnics and universities – in fields such as agriculture – consideration should be given to joint doctoral programmes between universities and polytechnics.

A strictly controlled and strategically guided process of doctoral authorisation at the level of school

or faculty -- rather than the polytechnic as a whole -- is advisable. The authorisation process should require a clear demonstration of capacity for high quality doctoral training, evidence that the programme is aligned to the institutional profile and mission, and relevant to the economic and social needs of external stakeholders served by the institution. A programme approval process could require, for example:

- Approval by the polytechnic's President and General Council, in which the proposed doctoral programme is clearly linked to the institution's profile;
- Review by A3ES (as is done for university PhD programmes);
- Participation of the programme's academic staff in R& D centres recognised as very good, excellent, or exceptional by the FCT.
- Participation of the academic staff in a multi-institutional graduate school, organised along lines of discipline or professional specialisation, on the model, e.g. of doctoral training programmes in the Netherlands.
- An externally reviewed motivation for the proposed PhD demonstrating a close connection between the doctoral programme, professional practice and regional needs. This process would look for representatives of industry, the public sector, or voluntary organisations to identify how the high-level skills of doctoral recipients would be used to improve their organisation's products, processes, and practices.

A review of post-graduate education could consider applying many of these principles more widely, to university institutions.

Policy Issue 4.2. Higher education institutional autonomy and responsibility have expanded, but remain insufficient

Public HEIs in Portugal enjoy a moderate degree of autonomy in organising their internal management and structures in comparison to those in some other European countries. However, the level of institutional autonomy in many other key areas remains limited in Portuguese universities and polytechnics, particularly in public institutions that have not transitioned to foundation status. National legislation governing public sector employment, public procurement and financial management are burdensome, and limit the ability of institutions to plan and manage their operations efficiently and effectively.

Foundation status, expected to transform institutional autonomy, has accomplished less than expected. Take-up of foundation status has been slow and limited – ten years after the adoption of RJIES, only five public universities have obtained foundation status. At the time of the review, no polytechnic institutions had obtained foundation status. Universities have made limited use of the legal opportunities that foundation status provides to develop a workforce and career structure under private employment law, most especially among academic staff.

Legal uncertainty persists concerning key aspects of foundation status that impair its wider adoption and effective use. Uncertainty about the extent to which staff working under public and private labour law are required to have parallel conditions for advancement and compensation has led institutions to eschew private law hiring. Additionally, some foundation universities report that uncertainty about the status of private donations to universities – whether private donations are treated by state budget authorities as fully fungible with public funds, and therefore subject to "captivation" – has hampered the development of private donations to universities.

Recommendation on strengthening the autonomy of HEIs

4.2. Strengthen the legal basis of autonomy for public higher education institutions.

Pursue full implementation of the foundational status for HEIs and take additional measures to increase flexibility in financial management and procurement for public higher education institutions.

As a matter of priority, MCTES should pursue five initiatives to deepen and widen institutional autonomy.

a. To improve the effective use of foundation status among institutions that presently have foundation status, the analysis and recommendations put forward by the Co-ordinating Council for Higher Education should be implemented. The financial management provisions originally agreed by the Ministry of Finance in 2009 when foundation status was first awarded should be put on a statutory basis though amendments to the State Framework Law.

b. To support the effective management of all public higher education institutions, the rules of financial management agreed with Finance Ministry should be put on a continuing basis, rather than subject to annual renewal in the State Budget Law;

c. The Official Plan of Public Accounting for the Education Sector and the Public Contracts Code should be appropriately modified so their provisions do not apply to institutions with foundational status.

d. In near to mid-term future, Portugal should aim to extend foundation status to all of its higher education institutions. This will require that it revisit the criteria that it uses when proposing institutions for foundation status.

e. New tests for sound financial management should be adopted that permit all well-managed public higher education institutions to achieve foundation status. Revenue diversification is an unnecessarily restrictive proxy for an institution's capacity to manage soundly their finances; it effectively prevents many of Portugal's higher education institutions obtaining foundation status. With sound tests for financial management capacity and wise hedges against risk – such as requiring institutions to carry a reserve or "rainy day fund" -- budgetary balance need not be put at risk.

Policy Issue 4.3. Public spending is provided in a way that hampers sound financial management by higher education institutions

Providing core public funding for education and operations to higher education institutions on a historical basis makes the funding of institutions opaque, and establishes a weak relationship between the money received by individual institutions and their level of effort and performance.

Annual funding – with frequent "captivations" to balance public accounts and lengthy periods within the year during which institutions are not permitted to commit public funds allocated to them – is harmful in the short-run to sound and efficient institutional management, and in the long run, to the development of institutional strategy and close collaboration with commercial and community partners.

Multi-annual, transparent and performance-based funding plans have been adopted in law, but not fully implemented. Or, they have been proposed, but not adopted. Three basic obstacles have hampered improvements to core institutional funding.

- MCTES does not have highly developed performance monitoring capabilities and funding expertise, and thus it is not fully equipped to manage a funding process that includes (past) performance components or forward-looking and profile-oriented performance agreements.
- Changes to funding methodologies used by governments are typically implemented, in part, through the addition of new resources, not purely through the redistribution of resources among higher education institutions according to a new set of rules, since this latter path creates clear 'losers' and precipitates more conflict than can be managed. Portugal's fiscal crisis and subsequent public austerity have left it with little capacity to dedicate the new resources that would be needed for the reform of higher education funding.
- Multi-annual budgets cannot be achieved by the efforts of education ministries alone. Rather, they require a whole of government commitments, typically in the form of a binding agreement between government and the higher education sector, which Portugal has been unable to establish.

Recommendation on reforming public funding of HEIs

4.3. Reform public funding for higher education institutions, strengthening transparency and providing incentives for good performance.

Ensure a properly balanced institutional funding regime. The regime should (a) predictably funds the core activities of institutions, (b) reward institutions for performance in a way that is recognised to be fair, and (c) provide incentives for the development of forward-looking institutional profile. Portuguese authorities should aim for the development of a funding methodology that allocates approximately 80%-15%-5% of institution resources across these three funding pillars (activity; outputs; and future profile).

Funding to support core activities (80%) and performance (15%) could be delivered based upon agreed models that contain methodologies common to institutions within a sector. Funding to support institutional profiling (5%) could be based upon a multi-year performance agreement between the higher education institution and the Ministry of Science, Technology, and Higher Education.

Institutional profiles would necessarily vary, focusing in some cases principally on research and innovation, while in other cases on professional education and regional engagement. Profiles focused on research could be used, for example, to allow HEIs to better integrate R&D units into the institution's research strategy.

Each funding stream would, preferably, be based upon a multi-year agreement that is agreed between Ministry of Science, Technology, and Higher Education and the nation's public higher education institutions.

In order of sequence Portugal should introduce:

a. A profiling instrument providing funds to: a) set up profile and plan and b) report on annual progress on plan implementation, with 5% funding conditional on progress assessed on a multi-year basis. An MCTES-convened panel could review initial profiling agreements with international experts drawn from systems that have experience of well-functioning profiling instruments, such as Finland. International experience demonstrates that Ministries can adopt a profiling funding stream even on fixed funding levels, since it results in the near term in a modest redistribution of funding levels.

b. Performance-related funding based upon a formula that reflects a combination of agreed outputs appropriate to all institutions, and other output indicators calibrated to the sector. Examples of the former include number of graduates, while the former would reflect, for example, PhD job placement for institutions with a focus on doctoral education, and work-based learning placements for professionally oriented institutions. MCTES can implement performance-related funding by channelling annual, incremental growth into this funding pillar.

c. Activity-related institutional funding (e.g. enrolments by field of study) is needed to create fairness and transparency and provide stability. This aspect, while fundamental, should be the last feature of funding reform implemented, and adopted when non-incremental new funds are available to limit disruptive redistribution of budget shares among institutions.

Policy issue 4.4. Funding and steering policies do not encourage institutional profiling and division of labour

The Portuguese government does not require public higher education institutions in Portugal to identify areas of strength and weakness, to link those to the distinctive regional, national, and international engagements they wish to pursue, and to reallocate resources that permit them to build upon areas of strength in service of their external engagements. The funding, regulatory, and steering arrangements with which higher education institutions operate provide few incentives for specialisation or improvements in performance.

Higher education institutions are not required to develop profiles within a clear national policy framework, nor is there a mechanism to help co-ordinate profiling between institutions to ensure the system as a whole delivers what Portugal needs. In 2007 the OECD proposed a higher education co-ordination body (CCES) that would be responsible for developing strategic goals and priorities for the university and polytechnic sectors; a higher education planning framework flowing from these strategic goals and its subsequent monitoring and adjustment on an annual basis; and a broad set of objectives based on this higher education planning framework to provide the basis for the ministry's negotiation of performance agreements with individual institutions. These needs remain in the nation's higher education system.

Government provides institutional core funding in support of public higher education and infrastructure on a historical basis, without taking into account directly the specific missions and potentially differentiated needs and objectives of different institutions. There are no ongoing funding streams provided by MCTES to public higher education institutions that encourage institutions to engage in profiling their institution.

The delivery of research funding for PhD study by FCT has also limited the development of institutional responsibility and profiling among public higher education institutions. Public funding for PhD study and, historically, post-docs is principally allocated by the FCT to individual applicants proposed by programmes, rather than to institutions whose graduate profile is co-ordinated by, for example, a Vice-Rector or Dean of Graduate Studies. The direct line of national funding to research groups (including both the multi-year research 'core' and individual 'project' funding) – and the absence or weakness of institutional governance with respect to research and graduates studies – prevents higher education institutions from setting an institutional research strategy that is aligned to their institutional profile.

The weakness of institutional profiling and development strategies in Portugal has a number of consequences for the performance of the higher education, research and innovation system as a whole. Teaching, research and innovation activities in individual departments and institutions are largely planned and implemented in isolation, without reference to the goals of the institution as a whole, to the activities of other institutions in the system and broader national development goals. The lack of strategic steering can also lead to inefficient duplication, missed opportunities for collaboration and a weak alignment of activities on the ground with the needs of particular localities, population groups or the nation as a whole.

The absence of clear profiles and strategies for each institution makes the system as a whole less readable or transparent, particularly for students looking to choose an institution and institutions looking to differentiate themselves from – or collaborate with – peer institutions in other locations. Additionally, with respect to the research missions of higher education institutions, the absence of targeted policies supporting institutional profiling has led to a higher education system in which research capacities are not strategically concentrated.

Recommendations to strengthen the HEIs in making responsible use of autonomy within a framework of national priorities

4.4. Strengthen the capacity of higher education institutions to make effective use of expanded autonomy and responsibility.

If higher education institutions are to be provided wider autonomy and responsibility, they must have the capacity to effectively put them to use. There are two ways in which institutional capacity can be strengthened.

First, the capabilities of professional and administrative staff in higher education institutions can be augmented. Government should consider providing financial support for the training of professional managerial staff through higher education and management training programmes and opportunities for staff to participate in secondments to key partner institutions with robust management systems in, e.g., the United Kingdom, Switzerland, and North America.

Second, steering and funding policies should be evaluated – and revised – to ensure that they support institutional responsibility, rather than diminish it. For example: MCTES should revise FCT research funding policies so they support the capacity of institutional leaders to set and implement a co-ordinated research profile. While applications for research funding – whether for individual projects, R&D Centres, or Associated Lab status – should be evaluated on their scientific merit, proposals should also be evaluated with a second criterion: their alignment to the institution's vision of its distinctive profile as a research organisation. When funds are awarded to research organisations within the higher education institution, whether Associated Labs or R&D units, a share should be set aside at an institutional level – and matched by local resources – to support the development and implementation of an agreed institutional profile.

4.5. Strengthen the CCHE

Strengthen the CCHE, along the lines of the OECD's recommendations of 2007, so that it can function effectively in bringing sector priorities to national debates and priority-setting for science, technology and higher education, and provide a stable framework of national priorities against which higher education institutions can expected to develop institutional strategies. This strengthening should include the addition of a budget for research and analysis, and a professional staff adequate to its expanded mission.

1.5. Higher education provision, access and support mechanisms

An adequate supply of individuals qualified at tertiary level is widely recognised as a key factor in enabling economies to shift towards higher levels of knowledge intensity and allowing industries to move up the global value chain. Internationally, increases in tertiary graduate rates have typically gone hand in hand with improved adoption and absorption of technological and process innovations, advances in productivity and the wealth creation associated with this. These developments are driven by the advanced subject knowledge students acquire through tertiary education and the wider transversal skills sets they develop through pursuing their education to a higher level.

Despite years of growth in tertiary education participation in Portugal, tertiary education attainment rates remain below the OECD average and below EU and national targets for 2020 and 2030. In this context, the Portuguese system needs to further widen access to tertiary education, while also ensuring as many students as possible successfully complete their studies.

Effective higher education systems, with high levels of participation and completion, support and encourage diversity and flexibility in the provision of study programmes, while also ensuring their quality. Greater institutional and programmatic differentiation ensures that institutional profiles and activities respond to the varied needs and interests of their student population, and society, and support the development of a broad range of skilled individuals.

Policy issue 5.1. Differentiation and flexibility in modes of provision and pedagogical approaches remains limited, jeopardising Portugal's attainment goals

Notwithstanding Portugal's binary system and recent efforts to create greater diversity, the higher education system still does not provide sufficiently flexible and innovative programme provision, structure and curriculum, most especially for non-traditional student populations. Higher education programmes, including across polytechnics, often remain theoretical in focus, with limited co-operation with the outside world and a lack of attention to developing key competences students needed for the modern economy. Programmes often have rigid structures and are oriented to specific professions, providing students with limited flexibility in combining courses. Traditional teacher-centred methods with a large number of lecture-based contact hours still prevail. In particular, modes of provision are not aligned to the needs and interests of a more diverse student population. Flexible, part-time, evening and distance learning options are more limited than in many OECD countries, and opportunities to study on an accelerated or an extended basis are not widespread.

While acknowledging the current quality assurance system's accomplishments, the current quality assurance system also deters the introduction of more flexible, innovative, student-focused and competency-based programmes. As the system is moving towards a lighter touch model of quality assurance, based upon institution-level review, this could be an opportunity to shift from a rather prescriptive approach to one that encourages greater diversification and innovation in the development of new types of programme, instruction methods, curriculum and delivery modes.

Recommendation for improving flexibility in modes of provision and pedagogical methods

5.1. Further improve the diversity of the educational offer

Remove obstacles in quality assurance and funding systems that limit the capacity of higher education institutions to offer part-time, distance and blended short cycle, bachelor and master's programmes, and ensure that provision is adapted to a full range of students, including adult learners. Provisions in the guidelines that underpin A3ES decisions relating to quality assurance of programmes and unnecessarily limit flexible programme design and curriculum should be reviewed and eliminated.

Policy issue 5.2. Pathways from secondary to higher education limit further widening and social diversification of higher education access

Portugal has a centralised admission process to tertiary education known as the General Access Regime (*Regime Geral de Acesso, RGA*) which provides students with a transparent mechanism for admission and has also reduced the costs of students in applying to individual institutions, and the burden for institutions to manage applications. However, the RGA's national entrance competition, the *Concurso Nacional*, is based on the secondary leaving examinations that are aligned to the curriculum of generalist (scientific-humanistic) upper secondary education. The design of the national competition – combined with the rapid expansion of secondary professional education, which now comprise about 44 percent of upper secondary students – has resulted in tertiary entry examination regime that is no longer aligned to the contemporary profile of upper secondary education, or to the nation's attainment goals.

Students who are outside the scientific-humanistic track in secondary schools are required to take an examination in subjects which are not part of the curriculum they have followed, putting them at a disadvantage to enter higher education. About 8 in 10 students (79%) completing the scientific-humanistic track entered higher education one year after completing their studies, while 16% of those completing secondary professional track continued directly to higher education – 6% enrolled in a bachelor programme and another 10% enrolled in a *Higher Professional Education (Cursos Técnicos Superiores Profissionais* - CTeSP) programme.

Portuguese education authorities recognise that the current entry regime for tertiary education now hampers wider access to tertiary education, and have organised consultation processes to identify policy responses.

Recommendation to widen access to higher education

5.2. Revise the higher education entrance examination system to ensure it is appropriately adapted to students from upper secondary vocational education.

To widen access to higher education, the entrance examination system for higher education should be aligned to the needs and profiles of students from both secondary professional and scientific-humanistic tracks. Following the option identified by the Working Group on the Assessment of Access to Higher Education (Grupo De Trabalho Para A Avaliação Do Acesso Ao Ensino Superior) in 2016, we recommend the addition of skills-focused examinations that reflect key aspects of the secondary professional curriculum to ensure that the knowledge and skills of students from vocational streams are properly recognised. Specifically, secondary school leaving and higher education access exams (Exames finais nacionais do ensino secundário e acesso ao ensino superior) should be designed to include additional modules that are aligned to the curriculum of the vocational stream. These should be accessible in principle to all upper secondary students, and be used to govern access to relevant programmes in polytechnics and universities. Vocational modules should be developed through co-operation between higher education and upper secondary educators. This will be essential to ensure take-up of the reform by students and higher education institutions, and the proper alignment of examinations to both the secondary curriculum and higher education programmes. It is crucial that new access routes be carefully developed and implemented with the wide engagement of HEI stakeholders.

In parallel, the Ministry of Education should ensure that the growing share of secondary professional students who continue to higher education are adequately prepared for success in their programmes, using feedback reports to equip teachers, school leaders, and families with evidence about the post-schooling trajectories of upper secondary professional students.

Policy issue 5.3. Financial and academic support for students

Portugal offers need-based grant assistance to about one in five higher education students, with modest additional support through public lending and specially targeted support. Nonetheless, some basic design features of the student support system are not fit for purpose, particularly for the government's target audience: young adults who completed a secondary education and directly entered the labour market, or who began but did not complete a higher education degree. For example, the low threshold of eligibility for social scholarships means that a working adult who earns a (fulltime, full-year) minimum wage has a household per capita income in excess of social support eligibility.

Portuguese higher education students are provided quite limited access to academic support and guidance services. Higher education institutions serving students at high risk of attrition have not yet developed institutional capabilities to systematically track, contact, and support students who experience academic difficulties. Portugal has taken steps in recent years to develop an integrated student-level education data system that collects and disseminates data on the higher education sector, including indicators on enrolment, completion and labour market outcomes. This work needs to be completed to ensure that students have information about the risks and benefits of higher education when making choices about what and where to study.

Recommendations for ensuring adequate financial and academic support

5.3. Improve student financial support policies

The current system of social scholarships should be subject to a rigorous review of its effectiveness in permitting all who might benefit from higher education to study.

The +Superior grant programme should be reviewed. If the programme cannot be designed so that grants are awarded prior to enrolment decisions – and therefore only subsidising enrolment decisions that have already been taken, then the programme should be discontinued, and those resources re-invested in other student support programmes.

Financial support policies for students should be adapted to the needs of working adults. For example, the aid eligibility methodology for social scholarships could adopt an income protection allowance for working adults. This allowance would permit those whose incomes are near the minimum wage to have some part of their earned income exempt from household per capita income calculations used to determine scholarship eligibility.

5.4. Adequately support students making the transition to higher education

Special attention should be given to ensuring that students are well-prepared and supported to complete higher education. Specific additional measures could include incentives (through performance agreements or other appropriate means) for higher education institutions and their staff to develop systematic co-operation and short-term staff exchanges or shadowing opportunities with upper secondary schools to help smooth and support transition to higher education. Co-operation and exchanges are potentially useful to raise awareness among students in secondary schools concerning the focus and challenges of higher education, so they can better prepare themselves. Moreover, they identify and increase understanding among teachers in both sectors of the biggest 'gaps' between what secondary education equips students to do and what higher education teachers expect them to do.

Additionally, developing and implementing systems at the higher education institutional level to monitor students' performance and to signal difficulties would be an effective way to support early intervention and promote student success. Information on students' academic performance (including particular deficiencies and gaps) could also be provided to upper secondary institutions through feedback reports, for example, to help review and recalibrate schools' curriculum and teaching practices.

5.5. Encourage higher education institutions to offer more extensive academic and social support to students, in particular for students from disadvantaged backgrounds and mature students

To improve student success and to encourage adults to return to education, higher education institutions that offer well-designed social and academic support to students, such as career guidance, remedial courses, tutoring or psychological counselling, should be rewarded through performance-based funding. The institutional support practices eligible for funding should be evidence-based, and well-adapted to the profile of students served by the HEI.

5.6. Provide targeted support to encourage pedagogical training and reward good teaching performance.

Portugal should encourage and support pedagogical training for academic staff, targeting both new and established staff members and reflecting the diversity of requirements across student groups and institutions and increasing flexibility of the educational offer. Although some countries (such as the UK) have developed national academies focused on pedagogical development, others (including the Netherlands) have provided public funding to pedagogical capacity building initiatives organised by individual or groups of HEIs. Such an initiative could initially be supported in Portugal through

pilot projects in selected HEIs. Additionally, the Portuguese government should explore ways to encourage institutions to include teaching performance as a key element in transparent, institution-wide systems of evaluation and promotion.

It is important for Portugal to include improvement of learning and teaching as a core objective in its national strategy for higher education and in institutional agreements to raise the profile of the issues at stake and incentivise action at institutional level. Key objectives should be increasing uptake of effective pedagogical approaches for skills development (problem-based learning, flipped classroom, use of technology etc.) and greater co-operation with employers and outside actors.

1.6. Doctoral training

Across the OECD, tertiary education institutions play a key role in training high-level subject specialists and researchers through doctoral degrees (PhDs). In Portugal, as in a number of other OECD countries, only higher education institutions officially recognised as 'universities' currently have the right to award PhDs, reflecting the traditional concentration of research in this type of institution. As elsewhere, a majority of doctoral graduates in Portugal have historically gone on to work in teaching and research roles in universities or, to a lesser extent, public research.

Despite the potential contribution of PhD holders to innovation and productivity growth within and outside the academic sector, questions remain in all OECD countries about the overall level of demand for PhD graduates and the best way to design doctoral training and related public support mechanisms.

Policy issue 6.1. The funding and delivery of doctoral training is not well configured to prepare doctoral graduates for today's research roles

From a low base, Portugal has succeeded in greatly expanding its capacity to train doctoral candidates in the last two decades. It would be hazardous to make any general claims about how many doctoral graduates a country 'needs' or should aim to train. This will depend, in particular, on how the purpose of doctoral training is conceived. For example, is it about training specialists with knowledge that they can apply in the short-term to boost innovation in businesses and organisations, or about pushing the boundaries of knowledge in a wide range of fields in the long-term?

It is important to consider how many, in what fields and in what ways doctoral candidates are trained in Portugal for at least three reasons. First, despite the crisis, Portugal is spending an increasing amount of public money on supporting doctoral training. Is this money being directed where it should be and being well spent? Second, most analysts agree that the developing knowledge economy will call for more high-level specialists, analysts and researchers. Is the way Portugal organises and supports doctoral training able to respond to specific and changing skills needs? Third, an increasing number of PhD graduates, combined with limited opportunities for permanent academic careers (see below), means doctoral graduates increasingly need skills and experience they can apply in non-academic settings. How well is doctoral training in Portugal performing in this respect?

Portugal has a diversified system of doctoral training, with PhD programmes in a wide range of institutions and a broad spectrum of scientific areas. However, the graduation patterns for doctoral graduates in Portugal largely reflect the historical, demand-driven

allocation of PhD scholarships by the FCT, rather than any clear and deliberate prioritisation of fields or sub-fields or a systematic assessment of the relevance of individual research projects to the development of institutional profiles and national research priorities. While it is important to retain capacity to fund PhD training across subject fields and protect basic research, there is scope to use public PhD funding more actively to strengthen research capacity in fields identified as priorities for institutional and national development.

At the level of training provision, doctoral programmes in Portugal vary considerably in scale. Many doctoral programmes are – nominally at least – operated in partnerships between research units in different universities, external laboratories or, in some cases, companies, which increases the potential for scale, shared training and interaction between candidates. However, the very large number of doctoral programmes offered in Portugal means the number of candidates in some programmes is very low, making it hard to provide quality cohort training and to build active research communities with the critical mass to achieve excellence.

Broader concerns include the considerable instability and unpredictability in the flow of public resources for doctoral training – in volume and the type of instruments used to allocate funding – and the concentration of public funding and decision-making responsibility in the FCT. The instability in the volume of funding has created difficulties for prospective students and institutions, with success rates for applications falling considerably over time. The changes in funding instruments (doctoral programmes vs centralised calls) appear to reflect concerns on the part of government and the FCT about how much discretion should be devolved to universities in attributing funds. Experience from other OECD countries suggests that Portugal is not alone in facing this question, but that most governments have opted to devolve greater discretion to institutions, even when Research Councils maintain national competitions for individual scholarships.

Recommendations on aligning PhD capacity and needs

6.1. Ensure closer alignment between allocation of PhD funding and national research priorities and skills development needs

Portugal has hitherto awarded funding for PhD training based on an assessment of the scientific excellence of applications for individual scholarships or doctoral programmes, with funding allocation between scientific fields based on historical allocations and an aspiration for balance between disciplines. Although it is important to maintain some demand-driven public support for doctoral research across fields, the current system limits the scope for the FCT to direct funding to develop Portugal's high-level skills in priority areas. Funding PhDs in areas where there is little demand for graduates is not only a poor use of public money, but encourages individuals to pursue a training and career path that diverts them from more productive options and may ultimately lead to frustration and disappointment.

It is challenging to predict the number of PhD graduates Portugal requires each year to develop research capacity further and meet the requirements of the country's science base and economy. Given available evidence on the employment outcomes of PhD graduates from Portugal, the number of graduates per capita in international comparison and the level of public funds available, it appears reasonable to continue to maintain the number of publicly funded PhD fellowships at around the current level (i.e. around 1 500 a year). There is no compelling evidence that would justify an increase in the number of grants beyond this, particularly in light of the overall constraints on public spending.

Within this overall level of public support, Portugal should ensure PhD funding is reserved for the 'brightest and the best' and target its public support for doctoral training more rigorously on fields of knowledge that have been identified as national priorities. Prioritisation of some fields will inevitably mean other fields are deprioritised. As part of a wider reform of FCT funding for PhD training (see also next recommendation), the FCT should reserve a greater proportion of its training budget for PhDs in fields which the country has identified as specific priorities or where there is an identified need to develop high-level specialists. This prioritisation should be identified in the national strategic frameworks discussed above. Priority fields could be promoted either through dedicated priorities in centralised calls for individual scholarships, or dedicated resources for doctoral programmes in priority fields (the UK's Centres for Doctoral Training (CDT) could be a useful reference model in this respect).

6.2. Direct more public funding for PhDs to higher education institutions through reformed support for doctoral programmes

Decision-making responsibility for selecting PhD candidates for public funding has historically been concentrated in the FCT. This leads to a situation where the FCT has prime responsibility for 'picking winners' by selecting the individuals best suited to pursue a doctoral degree. Other OECD countries tend to distribute responsibility for selecting doctoral candidates for funding more widely, notably by giving individual doctoral schools and departments freedom to select candidates for some or all publicly funding doctoral training places.

Portugal has experimented with providing funding to institutions through contracts for doctoral programmes, with selection of candidates devolved to institutions. This model appears to have been effective in creating innovative doctoral partnerships in areas of strategic importance to the country. Hitherto, however, these doctoral programmes have not used to support wider institutional strategies and strengthen differentiated institutional research profiles. Moreover, the calls for doctoral programmes in 2012 and 2013 almost certainly supported too many programmes, with too few students in each programme to achieve the real benefits of cohort training.

As part of the wider reform of support for doctoral training, the FCT should allocate at least half of the resources it has available to institutions to operate doctoral programmes. Funded programmes should have certain shared characteristics:

a. They involve partnerships between universities (and potentially polytechnics) and relevant research centres with developed profiles in the fields in question, allowing expertise to be pooled and critical mass to be created.

b. They have an annual entry cohort of at least 10 doctoral students (with exceptions allowed for specific niche fields where this would be unrealistic) to allow efficient delivery of common training elements and cohort benefits for candidates to be realised.

c. They include a set of relevant common training components, including a focus on transferable skills sets relevant to careers outside academia.

d. They have in place well-developed mechanisms to provide mentoring and career guidance to doctoral candidates.

Devolution of responsibility to institutions for selecting candidates for PhD funding should be accompanied by strengthened mechanisms of external quality control to ensure high standards are delivered in practice. As part of the new system of institutional accreditation, A3ES should require all higher institutions wishing to offer PhD programmes to demonstrate that they meet high quality standards for doctoral training. The standards to guide this aspect of accreditation should be devised

by A3ES in consultation with FCT and institutions. The standards should accommodate different forms of doctoral training to promote diversity of provision and take into account factors including:

a. the alignment of the doctoral programme to the institution's institutional profile

b. the extent to which staff running the programme are performing with success as researchers/innovation partners, as evidenced by relevant publications, collaboration with business, etc.

c. opportunities for doctoral candidates to collaborate with researchers and research groups in other countries

d. past performance on rates of attrition and time to completion in existing or similar programmes in the institution

e. evidence of the employment outcomes of past doctoral graduates from the programmes / departments in question, including in the non-academic sector.

Policy issue 6.2. More needs to be done to create quality employment opportunities for doctoral graduates in Portugal

The results of the 2015 survey on the Careers of Doctoral Holders (CDH) in Portugal show that the recent doctoral graduates are far less likely to work in the academic sector than those who graduated in previous years, with increasing numbers working in the wider public or private sectors. Graduates wishing to work in the academic sector have often only been able to access precarious, grant-based post-doctoral positions, rather than regular academic posts. The government is in the process of creating additional contractual positions for post-docs (ending the previous grants-based system). However, notwithstanding this development and a likely increase in recruitment by universities, polytechnics and research centres as funding levels are increased, the academic sector will only ever be able to absorb a small proportion of those graduating with doctorates each year.

PhD graduates in Portugal have found it relatively difficult to find relevant employment in the private sector and public sector outside higher education and research. This situation is primarily a reflection of the structure of the Portuguese economy, which is dominated by micro enterprises and specialised in low and medium-technology sectors. Discussions with stakeholders also suggest it reflects a tradition of limited co-operation between academic research and productive sectors and public services, which means that many business leaders are unaware or unconvinced of the need for highly qualified research staff. Poor management skills and limited awareness of opportunities for innovation and productivity gains in the Portuguese business sector are a key issue highlighted in the most recent *OECD Economic Survey of Portugal*.

As discussed above, there is, in many cases, limited direct alignment between the thematic focus of PhDs and possible applications of this knowledge, and associated skills acquired by PhD holders, in the wider economy. Although, any strategic prioritisation of thematic areas for doctoral training must adequately safeguard study fields without direct links to the economy (a core aspect of basic research), there is clearly scope to increase the focus on PhD training with direct application in the wider economy.

Data on inward migration in selected countries in Northern Europe, as well as anecdotal evidence from stakeholders in Portugal, suggest that significant numbers of highly qualified Portuguese graduates leave the country to work in the private sector and academia elsewhere in the world. Although the current economic recovery in Portugal is likely to

increase employment opportunities in the country, the risks associated with 'brain drain' should not be ignored in planning research and innovation policy. Improving the availability and attractiveness of career opportunities in Portugal in the academic and private sectors must be a core element in any national response to brain drain. In addition, however, the domestic absorptive capacity for doctoral graduates should be taken into account to a greater extent in determining the numbers of PhD places to fund.

Recommendations on developing employment opportunities for doctoral graduates

6.3. Develop tailored selection and quality criteria for doctoral training programmes in the business or wider public sectors

Through its support to individual PhD candidates and doctoral programmes, the FCT should seek to increase the number of doctoral candidates undertaking their PhD in a business or other non-academic setting. The selection criteria and general requirements for FCT-supported doctorates appear not to be adequately tailored to the needs to PhDs that are not based in universities and research centres. As such, the FCT should review the relevant selection criteria and conditions in consultation with representatives of businesses and public sector organisations that would be susceptible to hosting PhD candidates. The CASE scholarships used by UK Research Councils could be a useful reference point.

Given the composition of the Portuguese economy and the limited number of businesses likely to be able to host PhD candidates in the short to medium-term, it is also important that adequate opportunities are given to undertake PhDs in public sector organisations (hospitals, public service organisations and ministries) which potentially have considerable capacity to provide appropriate environments for PhDs researchers.

6.4. Maintain and expand the practice of supporting 'mixed' PhD scholarships

The Review Team considers that the model of 'mixed' PhD scholarships, whereby the doctoral candidate spends part of their PhD training period abroad is an example of good practice that should be maintained and strengthened. Mixed PhDs provide individuals the opportunity to gain valuable international experience and exposure to expertise and experience that are not necessarily available in Portugal. As such, the 'mixed' model should be retained in the reformed system of FCT support, both for individual scholarships and scholarships awarded through doctoral programmes.

6.5. Improve data collection about the career paths of doctoral candidates and graduates, including those who move abroad.

The quality of date available on the academic career paths and subsequent professional development of doctoral candidates and graduates is inadequate to support effective policy making by government and strategy setting by higher education institutions. Improved information is also of vital importance to career guidance services and those considering embarking on a doctoral degree. The absence of information on out-migration by doctoral graduates from Portugal is particularly problematic.

As a first step, the Portuguese authorities should require any doctoral candidate supported by the FCT to provide regular updates on their careers as a condition of funding. A suitably simple questionnaire system, respecting relevant privacy legislation, should be developed. The system could be open to students and graduates not supported by the FCT on a voluntary basis. Data collected should be used to undertake regular assessment of the results and impact of FCT funding for doctoral training.

1.7. Academic Careers

The core academic workforce in Portugal is composed of professors, lecturers and researchers working in the country's public and private tertiary education institutions and publicly funded research units. Academics and other staff categories in public institutions have historically been – and in most cases remain – civil servants (*funcionários públicos*), with contracts aligned to the legislation covering employment in the public sector more generally. Public institutions that have moved to foundation status (see above) can appoint academic and other staff using private law contracts, governed by the general Portuguese Labour Code that applies to employees in the private sector. Staff in private institutions are employed exclusively under private law.

Academic staff in all sectors are appointed to permanent contracts through public competitions. In practice, alongside permanent teaching staff and researchers (*docentes* or *investigadores de carreira*), academic staff can also be hired at any of the three core academic grades on fixed term contracts, usually on a part-time basis. In addition to the core academic grades, a large number of individuals are employed across all sectors on a fixed-term, part-time basis as junior lecturers (*assistentes*). A further distinction is made between academic staff who work exclusively for their institution – a status called 'exclusive dedication' – and those who also take on other work alongside their academic position (such as private consulting or work in a second institution), even when this is nominally a 'full-time' position. Staff numbers and the distribution of posts between staff categories have remained broadly stable over the last five years in public universities, but staff numbers have fallen in public polytechnics and private universities and polytechnics, primarily as a result of reductions in *assistente* posts.

Policy issue 7.1. Career planning and entry: queuing and in-breeding

Access to academic careers in Portugal has become increasingly difficult in recent years. This is the result of an increasing supply of potentially qualified candidates for academic positions and falling demand for new academic staff from the higher education and public research sector. One potentially desirable consequence of the increased flow of new doctorate holders and falling demand in the academic sector is an increasing tendency for doctoral graduates to seek and find productive work in other sectors of the economy. However, a more problematic consequence has been the increase in the number of doctoral graduates in precarious post-doctoral positions, without formal employment contracts and with limited perspectives of obtaining a permanent academic post in the longer term.

Entry to academic and research careers in Portugal is already marked by a high degree endogamy or 'in-breeding'. Institutions have a strong tendency to recruit their own doctoral graduates and staff may go on to pursue their entire career within the same institution. Evidence from Portugal and elsewhere shows that "inbred" scholars produce less research and research of lower quality than do those who have been trained outside the institution in which they make their career. Moreover, inbreeding is widely thought to encourage traditionalism, and to endanger excellence and innovation.

A new initiative to promote scientific employment launched by the government in 2016 has the stated aim of creating more and more stable research posts in the academic sector and, in so doing, helping to address the precarious situation of post-doctoral fellows in Portugal. However, by creating a type of temporary contract, the new system risks perpetuating unrealistic expectations about the chances of obtaining a permanent academic post and diverting individuals from exploring job options and opportunities in other sectors.

For the institutions, the transitional regime proposed risks tying (future) resources to existing areas of post-doctoral research activity and restricting opportunities to refocus activities in line with renewed institutional profiles and institutional and national development strategies.

Recommendations on strengthening career planning and entry

7. 1. Improve information and guidance to prospective academic staff

Portugal needs to ensure talented people are able to make the best use of their knowledge and skills for the good of the country. Ensuring the brightest and best are attracted to careers in academia and public research is an important part of this. However, in the current system in Portugal – as in other OECD countries – too many young (and less young) doctoral graduates seek to embark on an academic career with unrealistic expectations about the probability of ultimately securing an academic post. This can lead to a sub-optimal use of talent, as individuals devote time and energy to pursuing unrealistic goals, when they could be otherwise engaged in rewarding jobs with stronger long-term career prospects. The higher education sector as a whole has a responsibility to be more transparent about the likely flow of job opportunities and the purpose of post-doctoral positions.

Appropriate public authorities, including the FCT, along with higher education institutions, should develop guidance and information campaigns to ensure those considering an academic career are well informed, including:

- Making clear that post-doctoral positions are only appropriate for those seeking to pursue an advanced research career, and should not be viewed as the default step for those completing doctoral training.
- Publishing transparent information about likely recruitment of staff into entry-level academic positions (professor auxiliar, professor adjunto, investigador auxiliar) by providing project recruitment plans for the next five years, which are updated annually.

7.2. Ensure that post-doctoral positions (*Investigador júnior*) allow post-docs to gain skills and experience that can be exploited outside academia

Recognising that entry to permanent academic posts will – and must – remain highly competitive, those who do embark on a period as a post-doc under the new system of post-doctoral support in Portugal must be supported to develop experience and skills which they can also use to obtain and thrive in work outside the academic sector in Portugal. As a condition for receiving direct or indirect funding from the state (primarily directed through the FCT), post-docs and their host institutions should be required to jointly produce a career and skills development plan setting out specific measures the post-doc will take to develop their wider skills sets and how the institution will support the post-doc in skills development and career planning. All post-docs should have access to a mentor, who is different from their direct supervisor, who can support them in career planning.

7.3 Adapt FCT funding rules to counter inbreeding

In order to promote greater mobility of students and junior researchers between Portugal's higher education institutions and research centres, the FCT should make mobility a condition of the award of a majority of its funding for doctoral training and junior researcher (post-doc) positions. To receive FCT funding doctoral candidates should be required to train in a different institution to the one where they completed their previous education. Junior researchers should be required to work in institutions other than the one that awarded their PhD. Exceptions to this general rule may be permitted where research topics are so specific that relevant training or junior research opportunities are available in only a single institution in Portugal. However, care must be taken to limit such exceptions and maintain the general principle that trainee researchers and junior researchers should move institution.

7.4. Ensure fixed-term and permanent employment positions created through the new initiative for scientific employment support institutional profiling and development strategies.

The new system to support scientific employment must be used to support the development of institutional profiles as recommended above. The best available candidates need to be employed in research and teaching activities that help the institution develop its areas of strength and build its profile. The objective of creating more permanent research posts is commendable and consistent with recommendations made in other research systems. However, it is imperative that the new system does not lead to poor quality candidates being employed on permanent contracts in fields which contribute little to institutional development and the needs of Portuguese society more generally. To avoid this, the Portuguese authorities should:

- Ensure that alignment with institutional profiling and national development goals is a criterion in the selection of new post-docs and other research posts created through the initiative on scientific employment.
- Encourage applications to posts from individuals based or educated in institutions other than the host institution for the post.
- Allow institutions the maximum degree of flexibility in creating permanent academic posts after the subsidised fixed-term contract periods have expired, notably through avoiding a narrow definition of the scientific area in which the new post should be created.

Policy issue 7.2. The structure of careers: weak differentiation and performance-based rewards

National legal and regulatory frameworks largely structure careers in public higher education institutions. As well as defining staff categories and selection requirements, the specific legislation dealing with careers for university and polytechnic teaching staff also specifies maximum and minimum ratios for particular grades and staff categories, imposes minimum and maximum teaching hours and contains general guidelines relating to staff evaluation, promotion and pay. Portugal also has the specificity of having a distinct legal basis to regulate 'research careers', even though university – and increasingly polytechnic – teachers (*docentes*) are expected to conduct research as well as teach. The comparatively detailed regulation of academic careers in law in Portugal creates rigidities in the system, in particular in relation to the way staff use their time and profile themselves.

Several factors have militated against the widespread implementation of effective performance evaluation and reward systems in Portuguese higher education institutions. As in other countries, the principle of academic autonomy and the absence of any tradition of performance evaluation for staff in higher education have made progress in this area slow. In addition, the rigid national pay scale applied in public institutions, with relative few pay steps in each grade and comparatively small pay differences between steps, and the absence of public money to fund individual pay rises in recent years have made it difficult to develop systems of performance evaluation that link performance with financial rewards.

Recommendations on ensuring greater differentiation in the career structure

7.5. Ensure institutions and academic staff have flexibility to allocate staff time efficiently and to follow different career profiles

The legal framework for academic careers should be modified, as necessary, to allow higher education institutions to set their own policies on the allocation of time among teaching, research and outreach obligations in response to short-term changes in opportunities and responsibilities. Further, HEI should create opportunities for staff to choose among differentiated career profiles for those who wish to adopt long-term changes to the balance of responsibilities they perform. Policymakers should use the new role of A3ES as an evaluator of higher education institutions as part of this process. Institutional review by A3ES should permit higher education institutions to demonstrate their fitness and capacity to take responsibility for workload and career profiles, and permit institutions to become self-regulating with respect to workload and career profile policies rather than subject to national regulation.

7.6. Encourage institutions to implement transparent and merit-based procedures for staff performance review that are aligned to institutional mission, and support differentiation in pay and rewards.

After transparent systems of performance review aligned to institutional mission are established, they should be used to support differentiation in compensation and other rewards. In the near term, these agreed evaluation systems should initially be used to support the allocation of benefits permissible under current law, such as performance bonuses, and temporary revisions to teaching obligations (within the national framework). In the longer run, performance evaluation plans should be used to support decisions about within-rank increases in compensation; limited adjustments to base compensation that may become available within a modified legislative framework; and to guide decisions for those who hold appointments under private law in foundation universities.

Policy issue 7.3. Career mobility and retirement: low mobility and late retirement

Those who hold career appointments in academia in Portugal tend not to move between institutions in the country. The combination of a national salary scale and low differentiation in career profiles across institutions reduces the incentives for academics to move institutions to obtain a role that better fits their desired profile or in order to gain a pay rise. The numerous available opportunities to conduct research outside one's host institution through affiliation with an associated laboratory or R&D centre further reduce the incentives to move. As noted in the earlier discussion of in-breeding, limited mobility reduces the range of experience gained by individuals and the innovation and development benefits for institutions of bringing in 'new blood'. Inbreeding and the comparatively static nature of academic careers in Portugal are also contributing factors in explaining the comparatively low level of internationalisation among academic staff in the country.

However, alongside the tendency for in-breeding, limited job opportunities in recent years, pay cuts and freezes and the wider structural problems affecting the organisation and performance of the system that are discussed in this report, have all combined to reduce the more general attractiveness of Portuguese higher education for international academics. Moreover, older staff often remain in post beyond pensionable retirement age, limiting opportunities for younger staff members to advance into posts that are more senior.

Recommendation for ensuring greater career mobility

7.7. Promote near-term measures to increase inter-institutional mobility and timely retirement, while, in the long-term, adopting reforms that increase domestic and international mobility.

In the near term, promote inter-institutional mobility through short-term faculty exchange programmes and expanded opportunities for visiting appointments through funds allocated by FCT, and awarded by higher education institutions. Additionally, ensure that research staff retires at a fully pensionable age, in line with national legislation, to ensure senior positions are freed up. The reforms described above – with wider institutional responsibility to set workload, career profile, and compensation policies that are aligned to differentiated institutional profiles – will significantly increase domestic mobility by creating incentives for mobility that are presently absent. These reforms, in combination with the further development of private law employment in foundation universities, will make Portugal a significantly more attractive destination for researchers than it is at present.

1.8. High-skilled employment, co-operation with HEIs and innovation in the business sector

Business innovation is far from limited to science-based innovation. It encompasses a wide range of types of innovation, from the knowledge-intensive projects based on internal R&D and collaboration with academic research to rather informal and incremental innovation activities.

A key factor of success of innovation system depends therefore on the ability of governments, in close interactions with the research and innovation communities, to set up in a co-ordinated way a two-fold approach supporting business innovation from both sides of the supply and demand of knowledge:

- An 'intensive margin' approach aims to deepen the knowledge-intensity of medium high and high-tech industries and services.
- An 'extensive margin' approach aims to support the upgrading of the innovation capacity of each sector, including lower tech ones. Key for this process is the provision of systematic, hands on and stable support to business innovation.

Policy issue 8.1. The Portuguese innovation policy mix needs a careful balance between the support to high and low tech business firms

The economic success of many Portuguese firms has been achieved by incremental innovation and learning by doing rather than by science-based innovation.

As in many OECD countries, the support to science-industry collaborations and science-based start-ups ranks high in the research and innovation policy agenda. More should be done, including at the level of HEIs to provide the right set of incentives for greater engagement with industry at institutional and individual levels.

However, these initiatives, although essential, concern only a limited number of companies with the sufficient 'absorption capacity' to collaborate with academic institutions. The new CoLAB scheme for example is an important new development that could alleviate the

problem of the lack of institutionalisation and long-term commitment of partners. It is however in practice limited to industrial partners that can afford multi-year financial commitments and have already built relationships with the academic institutions. Structured research-industry collaboration between industrial partners with little prior R&I experience and polytechnics, for example, might usefully complement the programme. Tapping into the potential of firms that do not yet significantly innovate and serve mainly regional markets is a major opportunity that has not been fully addressed.

Policy issue 8.2. There are emerging opportunities to support business innovation that merit well-designed policies

The Portuguese business sector has significantly enhanced its innovation capacity over the two last decades, in particular during the period preceding the outbreak of the 2008 crisis. Although the economic situation in years afterwards resulted in a decrease of business R&D expenditures, more recently there has been an increase in the participation of Portuguese firms in innovation support schemes. These trends include participation by companies newly engaged in innovation activities, a positive technological balance of payments, and a general recovery of investment in research and innovation.

Innovation input and, especially, output indicators (such as patents) have nonetheless remained at a low level compared to the OECD average, partly due to the dominance of SMEs and the weight of traditional sectors (textiles, food and beverage, ceramics/materials, paper/wood/furniture) in the economy. Although a few traditional industries (the shoe industry, but also textiles, clothing and moulding) have managed to quite successfully shift towards higher added-value products and services and increasing exports, large parts of the economy remains under-developed, producing non-innovative products for local markets.

Portugal has implemented a comprehensive portfolio of policies offering direct support for business innovation, largely co-financed by the Community Cohesion Policy. However, the project-based nature of Structural Fund investments and their emphasis on research excellence limit their capacity to build sustainable and regionally relevant innovation ecosystems aligned to longer-term specialisation priorities. Although hard to assert with certainty since only very few of these schemes have been assessed (beside some evaluations conducted at overall programme level in the framework of Structural Funds), the fact that the innovation support is often spread thin among a variety of business firms and intermediary organisations also probably limits their effectiveness.

Policy issue 8.3. Cluster-based approaches are instrumental to support innovation, including in less developed regions

Several examples in Portugal and elsewhere point to the importance of regional networks to support the upgrading of innovation capabilities of firms in low-tech industry and service sectors, even in remote areas.

The added value of some innovation support schemes, such as ANI's mobilising projects, lies in the technical services they provide or in networking effects, rather or in addition to direct financial support. Also, as shown by one rare example of specific scheme evaluation, Structural Funds have positively supported the formation of competitiveness and technology poles and clusters.

In some countries, including the United Kingdom, the United States and several Latin American countries, specific institutions have been set up to provide various 'innovation support services' to SMEs, most often in a regional context. These services include

technology transfer and diffusion services (support in the form of advice and counselling for technology transfer and uptake by SMEs) as well as innovation management and non-technological innovation services (innovation management advice, audits to identify needs, innovation coaching, design and support for marketing innovative products, etc.).

These initiatives can also have a positive effect to alleviate regional imbalance in innovation, a major concern for Portuguese authorities. However, there are important limitations to what research and innovation policies can, alone, achieve to counter the strong territorial concentration dynamics. Stronger and wider co-ordination between policy fields will be needed to address these issues and ensure that research and innovation policies contribute to alleviate economic and social development imbalances. Cluster policies have proved effective in several countries not only to support firms but also as policy co-ordination tools in a localised area.

Recommendation on providing resources to upgrade innovation capabilities

8.1. Establish regional innovation platforms to provide domestic SMEs easy access to critical resources – such as information, expertise, and equipment – for upgrading their innovation capabilities.

Efforts should be devoted to enhance the density of relationships in regions between domestic firms, higher education institutions (particularly polytechnics and regionally oriented universities), and the various intermediaries. This will require local and regional networks with a clearly acknowledged node offering a broad range of innovation services adapted to local needs.

The core of these networks could take the form of a permanent (rather than project-based) local platforms, i.e. 'light' co-ordination structures that gather on one site the competencies and offer of services of multiple partners (HEIs, Technology centres and various other intermediary organisations, consulting and engineering companies, individual experts, local administrations, etc.). Although not very formal (with a status of not-for-profit association for instance), it is essential that these platforms be resourced with some dedicated experienced staff and equipment (e.g. for metrology and testing) with the capacity to support the innovation activities of local companies. Different models exist, from the various types of regional innovation agencies (OECD, 2011) to technology-focused extension service organisations.

Emulating the best international practices, their activities should include not only specific hands-on support activities to individual (or groups of) SMEs (technical assistance and consulting, interface between experts, from academia and industry) but also public mission services (provision of information, awareness-raising, promotion of innovation, general capability building, etc.).

The public mission services provided by the platforms should be financed by the government on both the supply and demand sides:

- on the supply side, the platform needs permanent funding to set, operate and maintain the needed skills and equipment
- on the demand side, incentivise companies to use these services, for instance using ANI's current R&TD Vouchers.

The twofold mission of regional innovation platforms

Public mission background work	Specific support to SMEs or groups of SMEs/joint projects
– Provision of information on opportunities for improvement in existing technologies, best practices, international trends, relevant regulations, business networks, opportunities to become government suppliers and other support to contractual arrangements – Awareness raising – General capability building – Stimulation and/or running of networks and clusters – Node for local/regional partnership – Promotion of internationalisation, promotion of foreign investors – Facilitator for sharing scientific and technical equipment – Maintenance of database of experts	– Benchmarking of companies in the industry at the national and international levels to gauge performance level – Technical assistance and consulting in the context of innovation/improvement projects designed individually for interested companies (including identification of needs) – Training of plant and administrative staff for the effective use of technologies more advanced than those previously used by the company – Provision of services to a group or network of companies with common needs and challenges that are not directly related to competition among them – Joint projects of companies and public and academic laboratories for solving specific problems associated with the companies' products or processes – Advice on developing new strategies for the company and assistance in diagnosing and managing impending changes during implementation

Sources: Adapted from OECD (2011), "Maximising the impact of regional innovation agencies, http://dx.doi.org/10.1787/9789264097803-9-en; Rogers (2013), "Technology extension services".

Their beneficiary targets should include SMEs with limited in-house innovation capabilities that rarely co-operate with academia, do not hire highly skilled staff and seldom use shared equipment. These companies generally do not innovate due to a lack of entrepreneurial culture, skills, and incentives, or their inability to identify innovation opportunities.

Several organisations deliver some of these activities, including polytechnics, technology centres (and other intermediary organisations), Clusters and Poles, and networks financed by ANI's Mobilizing Projects. Building on the experience and resources of these organisations, the added value of the regional innovation platforms lies in their systematic approach and the wide range of services they would provide.

The precise composition and status of these platforms is beyond the scope of this Review. It should result from negotiations between national and regional authorities and the existing providers of some of these services.

Different options exist, including creating platforms within or in close connection with polytechnics, which could be the backbone of these platforms in each of their respective speciality. Several of the polytechnics the Review team visited have already engaged in significant collaborations with regional industries and services but these remain often on a limited scale. These institutions should be provided sufficient support and incentives to become acknowledged as key providers of research and innovation services in companies.

Policy issue 8.4. Mismatches between the supply and demand of qualified personnel may be hampering innovation

Portugal has improved the level of qualification of its population over the past decades (see Chapter 2). It now offers a fairly highly-qualified human resource base of graduates and PhD holders and lower labour costs than other Western Europe economies. However, there are some mismatches in graduate qualifications and industry needs. Specifically, there appears to be an overemphasis on academically-oriented PhDs relative to engineers or more professionally-oriented PhDs.

This originates in secondary education, where practice-oriented curricula are not held in the same high esteem as theoretically focused curricula. As consequence, practice-oriented higher education, e.g. at polytechnics, tends to be perceived as less attractive than academic education at universities.

Higher education and PhD training even in engineering disciplines do not consistently develop close links with industrial practice. Academic requirements seem difficult to reconcile with the need to prepare graduates for later employment outside of the public research system, and incentives for academics to intensify their collaborations are limited.

Recommendation on supporting efforts to strengthen local development

8.2. Continue upgrading polytechnics and regionally-profiled universities, supporting their capacity to further develop as 'practice-based knowledge-intensive institutions' dedicated to local development

Following a thorough review of their capabilities concerning linkages with industry partners, the most dynamic polytechnics and regionally profiled universities should be supported and incentivised to strengthen their profile in enhanced professional education. This profile would include short courses on emerging technologies, digitalisation, innovation management or other matters of primary relevance to industry, collaborative research and, more generally, the types of innovation support services needed in the regional innovation platforms. This would allow them to play a more extensive role in the provision of professional skills to support the upgrading of industry and services than they currently do.

The broadening of their range of missions and corresponding activities should be encouraged according to local needs, e.g. special forms of staff training geared towards the needs of clusters (on innovation, intellectual property (IP) management, digital transformation, internationalisation, etc.) and other support services to local companies. The type of public support they receive, currently focused on innovation projects in a rather narrow sense in the framework of the Structural Funds, should be adapted to this broadened portfolio of activities.

These HEIs could be incentivised to provide enhanced professional education through for instance institutional evaluation and performance contracts, in close connection with their research activities. Regarding Polytechnics specifically, the on-going specific FCT support to their research activities in collaboration with industry should be continued.

Policy issue 8.5. Further support for intermediary organisations in low tech industry and service sectors is needed

Cluster-based initiatives often develop around intermediary organisations, such as technology centres, or higher education institutions, particularly polytechnics and regionally profiled universities. The government has progressively created a diversified system of intermediary organisations (transfer offices, technology centres, S&T parks, incubators, poles and clusters) to fulfil a wide range of business knowledge transfer and service needs, from science-based to incremental and problem-solving innovations. Some of these intermediary organisations, in particular Technology Centres, have been in several cases instrumental in this upgrading process. They not only gradually provided the needed technologies and skills, but also promoted and supported collective actions among sometimes competing firms. This upgrading process came, however, at the price of significant job losses in these sectors, as exemplified by the shoe industry.

Most of these institutions operate with fragile business model in which systematic public support is absent. Some intermediary organisations received Structural Funds when they were launched, but have since received no basic funding. This has resulted in more consulting engineering and other commercial activities, and less "upstream" applied research and innovation collaborative activities. The 2017 Interface Programme provides some multi-annual basic funding, measures to support the hiring of PhDs by these organisations in collaborations with industry, and financial support for the acquisition of new equipment. This institutional funding, if stable over years and conditioned to regular evaluations, could have a significant effect on the upgrading of the domestic firms innovation capacity.

Policy issue 8.6. The Knowledge transfer infrastructure should be strengthened

Technology transfer offices and science and technology parks can help overcome the lack of absorptive capacity among traditional SMEs and bridge the gap been firms and academic institutions. This has been demonstrated by international experience, and by several Portuguese 'start up' success stories.

However, TTOs have often limited budgetary and human resource. Studies have shown that the performance of knowledge transfer organisations and services is positively linked to the size of the higher education institutions to which they are connected. The University Technology Enterprise Network (UTEN) is an interesting initiative in that regard as it brings together the most internationally oriented technology transfer offices to strengthen their commercialisation of domestic research activities via joint activities and exchange of good practices (including through training of Portuguese technology transfer officers by American specialists).

Some countries have gone further and experimented with new approaches to strengthen knowledge transfer institutions and reach critical mass and high quality of services, for instance via the creation of new models such as technology transfer alliances (TTAs) which bundle the resources and standardise the practices of some TTOs.

Recommendations on intermediary organisations to provide knowledge exchange and innovation services

8.3. Ensure that intermediary organisations have a sufficient level of guaranteed multi-annual funding to maintain and expand their networks, infrastructures and support services

Intermediary organisations (clusters, technology centres, applied research centres, etc.) fulfil various tasks to support innovation in firms and public organisations. Some of these tasks have the nature of public mission and should therefore be funded via stable state or EU funding (at a level of 20 to 30% of their turnover, as most of their counterparts with which they increasingly compete in Europe) in order to avoid significant drift toward more lucrative commercial activities (engineering consulting, etc.).

The government has recently announced the launch of the Interface Programme, which includes several support schemes (including a share of basic funding) for selected 'labelled' intermediary organisations. This programme should be implemented and maintained on a continuous basis for intermediary organisations that have successfully fulfilled the objectives announced in their development plans.

8.4. Support the sharing and pooling of resources among knowledge transfer organisations

The sharing and pooling ('mutualisation') of knowledge transfer services of different institutions should be promoted in order to encourage critical mass of project deal flows and strengthen the specialised expertise of internal staff of these organisations.

Various models of such groupings and partnerships –for instance the Technology Transfer Alliances – exist and could serve as examples [e.g. Innovation Transfer Network (ITN) in the United States, and *Sociétés d'Accélération du Transfert de Technologies* (SATT) in France. These initiatives differ according to the methods to mutualise knowledge transfer services, from the creation of networks and consortiums where some resources and shared and exchanges encouraged, to the merger of TTOs. The models also vary according to the logic of mutualisation, regional (one TTO to serve all universities and research institutions in a given region) or thematic (specialised 'hubs' of TTOs in specialised thematic areas).

Note

1. The detailed assessment framework is presented in Annex A.

Chapter 2. Conditions for higher education, research and innovation in Portugal

This chapter discusses the underlying economic and legal conditions in Portugal that shape its higher education, research and innovation system – its network of institutions and policies created by government that aim to develop advanced skills and knowledge, and link them to firms and communities. It starts with a brief discussion of recent macroeconomic developments, looking at factors such as growth dynamics, productivity and industrial structure, outlining the country's major economic challenges. In addition, this chapter presents an overview of the structure and performance of the Portuguese Higher Education Research and Innovation (HERI) system in terms of funding and human resources and reviews its outputs in terms of participation, attainment and returns. It then explores the inputs of the research and innovation system and reviews its performance, notably in terms of academic impact and innovation indicators. The chapter focuses particularly on recent evolutions, highlighting progress and identifying bottlenecks.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

2.1. Macroeconomic performance

Portugal's gross domestic product (GDP) began rising in the 1960s and, after a period of economic turmoil following the Carnation Revolution of 1974, had started to converge with the European Union average by the late 1980s. Growth slowed in the early 2000s, and the 2008 financial crisis brought the process of economic convergence to a halt. While GDP started to grow again in 2014, the effects of the crisis are still being felt in terms of social and economic well-being: the financial crisis increased poverty and deepened inequalities through increased unemployment.

While it is difficult to disentangle the multiple forces that have affected Portugal's relatively low growth performance, several factors can be identified as potential contributors:

1. productivity remains low and total factor productivity, in particular, has been stagnant since the 1990s
2. the sectoral composition of the economy is also not conducive to high growth performance: the manufacturing sector – which has historically played an important role in boosting growth in converging economies elsewhere in Europe – is comparatively small and specialised in low and medium-low technology sectors, limiting productivity
3. unemployment increased considerably during the crisis and, despite significant improvements in recent years, the overall level of qualification of the Portuguese workforce remains low by international comparison
4. barriers to investment, including limited access to investment capital, make it harder for firms to upgrade their activities.

In this context, increasing skills levels and the capacity of the Portuguese economy to innovate as a means to increase productivity have been identified as key priorities for public policy in the country (OECD, 2017a).

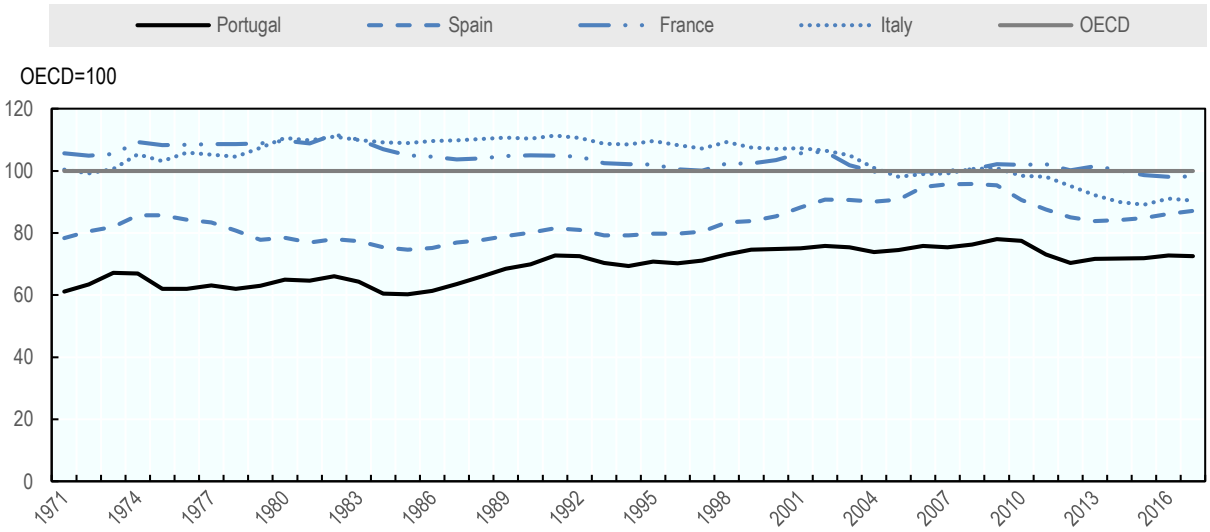
2.1.1. GDP growth, inequalities and well-being

Portugal's GDP per capita was 73% of the OECD average in 2016 (Figure 2.1). It was on a path of convergence towards the OECD average in the mid-1980s and again in the mid-1990s. During this period the catch-up process was slow, and driven principally by an expansion of the service sector and low-to-medium added value exports (Solsten, 1993). Portugal's growth trajectory began diverging from the OECD average in the aftermath of the crisis, going from 78% of the OECD average GDP per capita in 2009 to 72% in 2015.

GDP growth resumed in Portugal in 2014 and has been on an upward trend ever since, reaching 2.6% in 2017, almost catching up with the EU15's annual growth rate and doubling between 2016 and 2017. GDP growth is projected to remain at 2.3% for 2018 and 2019, driven by domestic consumption and exports (OECD, 2017b). Portugal's GDP per capita was 71.4% of the EU15 average in 2016, indicating the country is starting to converge with other Western European economies.

Geographically, growth in Portugal has been concentrated in six of the country's 30 statistical regions (TL3 level), including the Lisbon and Porto metropolitan areas. These six regions together contributed to 87% of the overall GDP growth between 2000 and 2013 (OECD, 2016a).

Figure 2.1. GDP per capita, Portugal and selected countries, 1970-2017

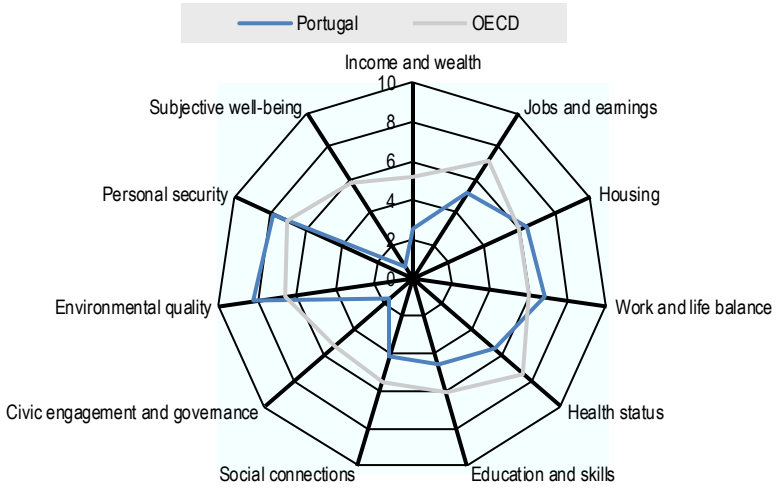


Note: Calculations are based on GDP per capita in current prices, current PPP. Values before 1995, and OECD figures are estimated. Data for 2016 and 2017 are provisional.
Source: Based on OECD (2018), OECD National Accounts Statistics (database), https://doi.org/10.1787/data-00017-en (accessed on 02 August 2018).

Income inequality is high in Portugal. The country has the 12th most unequal income distribution in the OECD, largely as a result of high unemployment and related poverty levels, rather than high wage dispersion (Pinheiro Alves, 2017). The poverty rate rose in the aftermath of the crisis from 11% in 2008 to 14% in 2014[1] (OECD, 2017b). Portugal is also characterised by substantial regional disparities. The gap in GDP per capita between the bottom 20% top and 20% statistical regions was the 10th largest in the OECD in 2013, although this disparity decreased since 2008. The gap between top and bottom regions narrowed by almost 10 percentage points over this period, as GDP per capita in poorer regions declined more slowly than in richer regions.

The OECD Better Life Index shows Portugal lags behind other OECD countries in terms of income and – to a lesser extent – other key quality of life indicators, such as jobs, education and health. Portuguese citizens also have a low self-perception of their well-being (Figure 2.2). Nonetheless, Portugal ranks above the OECD average with respect to work and life balance, housing, personal security and environmental quality (OECD, 2017b).

Figure 2.2. Well-being outcomes: OECD Better Life Index



Note: Each well-being dimension is measured by one to three indicators from the OECD Better Life indicator dataset. Normalised indicators are averaged with equal weights.
Source: OECD (2018b), "Better Life Index", OECD Social and Welfare Statistics (database), http://dx.doi.org/10.1787/data-00823-en (accessed on 04 May 2018).

2.1.2. Productivity

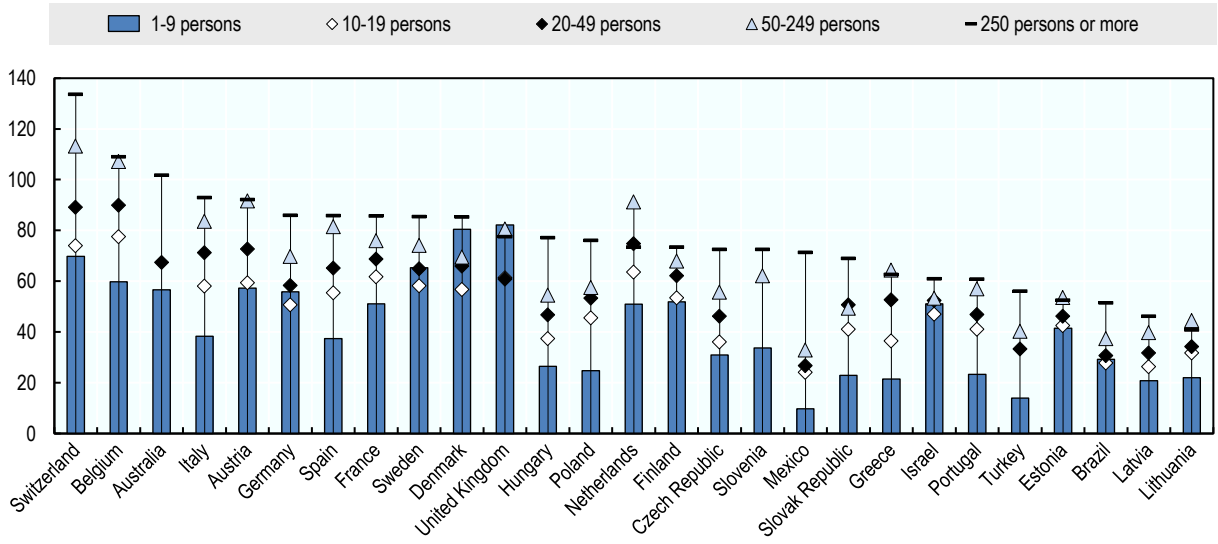
Aggregate productivity measures the efficiency with which labour and capital are used to produce value in a country. Labour productivity in Portugal is low in international comparison, especially for micro-enterprises (1-9 employees) and large firms (Figure 2.3). Low productivity is pervasive across sectors: out of the 19 NACE (Statistical classification of economic activities in the European Community) two-digit sectors in which Portugal is the most specialised, only five had a productivity surpassing the EU27 average[2] (FCT, 2013).

Labour productivity in Portugal was on a path to convergence with advanced (EU15) economies from the 1970s until the 1990s, as a result of increased capital investment, macro-economic reforms and a shift in labour allocation away from agriculture and traditional industries and towards more productive service sectors (Pinheiro Alves, 2017b). Productivity growth has since slowed in comparison to other advanced economies. The contribution of the capital stock to labour productivity growth has declined over the last few years (Table 2.1), as the movement of capital from low to high productivity firms has slowed by half.

Lack of investment is an important bottleneck for productivity growth in Portugal. Total investment significantly decreased in the wake of the last recession: investment in 2015 was over 30% below the 2005 level, with private and public investment accounting for similar shares of the decline (OECD, 2017b). Since 2012, investment has barely exceeded the depreciation of the existing capital stock, meaning there has been virtually no real growth in the productive capital stock. This comes in addition to declining labour inputs (Table 2.1), as employment has fallen due to demographic decline, low labour participation and high unemployment.

Figure 2.3. Aggregate labour productivity by enterprise size, business economy

Value added per person employed, thousands of USD, current PPPs, 2014, or latest available year.



Note: Data for Israel and Mexico refer to 2013. Data for Switzerland correspond to value added per employee. Data for Mexico refer to establishments. Data for Switzerland exclude enterprises with less than 3 persons employed.
Source: OECD (2017), Entrepreneurship at a Glance 2017, OECD Publishing, Paris, https://doi.org/10.1787/entrepreneur_aag-2017-en.

Multifactor productivity growth represents the change in output that cannot be explained by an increase in inputs (i.e. labour and capital) and is assumed to reflect increased use of knowledge, technological or organisational progress and innovation. From the 1970s to the 1990s, growth in MFP in Portugal was higher than that of the EU15, Japan and the United States. However, MFP slowed at the end of the 1990s and has stagnated since (Table 2.1 and Figure 2.4), despite improvements in factors conducive of MFP growth such as educational attainment, investments in R&D and in ICT capital, internationalisation of firms and enterprise creation. Possible factors leading to MFP stagnation include the consumption-based growth model, a focus in the economy on non-tradable sectors (which had low or negative MFP growth) and insufficient investment (Pinheiro Alves, 2017b). Similar trends have been observed in Greece, Italy and Spain, where MFP either stagnated or decreased during the first decade of the 21st century (Dias *et al.*).

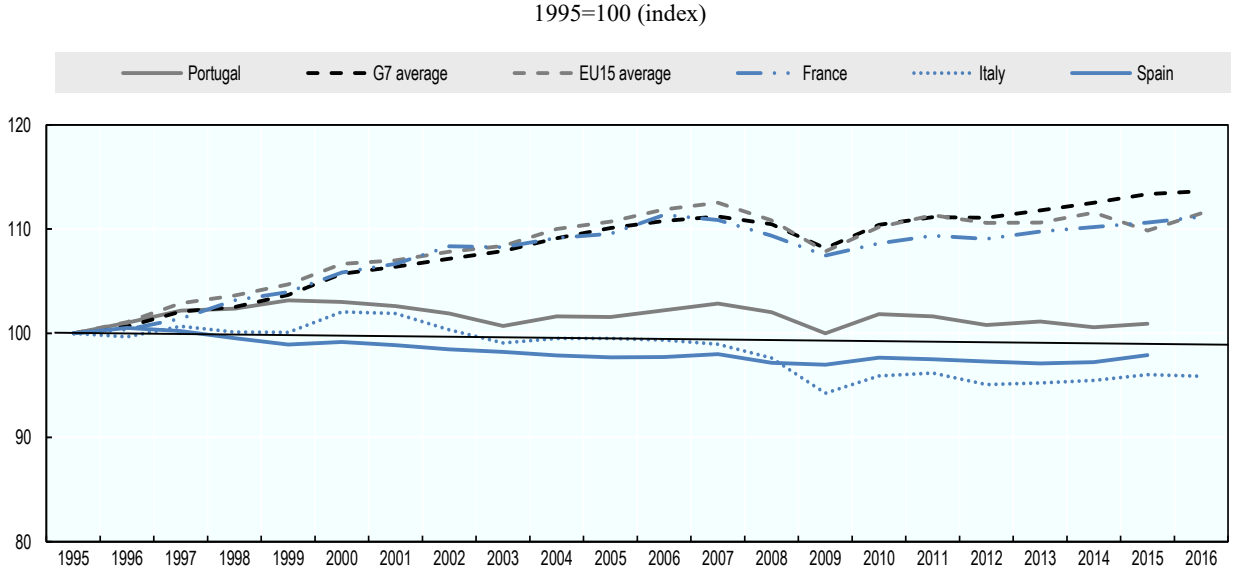
Between 2000 and 2013 productivity increased more quickly in Portugal's less developed regions – as employment in low-productivity industries declined – than in the economic centres of Lisbon and Porto. This led to convergence in productivity rates across the national territory – a pattern that contrasted with trends in the OECD as a whole, where the 10% most productive regions experienced the fastest productivity growth rates and widened the gap with less productive regions (OECD, 2016b).

Table 2.1. Growth and productivity

Average annual growth rates (%)		2003-09	2009-15
GDP per capita		0.5	-0.1
Labour utilisation		-0.6	-0.9
of which:	Labour force participation rate	0.1	-0.5
	Employment rate[1]	-0.6	-0.6
Labour productivity		1.2	0.8
of which:	Capital intensity (capital stock per labour hour)	1.7	0.8
	Multi factor productivity	-0.5	0.0

Note: 1. The employment rate is defined with respect to the economically active population; a positive growth rate corresponds to a decline in the structural unemployment rate and vice-versa. 2. An adjustment variable is added to the decomposition to capture the impact of non-resident workers.
Source OECD (2017a), "Portugal", in *Economic Policy Reforms 2017: Going for Growth*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/growth-2017-42-en.

Figure 2.4. Multifactor productivity growth in Portugal and selected EU countries, 1995-2016



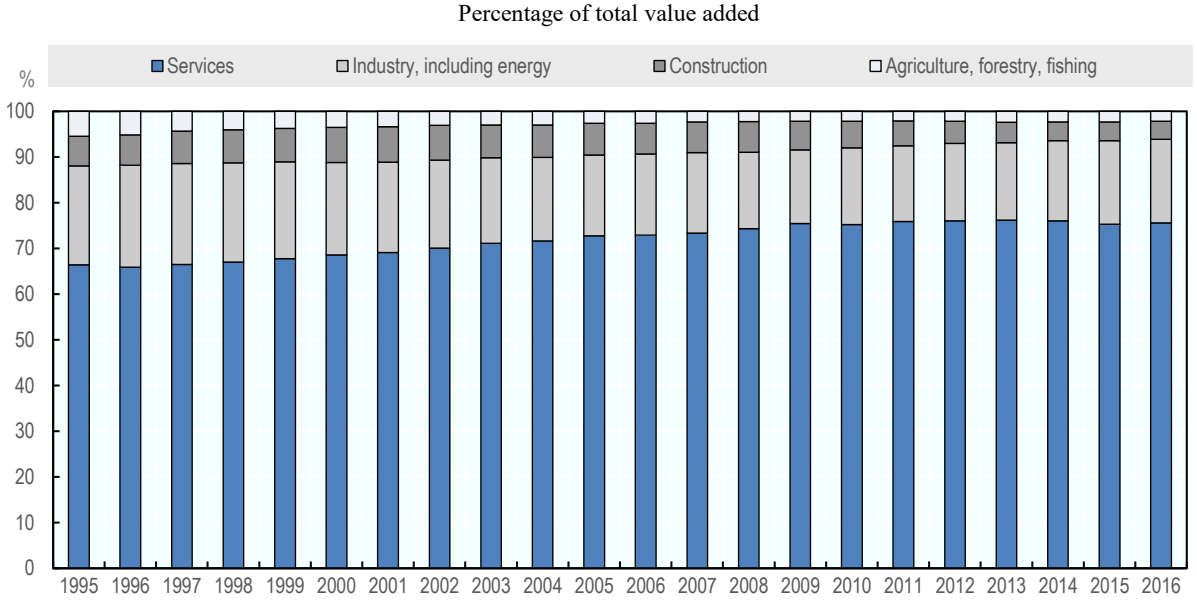
Note: EU 15 average does not include data for Austria, Greece and Luxembourg.
Source: OECD (2018c), productivity database, http://dx.doi.org/10.1787/pdtvy-data-en downloaded on 2 August 2018

2.1.3. Economic structure

The sectoral structure of the economy has an impact on countries' growth potential, particularly in emerging economies. As in most OECD countries, service sectors now dominate the economy in Portugal; their share of added value increased markedly between 2000 and 2016 (Figure 2.5) Services made up 75% of value added and accounted for 67% of total employment in 2015 (Corado Simões et al., 2017). Manufacturing has never represented a large share of the value added in Portugal, as resources were shifted directly from the agricultural sector to sectors characterised by low productivity growth (construction, trade, market and non-market services) (Pinheiro Alves, 2017b). The most important sectors of the Portuguese economy in 2015 were wholesale and retail trade[3] (25%); community, social and personal services (23%); and real estate, renting and

business activities (19 %). Manufacturing accounted for 14% of added value (OECD, 2017d).

Figure 2.5. Value added by activity of Portugal, 1995-2016



Note: Value added reflects the contribution of labour and capital to production. Value added by activity breaks down the total value added by sector, namely agriculture, industry, utilities, and other service activities. The shares of each sector are calculated by dividing the value added by each sector by total value added. The breakdown of value added by activity has changed considerably over recent decades. The share of agriculture is now relatively small in almost all OECD countries. The share of industry has also fallen while services now account for well over 60% of total gross value added in most OECD countries. Data are under 2008 System of National Accounts (SNA 2008) for all countries except for Chile, Japan and Turkey (SNA 1993).
Source: OECD (2018d), National Accounts of OECD Countries, Volume 2018 Issue 1: Main Aggregates, OECD Publishing, Paris. http://dx.doi.org/10.1787/na_ma_dt-v2018-1-en

In comparison to the average in EU economies, the Portuguese economy has high relative specialisation in sectors[4] of low or medium-low technological intensity, both in terms of relative share of value added and employment. Footwear, clothing, air transport and textiles are the highest ranked according to the Value Added Specialisation Index,[5] which measures the ratio of the importance of a sector in terms of value added as compared to the EU27 average[6] (FCT, 2013). A finer sectoral analysis reveals Portugal's relative specialisation in 19 NACE 4-digit technology-intensive activities, including manufacture of electronic and transport equipment and chemical products, telecommunication and scientific R&D. However, most of these sectors have a lower productivity performance in Portugal than the EU average in the same sectors (see section 2.1.2). Overall, high- and medium-high-technology sectors represent only around 4% of value added in Portugal.

Exports data confirm this diagnosis. Road vehicles represented the main share of exports from Portugal in 2013-15 (10.4%), followed by petroleum and petroleum products (8.2%) and clothing and accessories (5.8%). Exports have diversified over the past two decades: they were much more concentrated in 1988-90, with clothing and accessories making up 20.8% of merchandise exports followed by textile yarn and fabrics[7] (8.7%) and footwear (7.9%) (OECD, 2017b). 75% of Portugal's exports and 78% of its imports are made within the EU, in particular Spain, France and Germany (European Commission, 2017b).

Virtually all firms in Portugal (over 99%) are SMEs, and in particular micro-enterprises with less than nine employees. SMEs contribute 68.5% of added value in Portugal, above the EU average of 56.8%, and also account for one of the highest shares of employment in the OECD (78.1%) (European Commission, 2017b).

2.1.4. Employment and skills

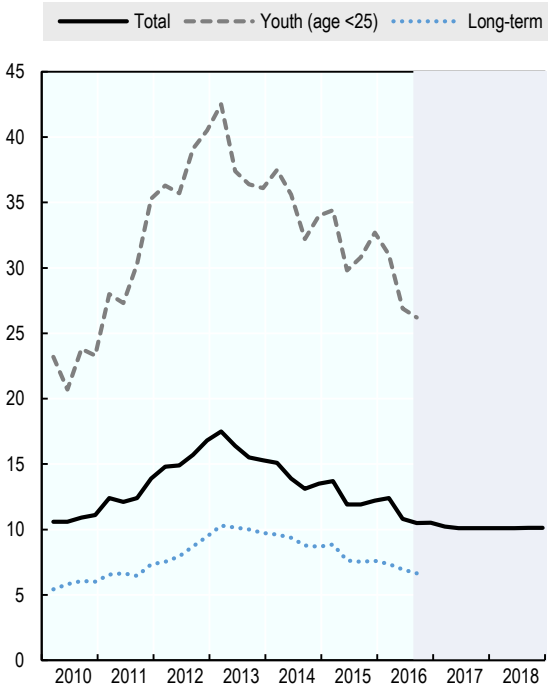
Unemployment in Portugal has been declining, but remains high at 9% (Figure 2.6 et Figure 2.7) Young people have been particularly affected: one-third of those aged below 24 and more than a quarter of those below 30 were unemployed in 2016 (OECD, 2017b). Long-term unemployment rates are falling more slowly than the general unemployment rate, reaching 6.2% in 2016, following a peak of 10.3% in 2013.

In contrast to other OECD countries, unemployment rates in Portugal for adults who have not completed upper secondary education are similar to those of workers who have attained this level of qualification (10.1%). Adults with higher education have lower unemployment rates (6.6%) as in many countries (Figure 2.7), although the employment rate of young higher education graduates (aged 25-34) fell from 91% in 2000 to 82% in 2016 (compared to an OECD average of 83%). The relatively limited employment advantages for more highly qualified individuals is likely to stem from the difficulty of accessing permanent, secure employment, limited managerial skills in private firms and a lack of co-operation between science and industry, which has hindered creation of knowledge-intensive jobs (OECD, 2017a). Among EU countries, Portugal has one of the highest shares of young workers, including higher education graduates, in temporary contracts (OECD, 2017b). Portugal's labour market is highly segmented into permanent and temporary contracts due to a large gap in protection between contract types (OECD, 2014a). Substantial labour market reforms undertaken since 2011 have reduced the rigidity of labour markets, but segmentation between long-term and temporary contracts remains (OECD, 2017b).

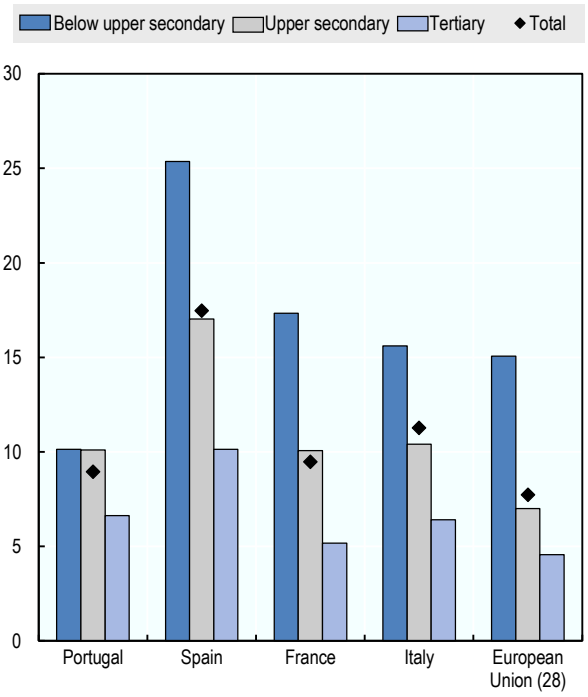
Portugal has succeeded in greatly expanding participation in education in the last two decades. As a result, the level of qualification of the Portuguese workforce has improved significantly, in particular among young adults (Figure 2.7). In 2016 about 67% of 25-34 year-olds had attained at least upper secondary education, a significant increase from 24% of 55-to-64 year-olds. The share of young adults (aged 25-34) who have attained higher education has also risen considerably – from 19% in 2005 to 35% in 2016 – although this remains below the OECD average (43%) and EU and national targets. Overall, Portugal still lags behind other OECD countries in terms of overall qualification levels, with a third of young adults not having completed upper secondary education compared to the OECD average of 16%.

Figure 2.6. Unemployment

A. Unemployment rates



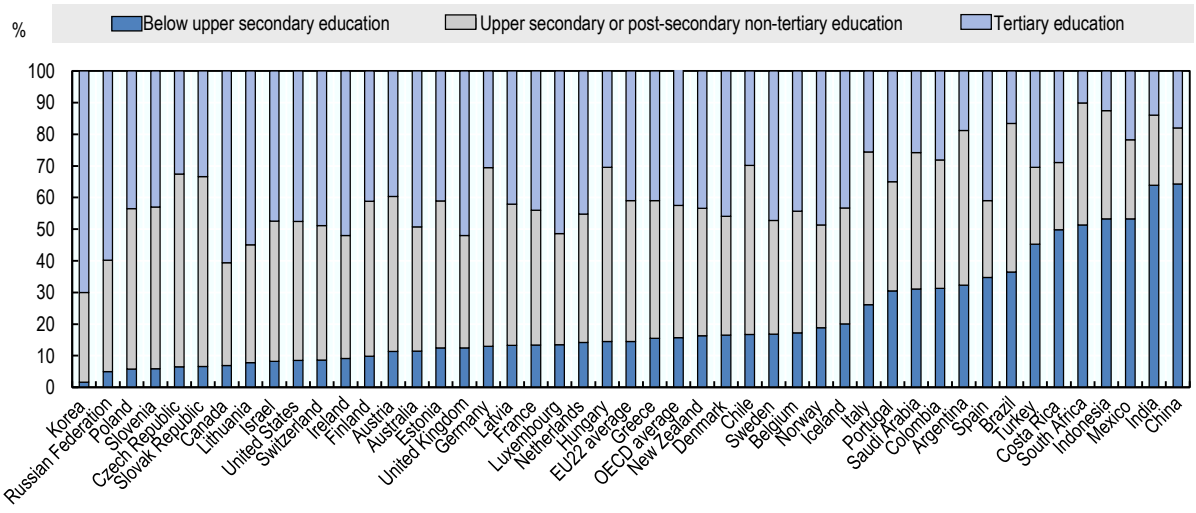
B. Unemployment rates by educational attainment (age 15-74) in 2017



Note: Panel A Data from 2016 onwards is based on extrapolations. Youth unemployment refers to unemployed persons as a share of active population under 25 years old. Long-term unemployment refers to unemployed persons who have been looking for jobs for 12 months or more as a share of the total active population.
Source: Panel A: OECD (2018e), OECD Economic Outlook No. 102 (Edition 2017/2), OECD Economic Outlook: Statistics and Projections (database), *http://dx.doi.org/10.1787/05b705e7-en* (accessed on 04 May 2018
Panel B: Eurostat (2018), "Labour Force Survey series – detailed annual survey results", Eurostat Database, http://ec.europa.eu/eurostat/cache/metadata/FR/lfsa_esms.htm (accessed on 9 February 2018).

While the level of qualification of the Portuguese workforce has improved, there is evidence that Portugal faces shortages of higher level technical and professional skills. In interviews with the OECD Review team, employers identified a lack of technical and scientific skills as a barrier to recruitment, in particular in STEM fields.

Figure 2.7. Educational attainment of 25-34 year-olds, 2016



Note: Year of reference differs from 2016 for Argentina, Brazil, Chile, China, India, Indonesia, Ireland, Russian Federation, Saudi Arabia and South Africa. Refer to the source table for more details. United Kingdom's data for upper secondary attainment include completion of a sufficient volume and standard of programmes that would be classified individually as completion of intermediate upper secondary programmes (1% of adults aged 25-64 are in this group). Data for Argentina should be used with caution.
Source: OECD (2017f), *Education at a Glance 2017: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2017-en

2.1.5. Framework conditions for business

Portugal does relatively well in the OECD Product Market Regulation (PMR) indicator, which measures how favourable national regulations are to economic activities. Portugal ranked 12th in the OECD in 2013, the latest edition of the PMR indicator (OECD, 2015a).

Portugal enjoys a dynamic business environment with a high rate of enterprise creation and a reasonably supportive regulatory and incentive environment for entrepreneurs, strengthened by recent reforms. However, the survival rate of young firms is low and business innovation is stifled by limited access to investment, especially among small firms. The country has made strong progress in reducing administrative burdens for business. Procedures for business creations have been simplified and costs and delays have been cut down (OECD, 2017a). Recent measures were introduced to advance these improvements. The *Simplex+* programme in 2016, which continued efforts made by the *Simplex* programme (2006-2011) and the *Simplificar* Programme (2014), focuses on administrative simplification and e-government. The *Aproximar* programme aims to improve public service delivery by introducing local kiosks and mobile units to reach low-density areas in complement to the existing network of one-stop shop for public services. Use of online public services has also been promoted (OECD, 2015b).

As a result of these efforts, Portugal ranks 29th out of 190 countries in the 2017 World Bank Ease of Doing Business ranking, close to Spain and France (respectively 28th and 31st) and significantly ahead of Italy (46th). Among the 10 categories of indicators of this ranking indicators, Portugal performs exceptionally well in terms of ease of trading across borders (ranking first). By contrast, in terms of ease of obtaining credit, Portugal compares unfavourably to a lot of countries: it ranks 105th on this indicator.

Another key factor is the ability of businesses to access finance to invest. This is a challenge for Portuguese firms which are still heavily indebted and only have limited access to external credit. This strongly limits the capacity to invest in and upgrade the production capacity of all firms, including high-potential companies. The scope for internal financing has also diminished in recent years as the average profitability of non-financial companies[8] declined from nearly 12% in 2010 to below 9% over the period 2011-14.

Credit to non-financial corporations continues to contract, although at a decreasing rate, mirroring the situation in most of the euro area (OECD, 2017b). Credit is also expensive. In a recent survey by the European Central Bank on SME financing, access to finance and high interest rate are cited as the principal limiting factors to get external financing in Portugal (ECB, 2016). The World Bank Global Innovation Index (GII) 2017 identifies access to credit as a weakness in Portugal's market conditions for innovation: for this composite index, Portugal ranks 84 out of 127 economies, much lower than its overall GII ranking of 31 (World Bank, 2018).

Against this backdrop, the current government has made the SME access to finance a major priority. Several programmes were recently launched to improve this situation, notably the *Capitalizar* programme, which in 2016 included over 60 new measures to improve businesses' access to financing and equity instruments. Several credit lines targeting SMEs and offering guarantees and preferential conditions have also been launched (OECD, 2018f). In addition, the Start-up Portugal programme aims to broaden market-based finance for SMEs (OECD, 2015d). The Portugal Venture Capital Initiative (PVCi) set up by the European Investment Fund (EIF) and other public and private actors in 2007 has also been a catalyst for the development of the venture capital and private equity market in Portugal during its investment period (EIF, n.d.).

As a result of national and EU investments, Portugal enjoys a high broadband coverage, with 33.6 subscriptions per 100 inhabitants. Portuguese firms are well connected to the Internet (96.3% of all firms have a broadband subscription), above the OECD average of 95.6%. Small firms (49 employees or less) fare worse than medium and large firms for which the coverage is virtually complete), a common pattern across the OECD. In terms of mobile broadband, Portugal's penetration is among the lowest in the OECD (65 subscriptions per 100 inhabitants).

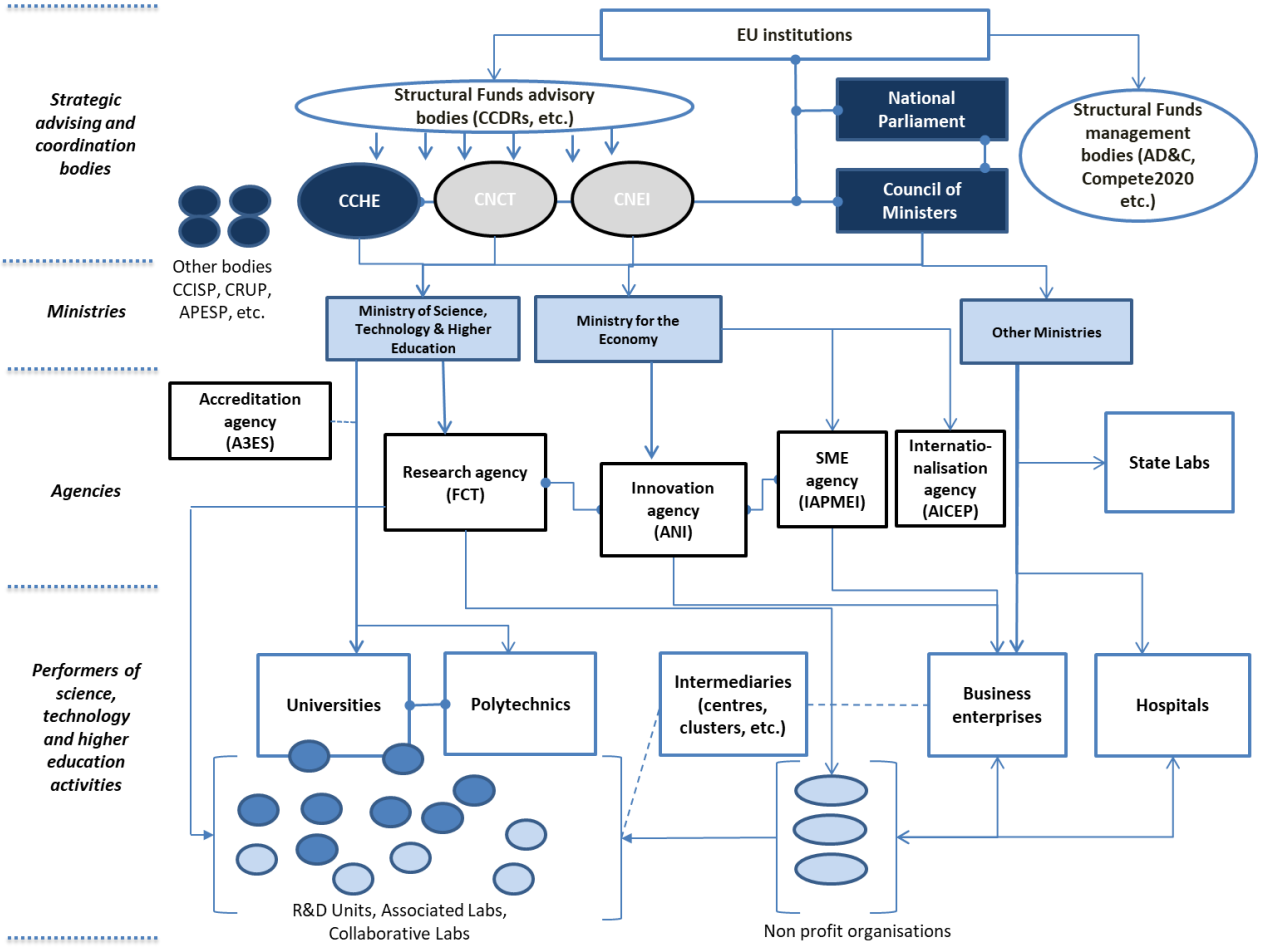
2.2. Overview of the higher education, research and innovation system (HERI) in Portugal

2.2.1. Overall structure of the HERI system

Portugal has a centralised state. It has no independent tier of government at regional level, and local authorities have limited responsibilities compared to counterparts elsewhere in the OECD (OECD, 2017e). This pattern is reflected in the governance and funding of the higher education, research and innovation system, in which the central government has exclusive responsibility for higher education. Most European funding for research and innovation is administered at the regional level through regional Operational Programmes, Portugal's regional managing authorities. However, these are unelected bodies that act within strict national and EU frameworks.

The national HERI system in Portugal (Figure 2.8) functions at four broad levels.

Figure 2.8. Structure of the Portuguese HERI system



At the highest level, the Portuguese government (Council of Ministers) has collective responsibility for higher education, research and innovation policy and for setting strategic direction. It is also responsible for implementing EU Structural and Investment Funds in Portugal within guidelines set by and agreed at EU level. Advice to government on research issues is provided by the National Council for Science and Technology (*Conselho Nacional de Ciência e Tecnologia,* CNCT), and on innovation and entrepreneurship by the National Council on Entrepreneurship and Innovation (*Conselho Nacional de Empreendedorismo e Inovação*, CNEI).

The second tier of governance is composed of individual line ministries, headed by ministers with a specific portfolio. A ministry in charge of research was established in 1995, and higher education and research have been under the responsibility of a single, dedicated ministry since 2002, apart from 2011-2015 when these responsibilities were merged into a single Ministry of Education and Science. The Ministry of Science, Technology and Higher Education (*Ministério da Ciência e Tecnologia e Ensino Superior*, MCTES) has responsibility for higher education, public research and science-based innovation activities involving HEIs and public research units supported by MCTES. The Directorate-General of Higher Education (*Direção-Geral do Ensino Superior*, DGES) is responsible for

ensuring the design, implementation and co-ordination of higher education policies developed by the MCTES. The ministry regulates the higher education sector, including through establishing admissions policies setting the total number of student places for all study programmes in both the public and private sectors. The Co-ordinating Council for Higher Education (*Conselho Co-ordenador do Ensino Superior*, CCES) advises MCTES on higher education policy. Primary responsibility for business innovation policy lies with the Ministry of the Economy. Important prerogatives are also in the hands of the Ministry of Planning and Infrastructure, which is in charge of the management of the EU structural funds in various areas, including regional development, sea and fisheries, and agriculture, among others.

The third tier of governance is composed of agencies with implementation or regulatory responsibilities. The Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*, FCT) manages project-based funding of public research and carries out associated *ex ante* evaluations of research projects and centres. The national innovation Agency (*Agência Nacional de Inovação*, ANI), created in 1997 and reestablished in 2014, manages incentive programmes targeting businesses and technological interface centres. It aims to foster technology transfer and knowledge promotion and focuses on collaboration. ANI also manages the tax incentive scheme "System of Fiscal Incentive for Business R&I" (*Sistema de Incentivos Fiscais à I&D Empresarial*, SIFIDE). The Competitiveness and Innovation Agency (for the support of SMEs) (*Agência para a Competitividade e Inovação*, IAPMEI) aims to foster innovation activities and boost competitiveness of Portuguese firms through financial support as well as business support services and training. Portugal Global – Trade & Investment Agency (*Agência para o Investimento e Comércio Externo de Portugal,* AICEP) was created in 2007 to encourage investments in Portugal by foreign companies as well as support internationalisation of Portuguese companies. The Agency for Assessment and Accreditation of Higher Education (*Agência de Avaliação e Acreditação do Ensino Superior*, A3ES) is an independent foundation tasked with the evaluation and accreditation of higher education institutions and their study programmes, with the objective of ensuring the quality of the higher education system.

The fourth level of the HERI system is composed of the organisations that carry out the work of teaching, research and knowledge-based innovation, including higher educational institutions and public research organisations affiliated to them. In 2018, Portugal had 118 higher education institutions, 39 of which were public – 14 universities and 20 polytechnics. It had 79 private higher institutions – 24 universities and 55 polytechnics. Additionally, its higher education system included five public military institutions, which were outside the scope of this review (Table 2.2).

The 2007 Legal regime for higher education institutions (*Regime Jurídico das Instituições de Ensino Superior*, RJIES) defines the missions and the scope of autonomy enjoyed by higher education institutions in Portugal. Portugal has a binary structure in which polytechnics are legally responsible for providing professionally-oriented study programmes, while universities are responsible for providing theoretically-led academic programmes. Polytechnics are distinguished in the legal framework by their focus on professionally oriented studies and 'targeted research' (*investigação orientada*) and the fact they are only entitled to award bachelor and Master's degrees, but not doctorates, which can only be awarded by universities.

Table 2.2. Higher education institutions, by sector (2016-17)

	Public	Private	Total
University	14	24	38
Polytechnic	20	55	75
Other	5	n/a	5
Total	39	79	118

Note: The category "Other" includes military and police higher education, which are not the subject of this review.
Source: MCTES, 2017.

The majority of HEIs, and in particular those in the private sector, are located in coastal regions with greater population density and more dynamic labour markets, such as the metropolitan areas of Lisbon and Porto. Public polytechnics are more dispersed throughout the country and are present in 47 municipalities, whereas public universities are located in 16 municipalities, private universities in 13 municipalities and private polytechnics in 28 (MCTES, 2017).

Higher education institutions in Portugal are key actors in the research and innovation system, accounting for a large share of research expenditure and the research workforce. In contrast to higher education systems in which academic departments play a leading role in organising research activities, the R&D activities of Portugal's higher education institutions are principally organised by R&D units. These units may contain researchers from a single higher education institution; a set of higher education institutions; or contain researchers who are employed outside a higher education institution, such as a private (non-profit) foundation or a state laboratory.

After the democratic revolution of 1974, Portugal had few universities with weakly developed research capacities and cultures. To stimulate the development of high-performing research groups within its higher education system, central government authorities chose to provide research funding directly to designated R&D units that were chosen through a competitive process organised by the FCT, rather than provide untargeted research support to universities and the existing faculties and departments.

R&D units are currently selected though a process of peer review organised by the FCT, and funded for a period of three years. In 2017, there were 307 R&D units in which 40 000 researchers participated, of which 22 000 had a PhD. More than two-thirds of R&D centres were hosted by higher education institutions, while the remainder were located in Associated Laboratories (*Laboratórios Associados*) or, less often, private foundations.

Associated Laboratories form a key feature of the nation's research and innovation landscape. At the instigation of MCTES, high-performing R&D units were encouraged to join together to create research units of critical mass and excellence. In 2000, the first cohort of four associated laboratories was chosen by FCT following evaluation by an international scientific panel and awarded dedicated multi-year institutional funding to support their further development. By 2018, a total of 26 Associated Laboratories had been recognised by FCT, each holding this designation for a ten-year period. The Institute for Systems and Computer Engineering, Technology and Science (*Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência*, INESC TEC), for instance, hosted 13 R&D Centres, over 700 researchers, and had a 2016 annual turnover of EUR 14 million.

Portugal's nine State Laboratories also perform R&D, each operating under the direct supervision of a line ministry. Successive governments have chosen to focus on funding

research performed in higher education institutions and associated laboratories, rather than State Laboratories. Thus, their role in performing research has diminished compared to past decades. State Laboratories accounted for only 3% of GERD in 2015, as compared to 11% in OECD countries, on average. State Laboratories have been the object of several reforms over the past decades. In 2016, their legal statuses were changed to corporate entities or "autonomous funds and services of a business nature" (Resolution of the Council of Ministers No. 124/2006, of 3 October). In the context of the "Plan to Reduce and Improve Central Administration" (*Plano de Redução e Melhoria da Administração Central)* (PREMAC), the network of State laboratories was reorganised to optimise resource allocation, through mergers and creation of new laboratories (FCT, 2013).

2.2.2. The higher education system: inputs, participation, and outcomes

Funding higher education

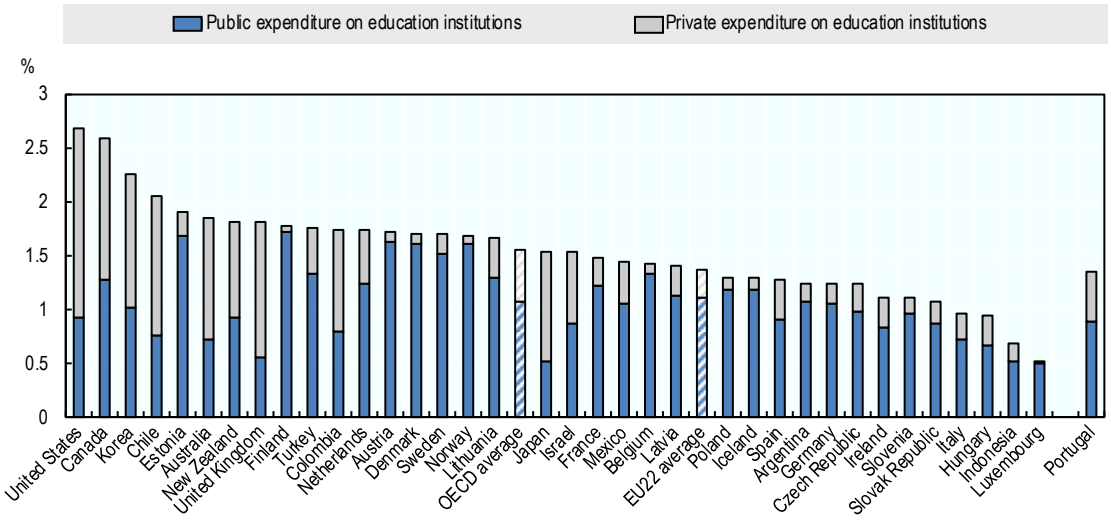
Total public and private expenditure on higher education in Portugal is equivalent to 1.4% of GDP, 0.9% of which is from public funds, and another 0.5% from private sources. While this total is slightly lower than the OECD average (1.6%), the share of national income allocated to higher education is slightly higher than that of higher education systems in the region, such as Spain (1.3%) or Italy (0.9%) (Figure 2.9) (OECD, 2017e).

While Portugal commits a share of national income only modestly below the OECD average, its GDP per capita is significantly lower than the OECD average (71%), thus annual expenditure per student by educational institutions is below the OECD average for all levels of education, especially at the higher education level. In Portugal, educational institutions spend USD 6 700 per student in higher education programmes, which is about USD 4 000 per student less than the OECD average (OECD, 2017f).

Expenditure on higher education decreased by 9% between 2010 and 2014. As the number of higher education students also fell during that time, the resulting decrease in expenditure per student was only 3%, but this was against an average increase of 6% across OECD countries in the same period (OECD, 2017). This lower expenditure was mostly driven by lower spending on educational core services (OECD, 2017f). Portugal allocated 10% of its annual expenditure by educational institutions per student to ancillary services (transport, meals, housing) and 90% to educational core services – compared to the OECD average of 6.5% and 93.5% (Figure 2.10) (OECD, 2017f).

Figure 2.9. Public and private expenditure on educational institutions

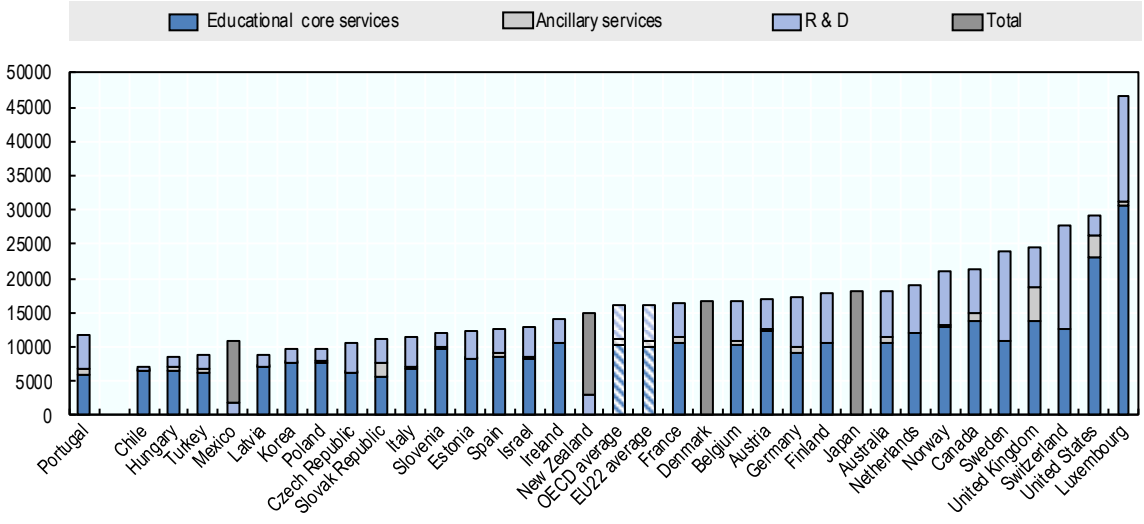
% of GDP in higher education, 2016



Note: The year of reference is 2015 for Chile, Colombia. Public does not include international sources for Australia, Chile, Japan. Expenditure on public institutions for bachelor's, master's and doctoral degrees for Korea, Indonesia and Slovak Republic.
Source: OECD (2017f), *Education at a Glance 2017: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2017-en.

Figure 2.10. Annual expenditure per student by educational institutions for core educational services, ancillary services and R&D, 2014

In equivalent USD converted using PPPs



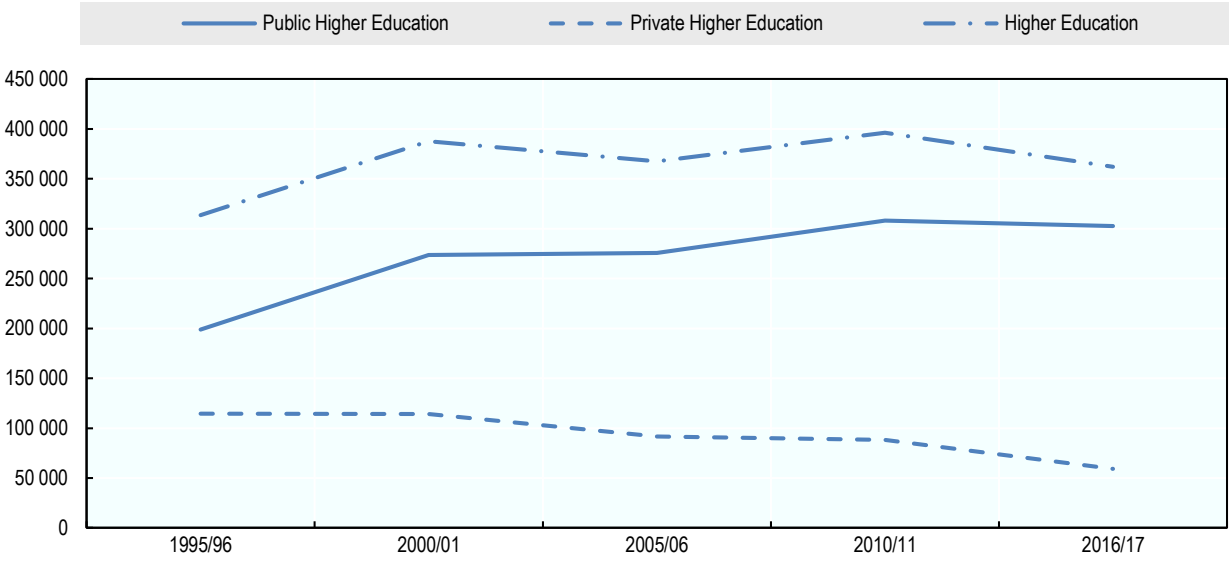
Note: Public institutions only for Canada, Luxembourg and the Slovak Republic. Ancillary services correspond to transport, meals, housing provided by institutions.
Source: OECD (2017f), *Education at a Glance 2017: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2017-en.

Participation in higher education and equity in access

Overall, in the academic year 2016-17, 361 943 students were enrolled at all levels of higher education. The majority of students (65.8%) were enrolled in universities and 35% in polytechnics. Another 1 794 students were enrolled in short-cycle non-higher education programmes.

Portugal has succeeded in greatly expanding participation in education in the last two decades. The nation's higher education system, which grew from 24 000 students in the 1960s to 400 000 in 2010, spurred by a growth in demand for higher education among expanding age cohorts, and the added supply of study places (MCTES, 2017). Declining numbers of young adults have led to declining enrolments (Figure 2.11) (Fonseca et al., 2014), with total numbers in 2015/2016 decreasing to 360 000 (MCTES, 2017). The private higher education sector has been particularly affected, with enrolments declining from 114 641 (1995/96) to 58 515 two decades later. While it accounted for 37% of students enrolled in higher education in 1995/1996, its share declined to 16% in 2015/2016 (MCTES, 2017).

Figure 2.11. Number of students enrolled in higher education institutions



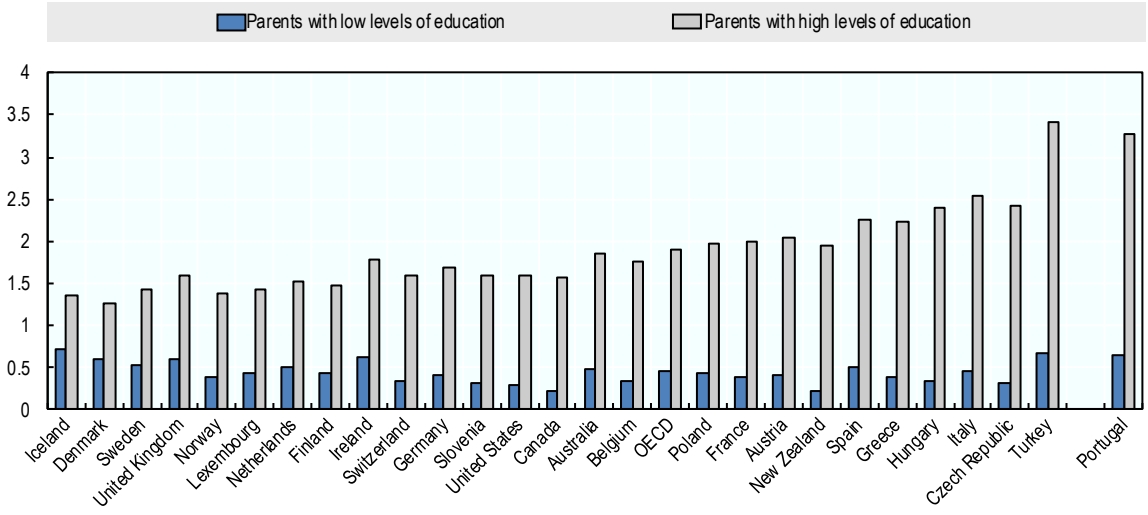
Note: Number of students enrolled including students enrolled in CTeSP.
Source: MCTES (2017), Country Background Report, MCTES.

The expansion of higher education has led to an increasing diversification of the profile of higher education students in Portugal, a phenomenon that has also been observed across OECD and partner countries. An increasing number of higher education students do not follow the traditional path into full-time study immediately following graduation from upper secondary education.

Despite increasing diversification of the higher education student population, young people from families with low levels of education still have a lower probability of participating in higher education than their peers from more advantaged backgrounds, and the gap in participation probabilities is wider in Portugal than in many OECD countries (Figure 2.12).

Figure 2.12. Relationship between students' participation in higher education and socio-economic status

Odds ratio of being a student in higher education by parents' educational level, 2009[1]



Note: This figure shows the odds of someone from a low (or high) educational background attending higher education. The odds ratio is calculated by comparing the proportion of parents with low (or high) levels of education in the total parent population to the proportion of students in higher education whose parents have low (or high) levels of education. If young people from a low (or high) educational background were as likely to attend higher education as those from more (or less) educated families it would result an odds ratio equal to 1. Countries are ranked in increasing order of difference between the odds ratios of being a student in higher education with low and high educational backgrounds.
Source: OECD (2012), Education at a Glance 2012: OECD Indicators, OECD Publishing, Paris, https://doi.org/10.1787/eag-2012-en.

2.2.3. Research and innovation: inputs and performance

Overall investment in research and innovation in Portugal – as measured by gross domestic expenditure on research and development (GERD) – is lower than in most OECD countries, and has been severely affected by the crisis. Research and Development expenditure in higher education (HERD) is comparatively higher, standing around the OECD median (OECD, 2018g). Indeed, HEIs carry out a large proportion of research and development expenditure and employ the lion's share of the research and development workforce, especially at higher qualification levels. They also perform well in terms of research and innovation outputs when compared to other OECD countries, including in terms of patenting. In contrast, the private sector lags behind in terms of investment in research and development, with a GERD intensity at the lower end of the OECD spectrum. This situation is reflected in innovation outputs, where the performance of the private sector is mixed.

Expenditure and funding

Investment in research and innovation in Portugal is lower than in most OECD countries, both in terms of GERD as a share of GDP and in terms of expenditure per capita. R&D expenditure is mostly concentrated in applied research and experimental development with almost equal shares of of GDP (0.5%), while basic research accounts for 0.3% of GDP, a distribution that is similar to countries with comparable R&D intensities.

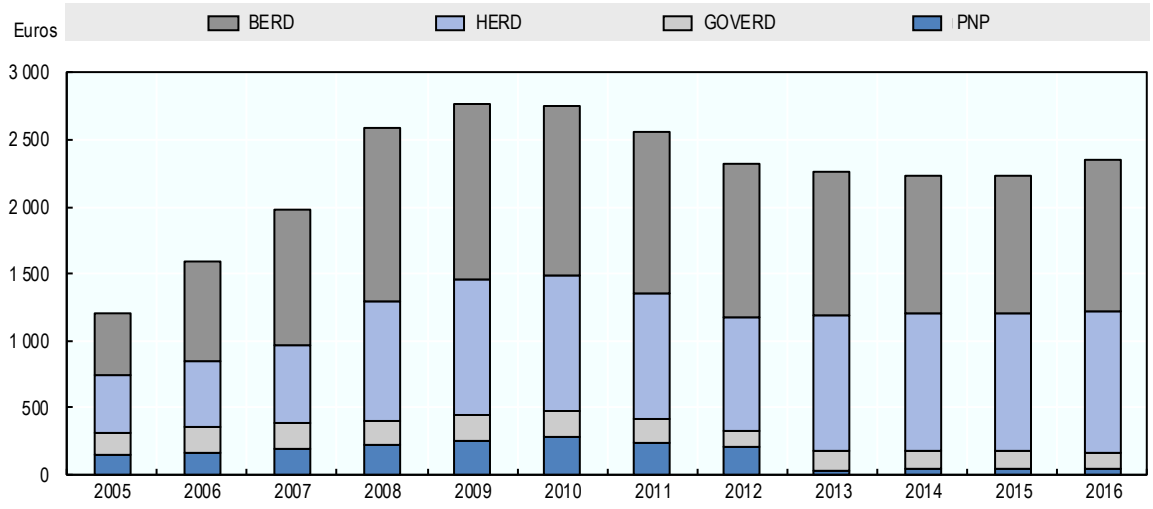
Following the 2008 economic crisis, GERD in Portugal declined from EUR 2.8 billion in 2009 to EUR 2.2 billion in 2015 (-19%), following a phase of steady expansion from 2005 to 2009 (Figure 2.13). R&D intensity also declined over the same period reaching 1.3% in 2016, slightly below the OECD median (1.6%). The public sector carried out 50% of R&D expenditure in 2016, mostly within the higher education sector, while the private sector was responsible for 50%. The decline in GERD was most pronounced in government expenditures on research and development (GOVERD), which contracted by 28% over 2009-2015, mainly driven by the declining role of state laboratories. This decrease was not compensated by higher education institutions' expenditures (HERD), which decreased by 2% over the same time period. However, a large share of R&D expenditures still occurs in universities representing 45% of the GERD and 0.58% of GDP in 2016. In terms of HERD per capita, Portugal is around the OECD median, ahead of France, Spain and Italy (Figure 2.14). The decrease of business expenditures for research and development (BERD) between 2009 and 2016 was particularly pronounced (Figure 2.15).

This slump was mainly caused by the financial crisis, which reduced firms' capacity to invest in R&D. However, business spending on research and development has been historically low in Portugal. At 46% of GERD in 2015, it was far below the OECD average of 69% (OECD, 2017g). One of the key reasons for the low level of BERD in Portugal is that the country has few large R&D-performing firms. The main ones in 2015 were Portugal Telecom (PT) (telecom), SONAE (distribution), Grupo Banco Comercial Português (finance) and BIAL (pharmaceuticals). The limited role of large domestic companies in R&D is not compensated by multinational enterprises (MNEs), in part due to difficulties in attracting foreign capital for R&D in the post-crisis economic context (Godinho et. al., 2016).

55% of business R&D expenditure was carried out in service sectors in 2016 in Portugal, one of the highest shares in the OECD. The financial sector plays a relatively important role in R&D expenditures (mainly dedicated to IT system development to respond to improve their operations), with at least two banking corporations in the top 10 R&D performers. In the manufacturing sector, only 53% of R&D expenditure were carried out in medium-high or high R&D intensity sectors in 2016: a particularly low rate in international comparison (OECD, 2017g).

Firms largely self-finance R&D expenditures. Public support to BERD in Portugal remains low, covering 4% of business expenditure on R&D in 2016, below the OECD median (Figure 2.16). In 2016, 6.9% of BERD was financed by funds from abroad in 2016. The majority of this funding came from international organisations (OECD, 2017g) with the EU R&D Framework Programmes playing an important role (MCTES, 2017). EU Framework programme funding to beneficiaries based in Portugal almost trebled in 15 years, growing from EUR 224 million in 2000 to EUR 663 million in 2015. This increase has offset, in part, decreased national funding for R&D over the same period.

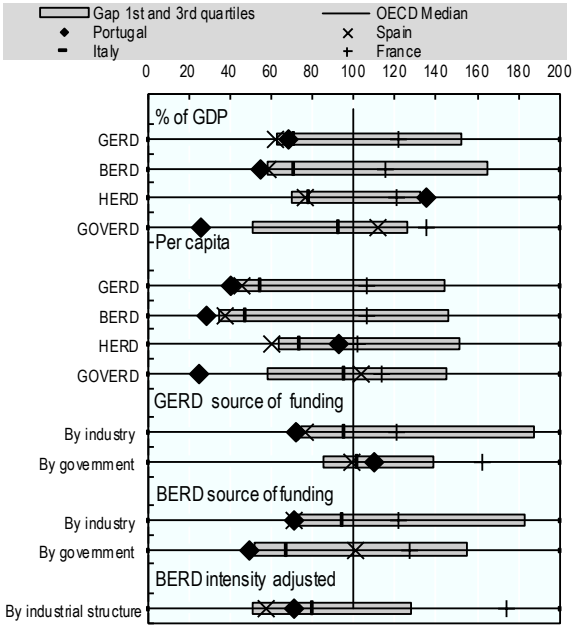
Figure 2.13. Portugal's total R&D expenditures by sector of performance, 2015



Note: Values for 2016 are provisional. Values for 2006 are national estimates or projection. Break in series occurs in 2008.
Source: OECD (2018), OECD R&D Statistics (RDS) Database, www.oecd.org/sti/rds (accessed on 2 August 2018).

Figure 2.14. International comparison R&D expenditure in Portugal and selected OECD countries

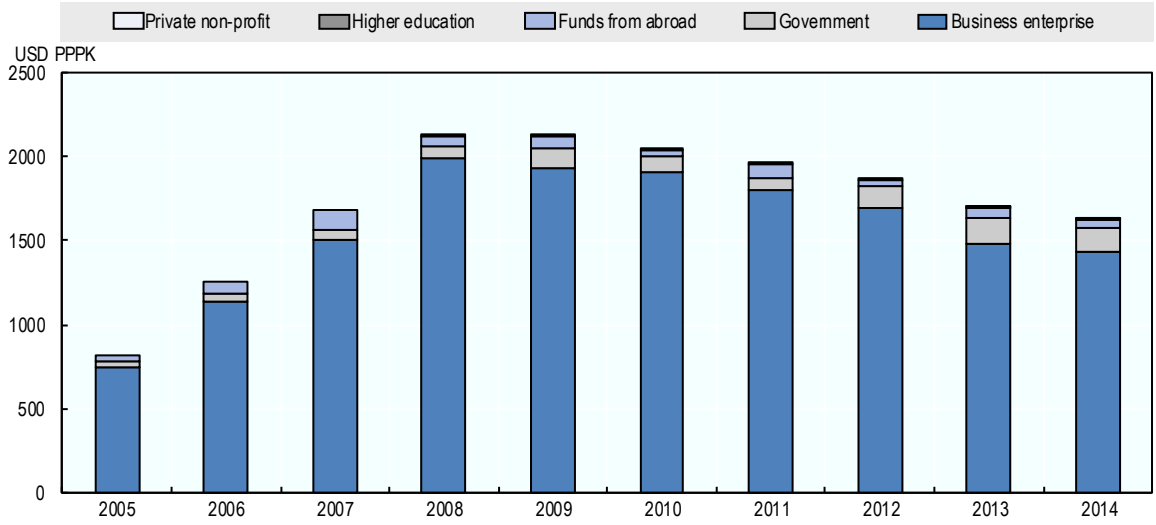
2016 or latest year available



Note: All indicators are presented in indices and reported on a common scale from 0 to 200 to make them comparable (0 being the lowest OECD values and 200 the highest). The median OECD value is represented by the bar at 100.
Source: OECD (2018), OECD R&D Statistics (RDS) Database, www.oecd.org/sti/rds (accessed in August 2018).

Figure 2.15. Portugal's BERD by source of funding

2010 USD constant PPP, million



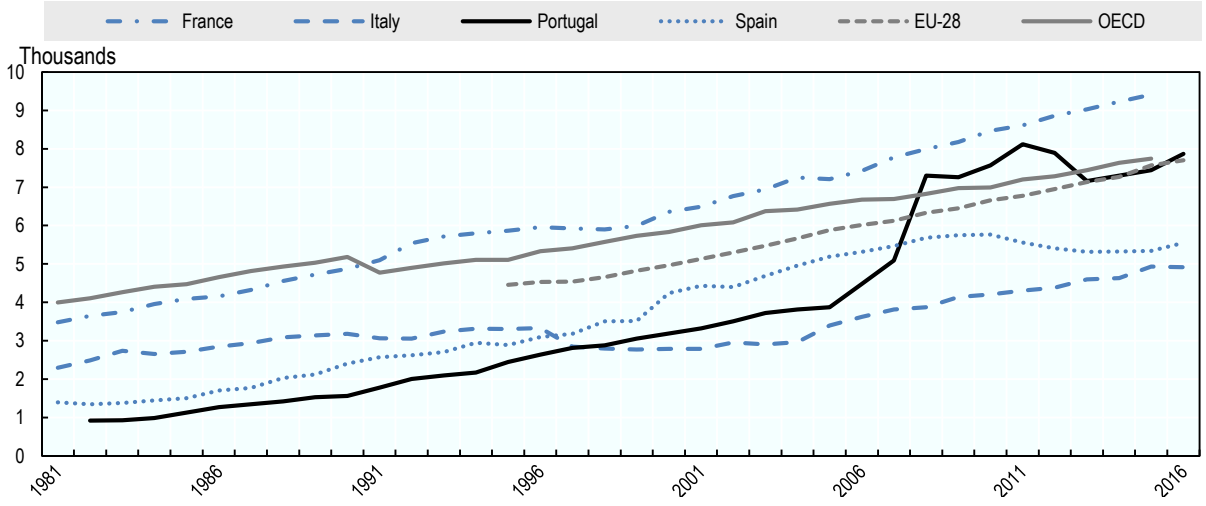
Source: OECD (2018), OECD R&D Statistics (RDS) Database, www.oecd.org/sti/rds (accessed on 2 August 2018).

The labour force involved in research activities grew dramatically over the first decade of the 2000s, peaking at 8.1 full time equivalent (FTE) researchers per 1 000 workers in 2011. At 8 FTE equivalent researchers per thousand workers in 2016, Portugal still outperforms the EU average and ranks below France but above Italy and Spain. This newly trained research workforce is mainly employed by universities and research institutions (R&D units and associated laboratories). Despite its relatively strong researcher workforce, Portugal's research and innovation system is faced with a shortage of other types of R&D personnel.[9] The share of 'other R&D personnel' in the country is among the lowest measured in the OECD.

Research and innovation performance

Portugal's scientific production has increased substantially over the past decade. Portugal had one of the highest average annual growth rates in publication output in the OECD over the period 2004-2012, second only to Luxembourg. The volume of publications remains modest, but around the OECD median when adjusted by population and ahead of France, Italy and Spain (Figure 2.16). However, the quality of Portuguese scientific production remained fairly stable, as measured by the share of publications in the 10% most cited publications worldwide, almost unchanged from 9.5 to 9.2% between 2005 and 2015 (OECD, 2017e). This places the country below the OECD median, but around the level of France and Spain. When considering all citations, Portuguese publications also appear slightly under the OECD average (cited 18% more often than the world average compared to 26% more often). The two sectors in which Portugal has the highest citation impact are multidisciplinary journals (a common occurrence worldwide) and engineering (OECD and SCImago Research Group, 2016).

Figure 2.16. Share of researchers labour force, selected countries



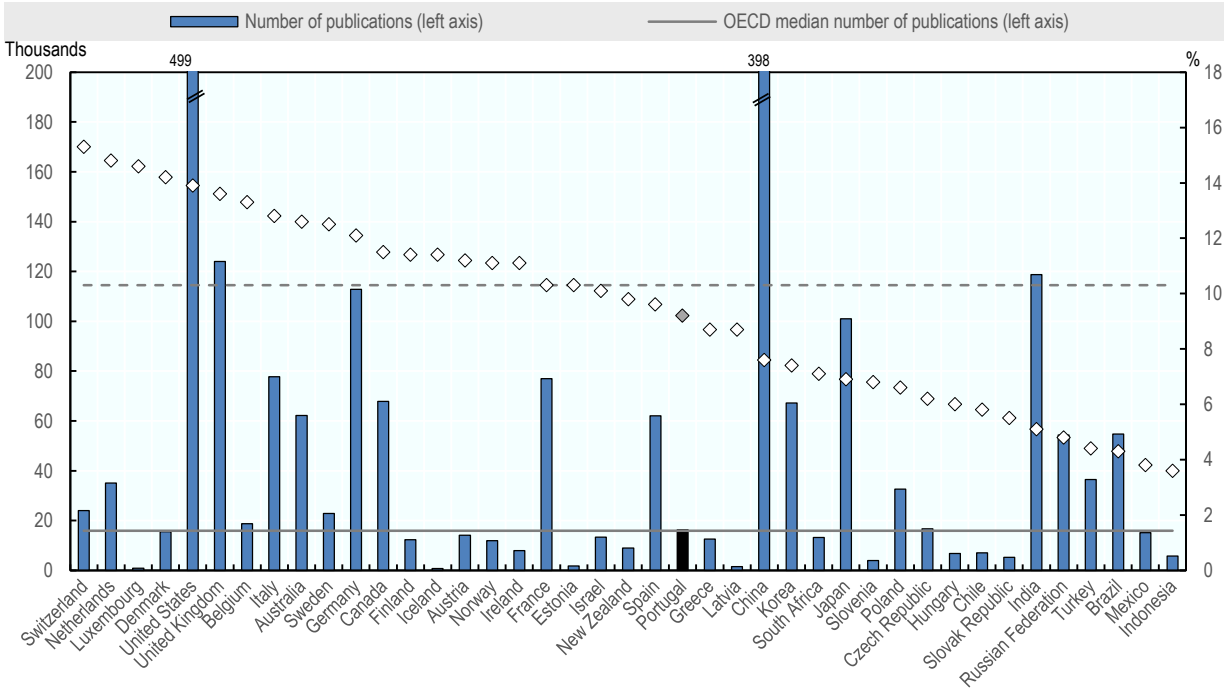
Source: OECD (2018) Main Science and Technology Indicators database, http://www.oecd.org/sti/msti.htm, (Accessed on 2 August 2018).

Over the period 2003-12, the higher education sector contributed 82% of scientific publications in Portugal, one of the highest shares in the OECD (Figure 2.18). The health sector was the second largest contributor (7.6%), followed by the government laboratories (9%).

Worldwide, and particularly in small economies who may benefit more from accessing global networks international, international co-operation positively affects the quality of research and innovation outputs. Portugal is above the OECD median in terms of international co-authorship with 47% of publications involving foreign co-authors over the period 2003-2012 (OECD and SCImago Research Group, 2016) and the rate of international collaboration has increased by 5% over this period. Looking at patterns of collaboration across sectors, co-publications with private sector entities represent 7% of cross-sectoral collaboration with the higher education sector, slightly below the OECD average of 8% and about half the share of the leaders (Belgium and Japan stand at around 14%).

Figure 2.17. Quantity and quality of scientific production, 2005 and 2015

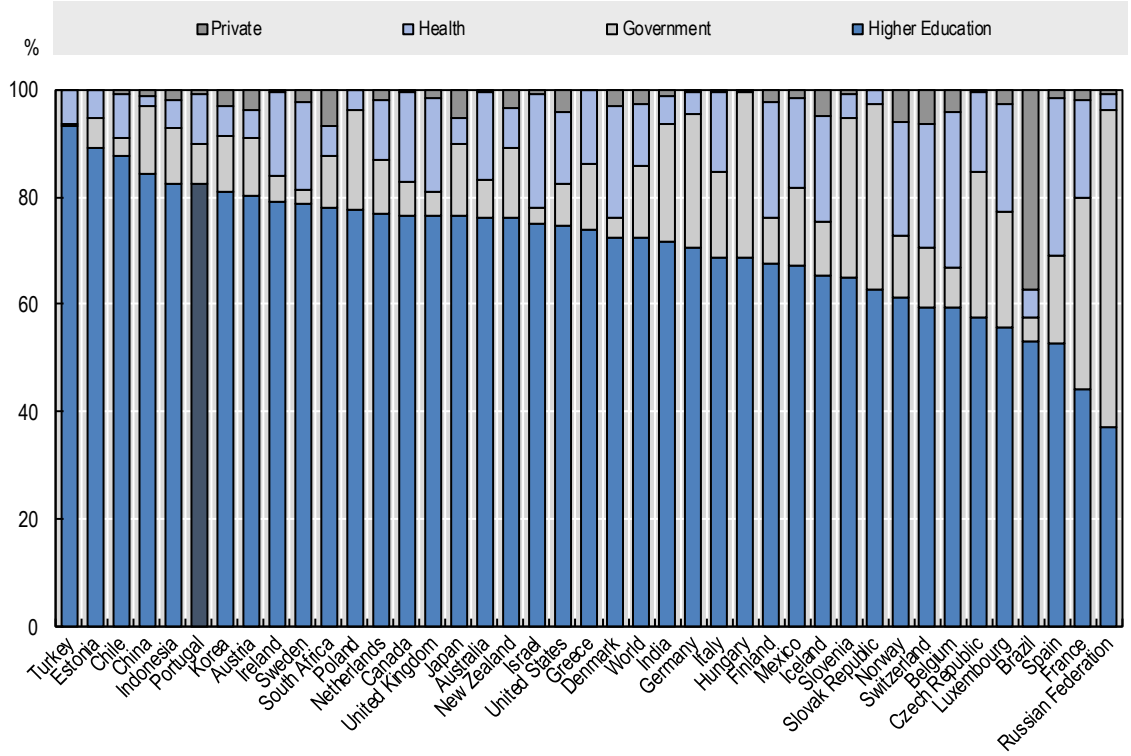
Number of documents and percentage among the world's 10% most-cited publications, fractional counts



Note: "Top-cited publications" are the 10% most-cited papers normalised by scientific field and type of document (articles, reviews and conference proceedings). The Scimago Journal Rank indicator is used to rank documents with identical numbers of citations within each class. This measure is a proxy indicator of research excellence. Estimates are based on fractional counts of documents by authors affiliated to institutions in each economy.

Source: OECD (2017k) calculations based on Scopus Custom Data, Elsevier, Version 4.2017 and 2015 Scimago Journal Rank from the Scopus journal title list accessed June 2017.

Figure 2.18. Distribution of scientific output by sector, by country, 2003-12



Source: OECD and SCImago Research Group, *Compendium of Bibliometric Science Indicators 2014*, based on Scopus Custom Data, Elsevier, December 2014.

The innovation performance of Portugal remains modest, as measured by international patenting. Although the number of patents per million inhabitants has been increasing over the past few decades, growing by 336% between 1990 and 2013, as compared to a 42% increase in the OECD, 90% in Spain and 28% in France over the same period, it remains one of the lowest in the OECD (OECD, 2017h). Portugal underperforms most OECD countries in terms of number of triadic patents,[10] below France, Italy and Spain (Figure 2.19).

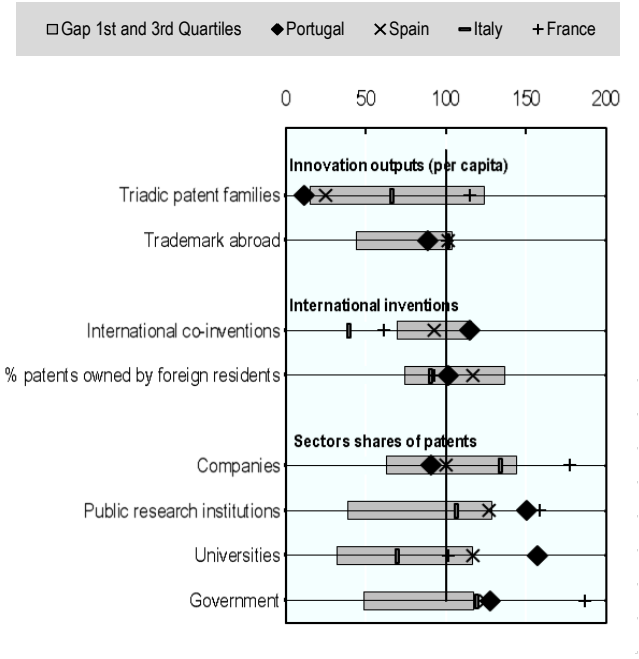
However, Portugal's innovation system is well-embedded in international knowledge networks despite the low share of R&D financed from abroad. A high proportion of Portuguese innovations are international co-inventions. The country ranks close to the first quartile in that measure, significantly ahead of Italy, Spain and France. The most common technology fields for patent applications in Portugal are pharmaceuticals (10% of applications), civil engineering (8%) and organic fine chemistry (7%) (WIPO, 2017).

Trademarking activity in Portugal does better than patenting activity by international standards: in 2016, Portugal was close to the OECD median in terms of trademarks filed abroad, which generally signals higher value innovation with global relevance. The country does even better in terms of resident trademark applications. The World Bank Group's Global Innovation Index identifies non-patent intellectual property assets as one of Portugal's strength. The country ranks 15th and 14th, respectively, of 127 countries in the number of resident trademarks and industrial designs (per billion GDP) (World Bank,

2018). Filings for industrial designs have increased dramatically over the past decade, from 16 787 applications in 2007 to 32 163 applications in 2016.

Figure 2.19. Benchmarking Portugal on a selection of scientific output indicators

2017 or latest year available



Note: Data on international co-inventions is for the period 2005-2016.
Source: WIPO (2018), *WIPO statistics database*, accessed on March 2018, https://www3.wipo.int/ipstats/index.htm; OECD (2017h) STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats, June 2017. http://statlinks.oecdcode.org/922017081p1g005.xlsx; OECD (2017j), *OECD Science, Technology and Industry Scoreboard 2017: The digital transformation*, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264268821-en.

Portuguese entities are quite active in Horizon 2020 (H2020) calls, accounting for 2.4% of submitted proposals between 2014 and 2016. The number of application per thousand R&D personnel and researchers is above the EU28 average. However, their success rate (12.8%) remains below the EU average (13.6%). Portuguese participants in signed Horizon 2020 grants represent 1.6% of the total grant budget, which translates to EUR 397 million, under the EU28 average in terms of budget per research personnel. Nonetheless, these results in H2020 are higher than those obtained in the EU 7th Framework Programme (FP) (1.15% of funding or EUR 564 million) and FP6 (1.03% for EUR 172 million) despite a slightly higher than average decrease in the success rate.

Geographically, participants in Horizon 2020 are quite concentrated. About half the grant recipients are located in the Lisbon Metropolitan area, a quarter in the North region, and slightly less than 20% in the Centre region (FFG, 2017). Academic research institutions[11] received the largest share of Horizon 2020 funding over the period 2014-2016 in Portugal (63%), ahead of SMEs (17%) and large enterprises (11%). SMEs are more represented in Portugal than at the H2020 level where small and large firms receive equivalent participations (both around 15% of the budget). Portuguese small firms have a higher than average success rate in the Horizon 2020 SME instruments (EC, 2018a).

In 2016, Portugal accounted for 1.3% of projects granted by the prestigious European Research Council (ERC) grants – focused on supporting excellence and funding frontier research, far below Spain even when taking into account differences in levels of GDP or GERD (ERC, 2018). Portugal's success rate was 8.8% over the period 2014-2017,[12] below the overall average of 12.7% (FFG, 2017). Unsurprisingly given the strong competition for ERC grants, Portugal's participation is concentrated among a few entities: the EUR 18.6 million contribution was distributed across 14 institutions, the first five receiving 58% of this amount.

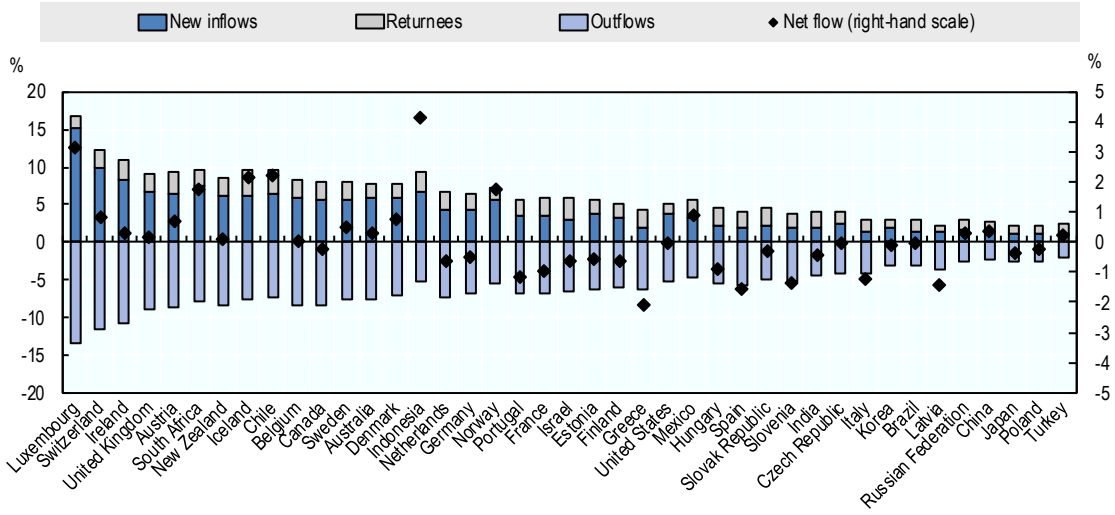
Mobility of scientists contributes to the diffusion and circulation of scientific knowledge across borders. One means to track mobility of publishing scientists is to trace changes in institutional affiliation over their full list of publications in scholarly journals (OECD, 2017k). Migration flows of scientific authors from and to Portugal are similar to those observed in most other OECD countries, with a rate of stayers close to the OECD average. In 2016, the large majority (87%) of Portugal's scientific authors remained affiliated to a research institution in the country, equivalent to the OECD average and more than in 2013 (83%). The same year, 6.8% of scientific authors left the country and changed their affiliation, 2% returned to Portugal and 3.5% were new scientific authors that had not worked in Portugal previously (Figure 2.20). Portugal experienced a negative net flow of researchers (-1.17%), placing it at the bottom of the OECD ranking but close to the balance of France and Italy.

Scientific researchers who left the country tend to be associated with higher-rated publications, compared to staying or returning scientists (OECD, 2017k). This pattern can be found in Portugal with outbound researchers displaying a higher expected citation impact (1.49) than stayers and returnees (1.08 and 1.06). New inflows score a little higher than stayers and returnees (1.36), while the three categories scored much closer together in 2013, possibly reflecting a positive trend in attractiveness. Overall, Portugal's academic impact according to scientific output ranks under the OECD's average across all four categories of scientific mobility. And the position of returnees' impact relative to other researchers in the country is low compared to almost all countries. This might indicate that Portugal is not benefiting from a learning effect from researchers who have been abroad at some point in their careers.

International mobility of research and innovation workers can also highlight a so-called "brain drain" phenomenon, whereby highly skilled professionals seek out opportunities in other countries. A possible measure of the brain drain of innovators is the measure of mobility of inventors listed in patent applications. The share of Portuguese inventors living abroad, calculated as the ratio between Portuguese nationals with foreign residence listed as inventors in patents divided by all Portuguese nationals listed as inventors (with residence inside or outside Portugal) was equal to 0.39% in 1991-2000 and 0.32% in 2001-2010, the second highest in Europe, after Greece (WIPO, 2013; Miguelez and Fink, 2013).

Figure 2.20. International mobility of scientific authors, 2016, as a percentage of authors, by last main recorded affiliation in 2016

Percentage of authors, by last main recorded affiliation in 2016



Note: Estimates are based on the comparison between the main affiliation of a given author with a Scopus Author ID publishing in 2016 and the closest available publication in a previous year. Only authors with two or more publications are considered. A mobility episode is identified in 2016 when an author who is affiliated to an institution in a given economy in his/her last publication in 2016 was previously affiliated to an institution in a different economy. Authors are assigned a given status from the perspective of the last destination in 2016. The "stayers" status is assigned if the main affiliation for both 2016 and pre-2016 correspond to the reference economy. The "returnee" status is assigned to those who move affiliation into the reference economy, but were affiliated to it in their first recorded publication. From the perspective of the previous economy of author affiliation, individuals can be computed as outflows, and the count is incorporated in the data presentation. Data are presented sorted by the share of outflows in the extended sum of possible mobility profiles from the perspective of a reference economy (stayers, returnees, inflows and outflows). The indicator is represented as the ratio between the number of authors in the relevant category, divided by the (absolute) sum of authors in the reference economy in 2016 plus the outflows from that economy recorded in 2016.
Source: OECD (2017k), OECD Science, Technology and Industry Scoreboard 2017: The digital transformation, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264268821-en.

Notes

[1]. Poverty rate is defined as the share of the population whose income falls below the poverty line; taken as half the median household income of the total population.

[2]. Electricity and gas, petroleum, telecommunications, paper and air transport. Data for Luxembourg are missing.

[3]. Wholesale and retail trade, repair of motor vehicles; transportation; accommodation and food service activities.

[4]. NACE 2-digit sectors.

[5]. Calculations by FCT based on Eurostat data.

[6]. Data for Luxembourg are missing.

[7]. Textile yarn, fabrics, made-up articles, etc.

[8]. Measured as earnings before interest, taxes, depreciation, and amortisation (EBITDA) relative to turnover.

[9]. These other types of R&D personnel include the technical, administrative, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

[10]. Triadic patents are patents filed at three major patent offices: the European Patent Office (EPO), the Japan Patent Office (JPO) and the United States Patent and Trademark Office (USPTO).

[11]. The statistical distinction between HEIs and PRIs is not relevant in Portugal due to the specific configuration of the Portuguese research system.

[12]. As of 30 September 2017 (FFG, 2017).

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Chapter 3. Governance, Strategy and funding in the HERI System

Following Portugal's accession to the European Economic Community in 1986, essential governance functions of the HERI system were formalised and strengthened. However, Portugal system is still characterised by a crowded and fragmented strategic policy framework. No single HERI strategy and little horizontal co-ordination mechanisms within government help guide public investment in research and innovation activities and ensure the effectiveness and efficiency necessary to achieve the country's high ambitions in this policy domain. Moreover, funding allocation processes at agency level result in the dispersion of research resources and limit the alignment of the higher education, research, and innovation system to national development goals.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

3.1. Introduction

The ability of individuals, teams and institutions engaged in education, research and innovation activities to perform their roles effectively is influenced to a considerable extent by the strategy and funding environment in which they operate. Out of the five broad features that characterise effective higher education research and innovation (HERI) systems (see 8.4.Annex A), two are particularly important when considering the strategic and funding environment:

1. *Setting clear objectives and stable and predictable rules and policy frameworks* is important because: i) through the process of collective objective-setting, they can allow stakeholders and public authorities to develop a shared understanding of objectives and agree on priorities and ii) they provide higher education and public research institutions and their innovation collaborators with clarity and predictability about national priorities and resource commitments in the mid- to long term. To be effective, these strategic orientations and policies have to be developed in close collaboration with those whom they affect or who benefit from them. They should draw on insights from those on the ground with specific expertise and society more generally. If done well, inclusive policy-making and strategy-setting can help build a greater sense of shared ownership of ideas and priorities. Effective education, research and innovation strategies provide clear guidance, while allowing room for innovation and initiative, and provide a framework of action or parameters within which other actors are authorised to take decisions.
2. *Sufficient and predictable resources and appropriate incentives for good performance and accountability* are necessary to support achievement of overall goals and priorities in system-level strategies. The mid-term predictability of resource levels is a key precondition for those planning higher education, research and innovation activities. This is especially true for research activities where long time horizons and the accumulation of knowledge often make sustained investment important to achieve real progress. International experience shows that strategies without committed resources commensurate with their ambitions have only limited influence. The way resources are allocated is also of paramount importance: alongside effective funding allocation mechanisms, funding agencies themselves need clear objectives and sufficient autonomy to allow them to achieve these efficiently, effectively and accountably.

As in other countries, strategy and funding are tightly intertwined in Portugal. In recent years the limited availability of funding has made it harder to make bold policies. Competition between ministries for limited resources has also made co-ordination around common strategic goals harder to achieve. Arguably, the lack of a clear strategy – as well as fluctuations in the level of public funding available – has made it harder to invest effectively and efficiently.

Although they cannot work in isolation, policy makers hold primary responsibility for creating the strategic and funding environment outlined above. Against this backdrop, the Review considers three key questions in this section:

1. To what extent is there evidence of a *clear, coherent and open national strategy* to guide the further development of higher education, public research and innovation actors in Portugal while leaving sufficient autonomy for these actors to define their respective plans, experiment and learn?
2. Are the *governance arrangements and processes* in place in Portugal sufficient to allow effective co-ordination and steering of higher education, public research and innovation policy, in line with the national strategy?
3. Are *adequate resources* made available for public investment in the higher education, research and innovation systems and are *effective organisations and resource allocation procedures* in place to ensure that available resources are used with the necessary accountability, efficiency and effectiveness in order to successfully implement the national priorities?

3.2. Context

This section provides contextual information on the three tightly intertwined issues of i) the strategic decision-making bodies and processes relevant to higher education, research and innovation (strategic governance); ii) the resulting strategic orientations produced (strategy) and; iii) the allocation of funding to HERI activities (funding).

3.2.1. Strategic governance of higher education, research and innovation

The formalisation of the rules, structures and organisations governing higher education, research and innovation in Portugal started later than in other EU countries. Following Portugal's accession to the European Economic Community in 1986, essential governance functions, such as horizontal co-ordination between parts of government, advisory bodies, dedicated planning, budgeting and evaluation functions were formalised and strengthened, often in order to comply with governance principles required for the implementation of European funding programmes.

Formal policy-making bodies

The Ministry of Science, Technology and Higher Education (*Ministério de Ciência, Tecnologia e Ensino Superior)* (MCTES) has responsibility for higher education, public research and science-based innovation activities, as well as the dissemination of scientific and technological culture and international co-operation in these fields (Government of Portugal, 2015a). Primary responsibility for business innovation policy lies with the Ministry of the Economy (*Ministério da Economia*). As in many countries, support to knowledge transfer, including collaborative applied research, is shared between these two ministries. Important prerogatives are also in the hands of the Ministry of Planning and Infrastructure (*Ministro do Planeamento e Infraestruturas*), which is in charge of the management of the EU Structural and Investment Funds. Other ministries are in charge of research activities under their respective sectors (health, defence, agriculture).

As discussed in Chapter 1, Portugal has created agencies outside the established structures of government ministries to implement different aspects of research and innovation policy, as well as a highly independent quality assurance agency for higher education. In Portugal,

as in several OECD countries, research and innovation agencies are not purely focused on implementation, but also play a role in setting policy. Both the Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*) (FCT) and the National Innovation Agency (*Agência Nacional de Inovação*) (ANI) have played important role in the development and monitoring of the main strategies in their respective areas. They also set policy *de facto* through the decisions they take about the allocation of funds to different activities. Currently, the FCT still has a formal role of policy co-ordination in its mandate.[1]

Strategic advice and horizontal co-ordination

With the progressive development of human capital, research and innovation policies in the 1990s, there have been irregular attempts to set up dedicated co-ordinating or advisory bodies at the higher level of the system.[2] These bodies, as is often the case in other countries, did not survive changes of government or the end of the Structural Funds programmes they served.

Two councils were created by the previous government (2011–2015), respectively covering innovation and research policy areas, both chaired by the Prime Minister. The National Council for Entrepreneurship and Innovation (*Conselho Nacional de Empreendedorismo e Inovação*) (CNEI) was created in 2011 as a forum for representatives of various sectors of the system to provide strategic orientation for innovation policy. Composed of high level researchers, the National Council for Science and Technology (*Conselho Nacional de Ciência e Tecnologia*) (CNCT) was created soon after, in 2012, to deliver advice on priority research areas and strengthen inter-ministerial co-ordination of science, technology and innovation policies, with a view to develop "medium and long term policies and national strategies" (Government of Portugal, 2011). The current government has not used these two councils, but, in 2016, relaunched a body that had nominally existed since 2007, the Co-ordinating Council for Higher Education (*Conselho Coordenador do Ensino Superior*) (CCES). It is chaired by a renowned Professor in Physics, with appointed experts and representatives of FCT, A3ES, the Directorate-General of Higher Education (DGES), the Council of University Rectors (*Conselho de Reitores das Universidades Portuguesas*) (CRUP), the Council of Polytechnics (*Conselho Coordenador dos Institutos Superiores Politécnicos*) (CCISP), the association of private higher education (*Associação Portuguesa de Ensino Superior Privado*) (APESP) and students' organisations.

The growing significance of European Structural Funds as a source of funding for research and innovation-related activities has led to the establishment of dedicated management entities and co-ordination bodies to oversee implementation of the Funds in these fields. In the current funding period, the "research" and "innovation" co-ordinating bodies have been integrated to govern COMPETE 2020, the national Operational Programme for Competitiveness and Internationalisation (Government of Portugal, 2014a). In addition, an Inter-ministerial Commission for the co-ordination of the Partnership Agreement (CIC) has been created, headed by the minister in charge of the regional development, along with several functional networks, in areas such as research and innovation, regional economic development, smart specialisation and science, technology and innovation support.

The Portuguese Smart Specialisation Strategy – formulated as a pre-condition for European funding – has its own comprehensive governance structure, with a co-ordinating council and an executive committee in charge of the strategic and operations aspects of the strategy respectively (Government of Portugal, 2014b). Both bodies gather a wide range of representatives of the different parts of the HERI system. The CNEI and CNCT also formed

part of the governance structure of the Smart Specialisation Strategy, as consultative bodies for the Co-ordinating council.

Public consultations

Public consultations occur periodically in the course of the policy cycle or within the framework of specific initiatives in the field of higher education, research and innovation, such as the development of new strategic documents. This was for instance the case of consultations ahead of the '*Commitment to knowledge and science*' (Government of Portugal, 2016a), the *National Plan for Science and Technology* in 2017 or when preparing the Scientific employment initiative. One of the broadest consultations recently conducted in Portugal aimed to develop the Smart Specialisation Strategy. In line with EU guidelines (European Union, 2013), the process relied on significant foresight and analytical work, as well as extensive consultations with relevant stakeholders at national and regional levels. At the national level, FCT led the inter-departmental working group in charge of the co-ordination of the assessment of the Portuguese national research and innovation system (FCT, 2013). Based on this thorough diagnostic exercise, consultations of the research and innovation community were then held in order to identify the national comparative advantage of Portugal in science, technology and its economy. National workshops conducted in 2013 focused on themes such as industry and production technologies and mobility, space and logistics and other initiatives (thematic workshops, surveys, etc.) and were conducted in each Portuguese region (FCT, 2017a).

MCTES also occasionally creates expert groups to contribute to the design of new policy. This was the case in 2016, in the lead-up to the evaluation of the R&D units and Associated Laboratories by FCT. More systematically, the FCT, *Ciência Viva* – the agency in charge of science and technology culture – and the Parliamentary Committee for Education and Science conduct a cycle of annual conferences, where the main stakeholders of the HERI gather to discuss relevant policy agendas and initiatives. The '*Ciência 2017'* conference, for instance, lasted three days and discussed issues such as the National Digital Skills Initiative, scientific diplomacy, cancerology and Collaborative Laboratories. FCT also has a regular procedure of consultation of the scientific community on relevant regulatory changes (Ciência 2017, 2017).

Finally, the Laboratory for Public Participation is a pilot initiative launched in January 2017 by MCTES in collaboration with *Ciência Viva* in order to stimulate the engagement of relevant stakeholders (including citizens, businesses, and civil organizations) in research and innovation agenda-setting. It was planned that these "open platforms for brainstorming and debate", either virtual or conducted via workshops, would be supplemented by a participatory budget, whereby up to 1% of the FCT 2017 budget should have been earmarked for the implementation of new projects and research agendas resulting from these consultations (MCTES, 2017a).

Foresight and policy evaluation

The most comprehensive and numerous policy or programme evaluations in the fields of education, research and innovation in Portugal are those carried out to meet the requirements of European Structural Funds. Evaluations conducted in the framework of national policy are very infrequent.

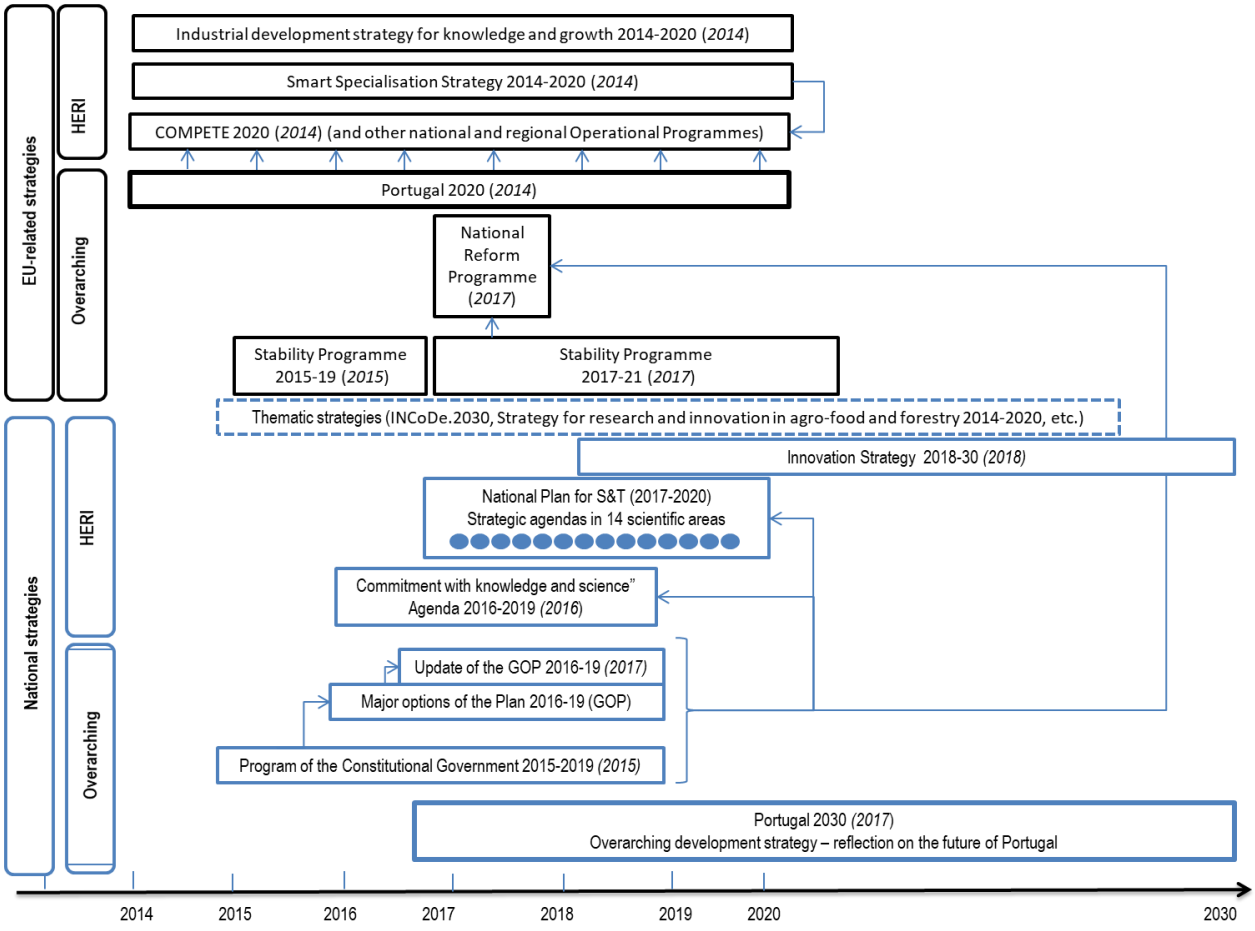
European Structural Funds programmes require *ex ante*, mid-term and *ex post* evaluations and have different scopes according to the specific needs perceived and overarching EU evaluation guidelines. Higher education, research or innovation funding initiatives have

generally been covered as part of wider evaluations of whole Operational Programmes rather than been the object of dedicated evaluations.[3]

Some evaluations conducted outside the framework of European Structural Funds programmes have also taken place. For example, the 2012 evaluation by the Academy of Finland of the well-funded academic partnerships with American universities including MIT and Carnegie Mellon University (Academy of Finland, 2012) examined the cost-effectiveness of these initiatives. The evaluation of the FCT by a panel of international experts in 2015 (FCT, 2015) was undertaken in reaction to criticism of the FCT following the 2013 review of R&D units and Associated Laboratories.

Foresight is not extensively used to guide policy decision-making in Portugal. Two of the main foresight initiatives were carried out during the preparation of the Smart Specialisation Strategy and at the occasion of the Portugal 2030, both of them closely related to the implementation of the European Structural Funds.

Figure 3.1. Main recent strategies and plans related to higher education, research and innovation



3.2.1. Strategic orientation for HERI

Over the last two decades, policymakers in many OECD countries have drawn on advisory groups, public consultation exercises and foresight work to develop various forms of national innovation strategy. In most cases, these have been broad in scope, covering innovation, research, entrepreneurship and aspects of higher education. In Portugal, the actors and processes described above have also produced a number of strategic documents that have sought to guide public investment in higher education, research and innovation.

Overview and typology of strategic documents relevant to HERI

Successive governments in Portugal have adopted a number of strategic documents aiming to guide the national higher education and research and innovation activities. These documents differ according to their scope (overarching or specific to certain thematic areas), time horizon (annual or multi-annual) and institutional nature (related to EU policy processes or related to national policy). Based on this simple typology, Figure 3.1 distinguishes four main types of strategic documents relevant to HERI in Portugal.

National overarching strategic documents

The 1976 Portuguese Constitution establishes the basic framework for the definition of the national strategies and plans. Each incoming government sets out its key policy objectives at the start of its term in the Programme of the Constitutional Government (*Programa do XXI Governo Constitucional* 2015-2019) (Government of Portugal, 2015b) and then provides a more detailed programme of work in the Major Options of the Plan (GOP), which is initially approved for the period of the legislature and then updated annually in conjunction with the state budgetary process.

The Programme of the Constitutional Government is a general political statement of the initial ideas of the government in all policy areas. The current Programme includes a specific priority on innovation (covering issues related to science, scientific culture, innovation and internationalisation of enterprises) and an agenda for modernising and diversifying higher education within a broader "priority to people".

Table 3.1. Programme of the 21st Constitutional Government 2015-2019: objectives for higher education, research and innovation

Research and innovation priorities	Higher education priorities
• Increasing competitiveness of researchers and research units • Stimulating employment of high skilled people in academic and private sector • Strengthening the institutionalisation of the HERI system • Directing funds to researchers / units with existing relevant competencies Adjusting policies to smart specialisation)	• Widening and democratising access to higher education. • Providing higher education institutions with greater financial stability and autonomy to promote quality, diversification and regional engagement. • Creating conditions for employing new teaching and specialist staff in institutions. • Improving successful completion rates. • Promoting the internationalisation of higher education • Creating internship programmes for students to promote their future employability.

Source: Government of Portugal (2015b), *Programa do XXI Governo Constitucional* 2015-2019, https://www.portugal.gov.pt/ficheiros-geral/programa-do-governo-pdf.aspx.

The GOP, updated annually, complement the Government Programme by providing strategic guidelines for economic and social development policy. Among the 35 policy domains for government action initially included in the GOP for the 2016-2019 period, three of them are directly related to the research, innovation and higher education policy areas (Government of Portugal, 2016b): innovation and internationalisation of firms; modernisation of higher education and; enhancing investment in science and technology and democratising innovation.[4]

National strategic documents in HERI policy fields

The GOPs are supplemented by documents providing more precise guidance and priorities related to research, innovation and higher education. The *Commitment to Knowledge and Science* Agenda, adopted by the government in 2016, established detailed priorities for the period 2016-20 and provided a mandate to MCTES to undertake further consultations with higher education institutions (Government of Portugal, 2016a). Following these consultations, a July 2016 agreement between the rectors of public HEIs and the government (Government of Portugal, 2016c) committed to 25 initiatives, including measures to support the modernisation of polytechnics, promote digital skills and incentivise high-skilled employment through fiscal measures.

The *Commitment to Knowledge and Science* also proposed the creation of a broad interministerial working group to set a multiannual financial framework to fund the various measures necessary to meet the GOP objectives. The group was to be composed of representatives from MCTES, finance, economy, environment, maritime affairs, planning and infrastructure and defence – as well as the Council of Rectors of universities, the Co-ordinating Council of Polytechnics, FCT and ANI. To date, this working group has not been created and no multiannual financial framework has been put in place.

The GOP update for 2017 included the preparation of a National Plan for Science and Technology. This strategic initiative, led by FCT in co-operation with ANI and Ciência Viva, was issued in June 2017 (MCTES, 2017b). The document consists mainly of 14 thematic agendas,[5] developed by dedicated expert groups composed of researchers, policy makers and industry representatives. A bottom-up participatory approach is clearly apparent in the document, which relies to a large extent upon the views expressed in each thematic group. Considerations regarding the international context also occupy a prominent place in each agenda. An initial proposal for a new knowledge strategy for Portugal to enable European convergence by 2030 has also been developed recently (MCTES, 2017c; 2017d).

On the innovation side, the main national strategy is the Industrial Development Strategy for Growth and Employment (*Estratégia de Fomento Industrial Para o Crescimento e o Emprego*) 2014-2020 (EFICE) developed in 2013 by the Ministry of Economy (Government of Portugal, 2013a). The area of entrepreneurship and R&D, one of the strategic axes, is centred on the promotion of co-operation between science and industry. It includes measures to strengthen R&D and innovation in line with the Smart Specialisation Strategy and set up a new dedicated governance system for innovation policy (with a dedicated agency, strategic intelligence resources, think tanks and policy experimentation platforms).

Even more recently, the Council of Ministers adopted a new Innovation Strategy 2018-2030, partly based on the aforementioned Portugal knowledge strategy for European convergence (MCTES, 2017d, Government of Portugal, 2018). This strategy covers research and innovation, and is to be implemented by the ANI. It sets ambitious, though

sometimes vague, objectives and targets pertaining to higher education, R&D and economic performance (Table 3.2). To achieve its ambition, this strategy briefly presents eight strategic axes, including the increase in R&D or entrepreneurship, and links these to existing programmes (Start-UP Portugal, INCoDe.2030, Interface programme, etc.).

A number of thematic strategies in other policy fields also include an objective or axis dedicated to research, innovation and higher education. Many of them serve primarily to guide the use of European Structural Funds, such as the National Strategy for the Sea 2013-2020 (Government of Portugal, 2013b) and the Strategy of the Ministry of Agriculture and Maritime Affairs for Research and Innovation in Agro-food and Forestry 2014-2020 (Government of Portugal, 2014c). Other strategies are cross-sectoral or horizontal, such as the National Digital Skills Initiative (INCoDe.2030), launched in 2017 (Republic of Portugal, 2017a), the 2016 Policy for the Internationalisation of Higher Education and Science and Technology (Government of Portugal, 2016e), developed by MCTES and the Ministry of Foreign Affairs, and the 2016 StartUP Portugal strategy for entrepreneurship.

Table 3.2. Main objectives of the 2018-2030 Innovation Strategy

Indicator	Target	Reference value
R&D intensity (GERD/GDP)	1.8% of GDP by 2020 3% by 2030 (1/3 expenditure and 2/3 of private expenditure)	1.3% in 2016
Higher education enrolment for people aged 20	60% in 2030	42% of 20 year-olds in 2016/17
Higher education graduation for people aged 30 -34	40% by 2020 50% by 2030	35% in 2016
Digital skills	European leadership level by 2030 (access and use of the Internet, digital business and skill development, etc.)	-
Exports of goods and services	50% of GDP by 2025, with an improvement of the technological balance of payment	40% in 2016
Venture capital	Catching up with European average	-
Foreign direct investment	Reinforce Portugal's attractiveness for FDI	4.8% of GDP (net inflows)

Source: Government of Portugal (2018) Resolution of the Council of Ministers n.º 25/2018, *Official Journal*, 1.ª série – N.º 48 – 8 March 2018.

Overarching strategies and programmes related to EU requirements

Like all EU countries, Portugal has to comply with obligations related to the rules governing European monetary union, including fiscal and economic policy monitoring by the European Commission and fellow member states undertaken through the annual European Semester process. Against this backdrop, the current Stability Programme developed by the Ministry of Finance presents the main macroeconomic trends and derives objectives for the mid-term (2016-21), along with a multi-year budget plan, with a view to guaranteeing sound public finances and making progress towards the Europe 2020 objectives (Republic of Portugal, 2017b).

It is complemented annually by a National Reform Programme (NRP), which presents the specific initiatives to be implemented (new schemes, reforms, programmes, etc.) to achieve these targets, in line with the objectives defined in the GOP. The 2017 NRP includes three main new initiatives: the scientific employment initiative, the Programme for the

Modernisation and Valorisation of Polytechnics and the Interface Programme (Government of Portugal, 2017a). Annexes to the NRP set out each year the progress in the execution of these initiatives.

Strategic documents in the HERI policy fields related to EU requirements

The European Structural and Investment Funds (ESIF) are a main source of financing for the National reform programmes in Portugal, in particular in the area of research and innovation. The overarching objectives and lines of action guiding the allocation of these funds in the current funding period (2014-2020), reflecting overall priorities agreed at EU level, are set out in the Portugal 2020 Partnership Agreement between the Government of Portugal and the European Commission (European Commission, 2014).

The precise objectives, monitoring indicators and allocation mechanisms for Structural Funds are described in Operational Programmes at national level – for broad, cross-cutting policy areas – or at regional level. The current national operational programmes most relevant to research, innovation and higher education are the Competitiveness and internationalisation (COMPETE 2020) and Human Capital Operational Programmes (*Programa Operacional Capital Humano* - POCH) (respectively financed mainly with the European Regional Development Fund and the European Social Fund). Regional programmes also contain priority axes relevant to innovation.

In order to use the ESIF 2014-20 more efficiently, national and regional authorities across Europe were asked to develop Smart Specialisation Strategies based on their respective comparative advantages, as well as emerging opportunities and market needs at national and regional levels. Against this backdrop, the Portuguese National Strategy for Smart Specialisation (ENEI) was developed in 2014, following extensive consultations (Government of Portugal, 2014b). The national priorities were presented in 15 broad priority themes (health, tourism, etc.) along five thematic axes. As shown in Table 3.3, some Smart Specialisation priorities were identified as relevant to several regions, in particular those related to oceans (maritime resources and infrastructure, blue economy, Maritime – bio-sustainability, fisheries), digital technologies (digital growth, ICT, enabling technologies), tourism and natural resources (agro-industry, food industry, forestry).[6]

Table 3.3. Regional priorities identified in the Portuguese Smart specialisation strategy

Regions	Regional priorities for Smart Specialisation
Norte	Health and Life Sciences; Territory and Tourism; Maritime Resources and environment; Culture, Fashion and Creativity; Enabling Technologies; Mobility and Environmental Industries; Digital Growth
Lisbon and Vale do Tejo	Tourism; Blue Economy; Cultural Industries/Art/Communication Technology; Engineering; Biotechnology; Advanced services
Centro	Agro-industry; Blue economy; Tourism; ICT; Materials.
Alentejo	Quality of Life; Blue Economy; ICT; Stones; Agro and Forestry; Food industry; Logistics and mobility; Heritage and territory; Renewable Energies
Algarve	Renewable energies; Blue economy; Tourism; Culture; Maritime Infrastructures; Fisheries
Acores	Blue Economy; Food industry; Infrastructures
Madeira	Agro-food; Maritime – Bio sustainability; Energy and climate change; ICT; Tourism

Source: Government of Portugal (2014a), *Estratégia de Investigação e Inovação para uma Especialização Inteligente (EI&I)*, November 2014 version, www.poci-compete2020.pt/admin/images/RIS3_Nacional_ENEI_Especializacao-Inteligente.pdf.

Using European and national funds, the Portuguese government expected to mobilise up to EUR 1 billion to implement the Smart Specialisation Strategy in the period 2014-20. The

alignment with this strategy is mandatory in the implementation of Portugal 2020 investments in research and innovation and is a priority in other areas, such as the support to SME competitiveness.

3.2.2. Funding of HERI activities

Overall budget process

MCTES manages the bulk of the funds allocated for higher education and research activities, while the Ministry of Economy is in charge of the funds to support innovation in businesses and intermediary bodies, such as technology transfer and innovation centres. While the budgets of different government bodies are approved on an annual basis, they are embedded within the framework of multi-annual budgetary planning, which defines ceilings on expenditure for each policy area, defined in budgetary programmes. Both the multi-annual and annual budgetary processes are designed in accordance to, respectively, the GOP and its annual updates (see above).

The multi-annual budget framework is submitted to the Parliament when a new government takes office and covers the following four years. It is updated each year for the four subsequent years. The annual budget cycle starts with the finance ministry providing an indicative spending envelope to each ministry in August, as a preliminary annual funding amount for the following year. Each ministry uses this to plan its allocation of spending for the upcoming fiscal year. Further to negotiations on this basis, by mid-October, the annual budget law proposal is submitted by the government to Parliament for review. This is then approved by the end of November, frequently with only a limited number of amendments (OECD, 2015b).

The Budget law is structured around thematic programmes. Most research and higher education activities are included in dedicated 'financing programmes' (Financing programme 10: 'Science, technology and higher education') (MCTES, 2017e). The budget for support to business innovation in firms and intermediary organisations is presented in a distinct programme (Financing programme 15: Economy) (Ministry of Economy, 2016). These financing programmes correspond to a large degree to the scope of activities of their respective line ministry, and the different budget items relate to institutions (agencies, HEIs, etc.) rather than actions. For the MCTES, the financing programme does include a breakdown of the FCT budget into its main lines of action, including advanced training, scientific employment, projects, etc. (Government of Portugal, 2016f).

The Budget Law only presents an initial allocation to each programme, the real budgets are regularised *ex post*, on the basis of actual expenditures. These can be somewhat different, especially for research and innovation since most funds are allocated competitively and real spending levels therefore depend on the uptake of calls and the nature of the responses. Since the rates of EU co-financing depend on the type and regional location of the beneficiaries, the significant contribution of Structural Funds can also generate discrepancies between planned and real expenditures. Finally, during the crisis and up to 2016, the government reviewed and cut part of the budgetary allocation to HEIs during the course of the year. In July 2016, MCTES committed to abandon this practice in exchange for HEIs agreeing to a solidarity mechanism, whereby any HEI facing a financial deficit will be supported through a loan granted by other HEIs in their sector, to be reimbursed over the following years.

The initial budget for higher education and research (Programme 10) amounts to EUR 2.7 billion in 2018, an increase of 5.6% relative to 2017, due mainly to the additional

budget allocated to the FCT to cover additional costs related to the employment of post-docs resulting from implementation of Law 57/2017 (see Chapter 6. Doctoral training). State laboratories are another relatively important research budget component, although their planned expenditures are not included in Programme 10, but in the budgetary programme of their respective line ministries. For most ministries other than MCTES and the Ministry of Economy, the State laboratories under their purview represent the bulk of their research effort (a total of EUR 132 million in 2005, EUR 139 million in 2015).[7] These budgets are, however, not entirely spent on research activities, as these institutions also have other public service missions. The funding of knowledge transfer, collaborative research and innovation in Programme 15 (EUR 1.6 billion in 2017) is mainly funded by Structural Funds. The funding of knowledge transfer, collaborative research and innovation in Program 15 (EUR 1.6 billion in 2017) is funded by Structural Funds. It includes most of ANI's annual budget (EUR 12 million), as well as part of IAPMEI's (EUR 649 million). The funds allocated to AICEP to support business innovation, under the authority of the Ministry of Foreign Affairs, are not included in either of these programs. Between November 2015 and June 2018, AICEP Portugal Global approved business innovation project contracts, involving a total investment amount of EUR 1 760 million, with a total incentive amount of EUR 636 million.

Table 3.4. Main higher education, research and innovation initial budgets, 2018

In million Euros

Ministry	Budget items	National	ESIF funds	Total
MCTES	FCT (functioning and investment)	356	148	504
	Higher education (universities and polytechnics' block funding, and social support)	1 777	313	2 090
Ministry of Economy	Support to knowledge transfer, collaborative research and innovation		512*	512*
Ministry of Defence	Support to defence R&D	9**		9**
Various ministries	State laboratories	137*	2*	139*

Note: * 2015, **2017.
Source: MCTES (2017b), *Plano Nacional de Ciência e Tecnologia, 2017-2020*, Initial terms of reference for discussion, June,, *Science, Technology and higher education, Budgetary Programme 10*, Proposal of State budget for 2018, October, explanatory note.

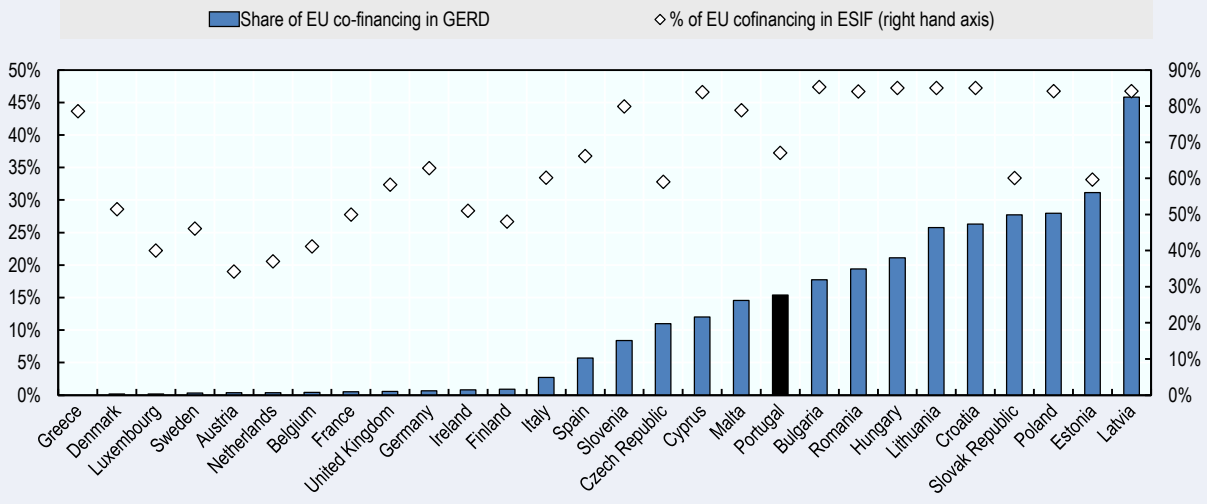
ESIF account for an increasing share of the overall budget for research and innovation. While ESIF funding was estimated at about 21% of the national research and innovation budget during the previous generation of ESIF (QREN, 2013) (JRC, 2016; 2017), it currently represents about a third (Portugal 2020, 2014-2020) according to our estimations (Box 3.1). If national co-funding is taken into account, the total amount of funding directed through ESIF instruments represents about half of all public support to research and innovation. This gives an indication of the proportion of public spending on research and innovation that is governed by EU cohesion policy decision processes and regulations.

Box 3.1. Structural funds and HERI activities in Portugal

Portugal 2020, the current Partnership Agreement between Portugal and the European Commission, defines the principles that govern the use of European Structural and Investment Funds (ESIF)[1] in Portugal for the period 2014-2020, in line with the European goals agreed in the Europe 2020 Strategy. The total estimated ESIF allocation to Portugal for the period 2014-2020 is EUR 25.8 billion (representing a potential total investment of EUR 32.7 billion with national co-financing). The programming and implementation of Portugal 2020 is organised through 16 operational programmes (six national and 10 regional programmes). Most funds dedicated to research and innovation and to higher education are directed through the COMPETE 2020 and POCH operational programmes at national level.

For 2014-2020, the amount of ESIF funding for research and innovation activities (excluding higher education) amounts to EUR 3.6 billion (EUR 513 million/per year and about 20% of total ESIF in Portugal). The share of EU share of ESIF investment currently accounts for about 15% of total spending on R&D in Portugal (GERD). This ratio positions Portugal in an intermediary position, less dependent on ESIF funds for R&D investment than Latvia, Estonia or Poland, but more dependent than Spain and Italy. The EU share of ESIF represents about a third of total public funds dedicated to research and innovation support in Portugal. Total ESIF investment, including both EU and national co-funding, represents 23% of the GERD and 49% of the public support to research and innovation.

Figure 3.2. Share of EU co-financing of ESIF 2014-2020 dedicated to research and innovation in the GERD and share of EU co-financing in ESIF



Note: For instance, in 2017, the Instituto Nacional de Investigaçao Agraria e Veterinaria (INIAV) received EUR 29.6 million from the Ministry of Agriculture, the Laboratorio Nacional de Energia e Geologia EUR 17 million from the Ministry of Economy and the Instituto Nacional de Saúde Dr. Ricardo Jorge, EUR 28.5 million from the Ministry of Health. These budgets items are included in different budgetary programmes.
Source: European Commission (2018), *Open Data Portal for the European Structural Investment Funds*, https://cohesiondata.ec.europa.eu. (Accessed on 12 March 2018)

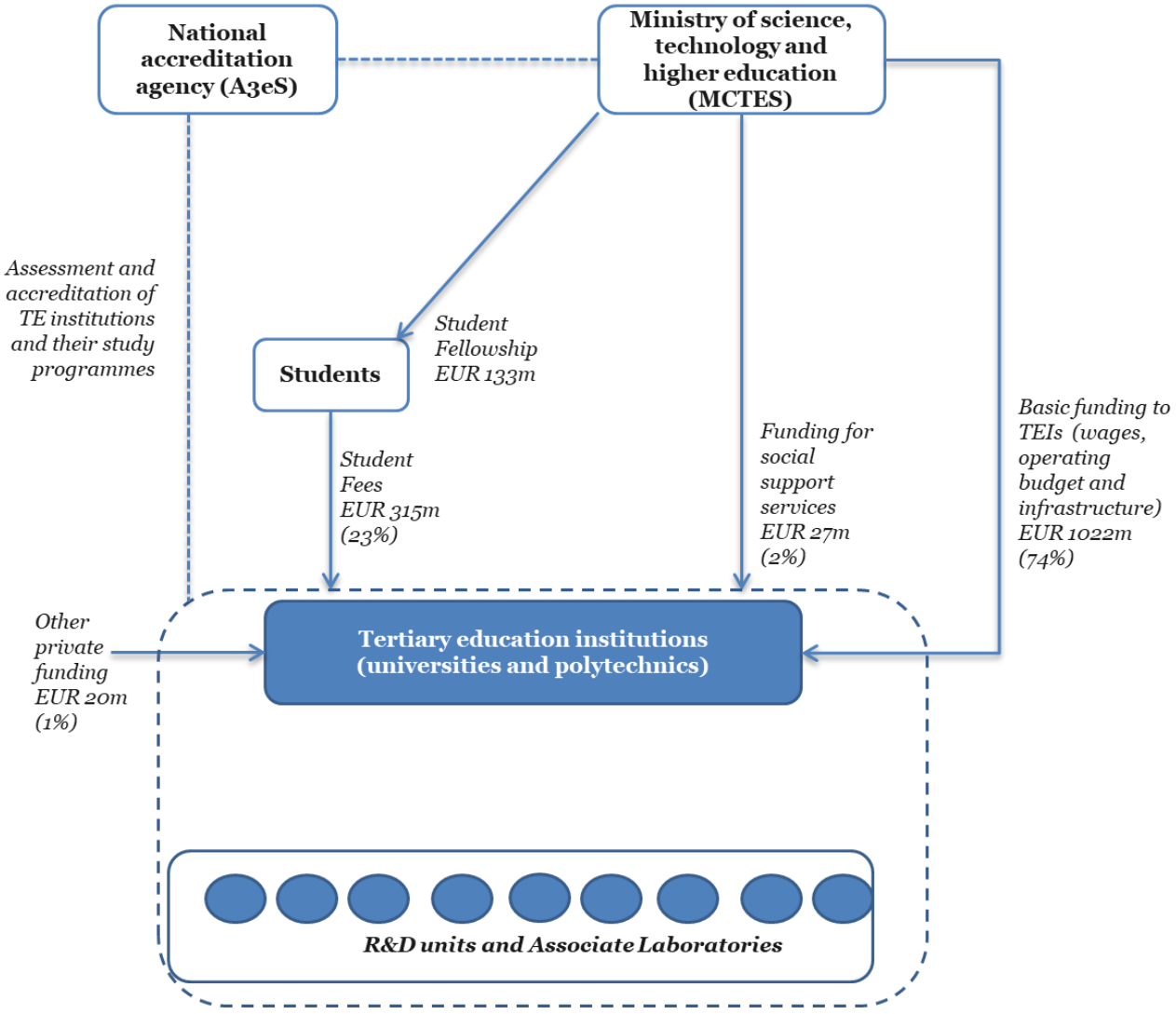
The importance of ESIF for HERI activities is even higher when one considers research and innovation in a broader sense. Support to the competitiveness of SMEs and to educational and vocational training, two themes with strong impact on the country's innovation capacity have been allocated, respectively, around EUR 8.5 billion and EUR 5.2 billion for the period 2014-2020 (compared to EUR 3.6 billion for research and innovation).

Government funding of higher education and academic research

One of the key characteristics of the Portuguese HERI system is the existence of parallel systems for organising and funding higher education and research activities, although these activities are closely intertwined.

Figure 3.3. Main sources of income for education and core activities in public universities and polytechnics

Figures for 2016 in EUR million and % of total HEIs' revenues



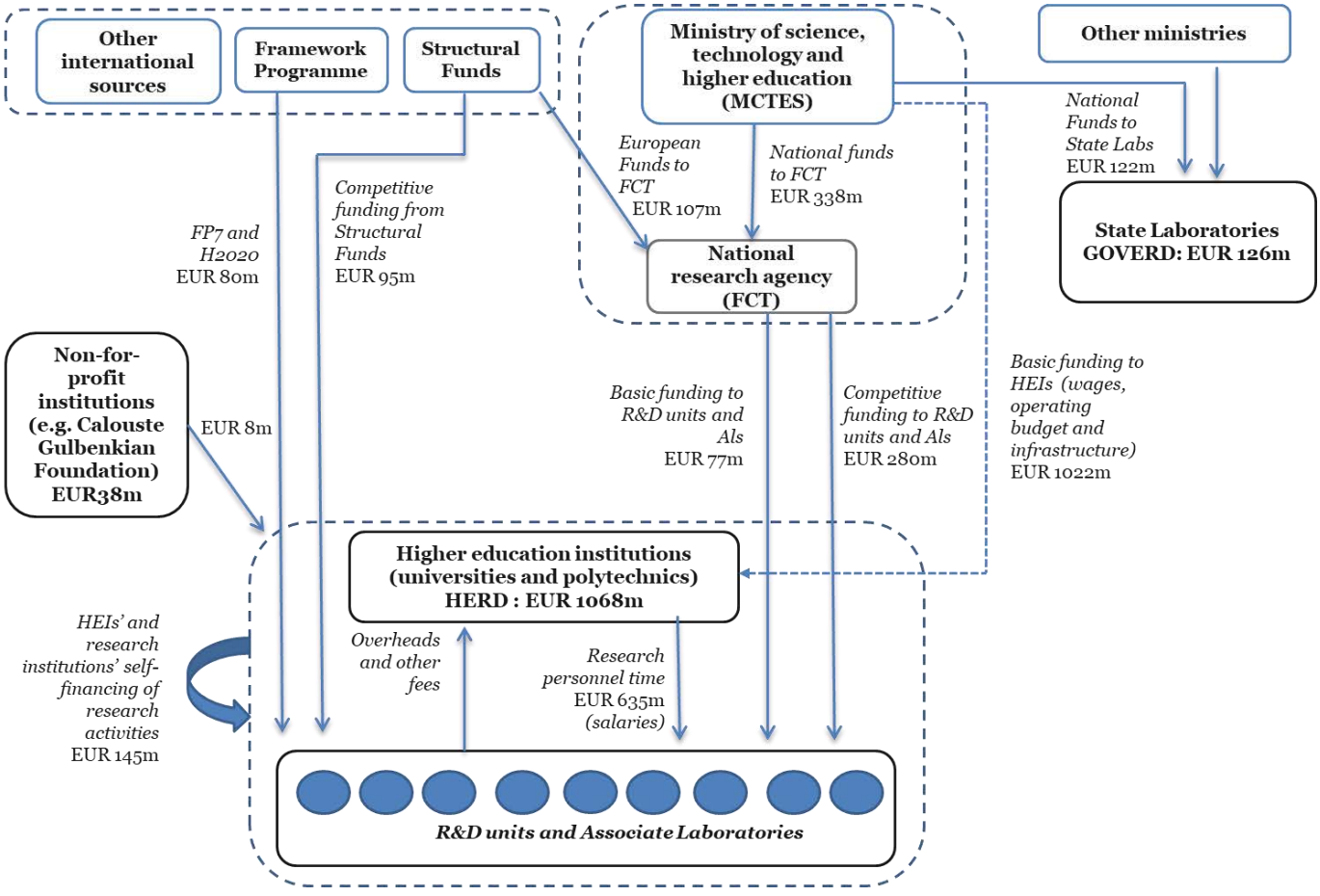
Note: This graph does not include funding allocated to research, development and innovation.
Source: Based on MCTES (2017b), *Plano Nacional de Ciência e Tecnologia, 2017-2020*, Initial terms of reference for discussion, June, http://www.fct.pt/agendastematicas/index.phtml.en.

Regarding education and other core operations (infrastructure, staff salaries), institutional funding for public HEIs in Portugal is delivered through basic funding allocated on an historical basis, accounting for 74% of HEIs' basic revenues in 2016 (Figure 3.3). The mechanisms for allocating core funding to institutions are discussed in detail in Chapter 4. HEIs also receive funding to support the social services they provide to students (including

catering services and accommodation), while students receive social support directly via grants awarded according to social criteria.[8] The other sources of revenues of public HEIs are the fees paid by students (23% of public HEIs' revenues in 2016) and some private funding originating from supply of accommodation, meals, rentals, etc. A3eS, the accreditation agency, does not intervene directly in the funding of HEIs. However, through its accreditation of study cycles, it indirectly influences the number of students institutions can enrol, which in turn affects the income from fees.

Universities and polytechnics do not formally receive institutional funding to perform research activities. However, the core funding to HEIs provided by MCTES also supports research, not least through the payment of the salaries of the academic staff that also perform research and the maintenance and construction of buildings and facilities used by this staff. In 2015, 75% of teaching staff (accounted in FTE) in public universities were integrated in a FCT R&D unit or associated labs (DGEEC, 2017a).[9] The total salaries of the academic staff in public HEIs also involved in research represented about EUR 635 million in 2015 (MCTES, 2017a).

Figure 3.4. Sources of annual income for research activities in HEIs and research institutions, latest annual data available, 2015-2017 (in EUR million)



Note: this graph is an attempt to match financials stocks (aggregates) and flows (funds allocated). Depending on data availability, the financial flows refer to different years between 2015 and 2017. These differences as well as their various origins explain the residual gaps between the flows and the aggregates (HERD, GOVERD).

Source: based on MCTES (2017a), *Science, technology and tertiary education in Portugal – Perspectives for 2030*, Background report to the OECD joint-review of Science, Technology and Tertiary Education in Portugal, draft document, Ministry of Science, Technology and Higher Education; and OECD (2018d).

This represents about half of the total resources (national and European, financial and in-kind) allocated to the research institutions. Depending on the specific arrangements they have with the HEIs to which they are more or less closely integrated, R&D units and associated labs pay overhead fees to the universities or polytechnics.

Some limited institutional funding for research is distributed directly by the FCT to R&D units and associated labs, which are affiliated to one or more HEI. This multi-year block-funding for research is awarded competitively, following regular national research assessment exercises. It accounts for about 6% of the total resources allocated to the research institutions. It is considered by the government as research seed funding (MCTES, 2017a). The bulk of public funding for research is therefore allocated through competitive funding, which includes project-based funding (project grants, individual grants, contracts and fellowships awarded to research students and researchers, from national and EU sources) and institutional funding awarded on a competitive basis directly to the research units.

Despite a significant budget decrease since 2011 (from EUR 465 million in 2010 to EUR 367 million in 2016), FCT remains the main source of research funding in Portugal. It was responsible for disbursing 39% of public funds allocated to R&D on average between 2007 and 2014 (FCT, 2017b). However, R&D units and associated labs increasingly rely upon competitive EU funds, either originating from structural funds or from framework programmes.

Table 3.5. Main sources of income for research activities in public research institutions*

	2011		2016	
	EUR million	%	EUR million	%
FCT research 'block funding' to R&D units and associated labs	108	15%	77	10%
FCT grants, contracts and fellowships (including international co-operation and infrastructure)	285	40%	280	38%
EU Structural Funds	79	11%	95	13%
European Framework Programmes	51	7%	80	11%
Other sources of funding (provision of services to industry, health, etc.)	190	27%	205	28%
Total	**713**	**100%**	**737**	**100%**

Note: * Data excludes state laboratories.
Source: MCTES (2017a), *Science, technology and tertiary education in Portugal – Perspectives for 2030*, Background report to the OECD joint-review of Science, Technology and Tertiary Education in Portugal, draft document, Ministry of Science, Technology and Higher Education.

State laboratories are affiliated to different line ministries (economy, health, etc.) and receive direct funding from these ministries on a historical and per capita basis. In the last decades, their role as research performers has decreased very significantly following structural reforms such as mergers and integration into HEIs. In 2015, they received EUR 137 million for their research activities and represented 6% of the GERD (down from 15% in 2005).

Funding for researcher training and scientific employment (PhDs and post-doctoral positions) accounts for about half of funds allocated by the FCT (61% in 2003; 50% in

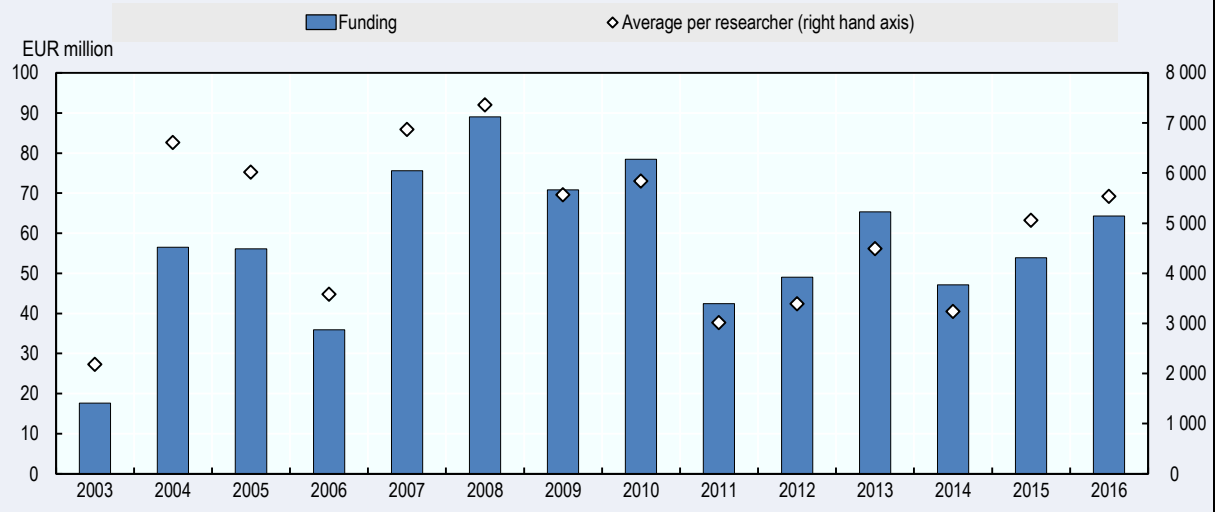
2010 and 43% in 2016). The allocation of block funding to R&D units and associated laboratories accounted for less than a fifth of the FCT budget (15% in 2003, 25% in 2010, 18% in 2016), as well as competitive project funding (22% in 2003, 25% in 2010, 15% in 2016).

Box 3.2. FCT block funding allocated to research institutions

Since 1996, the FCT has provided multiannual block funding to research centres following assessment of their achievements by an expert panel involving foreign peer researchers. This block funding comprises a base component, determined by structural features such as the number of PhD holders, and a strategic component which results from the peer assessment. Although the methodology has evolved over time, the last assessment exercise conducted between 2013 and 2015 marked a significant shift in approach, which was controversial in the Portuguese scientific community. The evaluation procedure was criticised for a perceived lack of transparency and the choice of indicators used (in particular its reliance on bibliometric indicators).

The amount of block funding transferred to R&D units and associate labs (in total and on average per researcher) varies strongly between years and cycles of multi-annual funding (Figure 3.5). The funds allocated also differ widely between research institutions. The last cycle of funding resulted in a strong concentration of funding: the 20 R&D units receiving the highest levels of funding obtained more than 50% of total allocated funding.

Figure 3.5. FCT block funding allocation to R&D units and associated labs, total amount (left axis) and average funding per researcher (right axis).

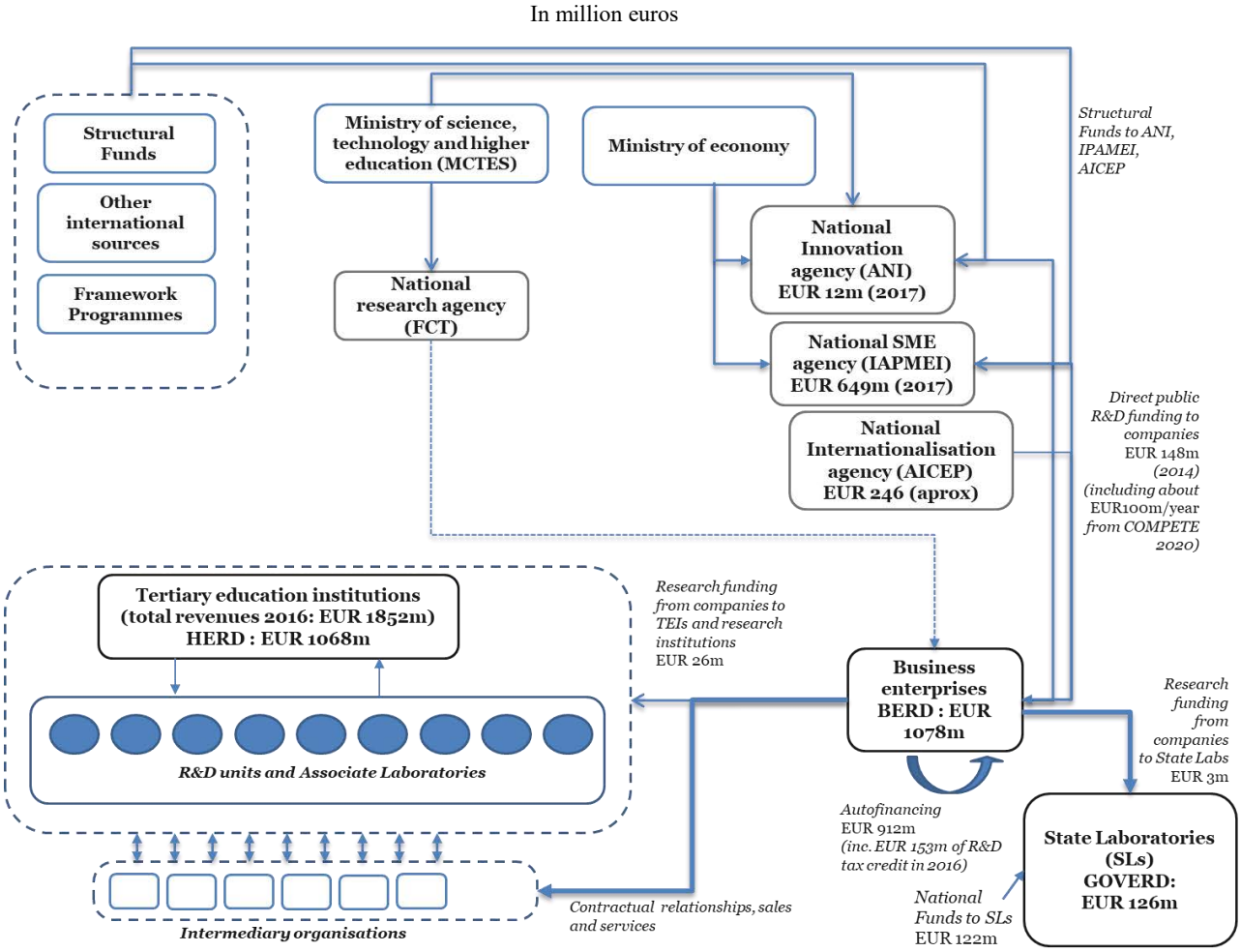


Source: Fundação para a Ciência e a Tecnologia (2017d), FCT database, http://www.fct.pt/estatisticas/unidades/index.phtml.pt (accessed on 15 January 2017).

Financial support to business innovation

Direct funding of innovation activities is highly and increasingly dependent on European structural and investment funds, mainly allocated through the operational programme COMPETE 2020, which is itself informed by the national Smart Specialisation Strategy. However, public funding represents only a limited share of the total expenditure on innovation in Portugal, since innovation activities are mostly self-financed by companies (89.7% in 2015).

Figure 3.6. Main sources of income for innovation activities 2014-2017



Note: This graph is an attempt to match financials stocks (aggregates) and flows (funds allocated). Depending on data availability, the financial flows refer to different years between 2014 and 2017. These differences as well as their various origins explain the residual gaps between the flows and the aggregates (BERD, HERD, GOVERD).
Source: based on MCTES (2017b), *Plano Nacional de Ciência e Tecnologia, 2017-2020*, Initial terms of reference for discussion, June,www.fct.pt/agendastematicas/index.phtml.en and OECD (2018d).

The direct public financial incentives to innovation have experienced a similar downward trend as those dedicated to academic research. However, the financial incentives have been restored and even increased in 2016 due to the opening of a large call for ANI's mobilising projects (*Projetos Mobilizadores*).

The funds for innovation are allocated competitively by three agencies: ANI, IAPMEI and AICEP via a comprehensive set of financial instruments (R&D projects, demonstration projects, mobilisation projects, R&D vouchers, etc.).[10] The beneficiaries, mainly businesses, can apply to most of these instruments as part of a team of partners (co-promotion projects) or as individual organisations (individual projects). In most cases, co-promotion projects are dealt with by ANI, while IAPMEI is in charge of the individual project applications. AICEP only manages one instrument related to the financing of innovation: the investment contract scheme (RCI). Other initiatives called collective actions (*Sistema de apoio a ações coletivas*) aim to support other type of actors in the system, in particular to strengthen knowledge transfer.

Portuguese innovative firms also benefit from a generous indirect funding system via the SIFIDE tax incentive scheme, in place since 1997. Over the last 10 years, as in many OECD countries, Portugal has increased its reliance on tax incentives for R&D. The relative importance of tax incentives has, however, logically decreased during the crisis years, as businesses have reduced their R&D expenditures and, along with these, their fiscal reduction claims on these expenditures. In 2015, the latest year available, fiscal incentives accounted for 76% of total public support for R&D and represented 0.1% of GDP (OECD, 2018a).

3.3. Assessment

In Portugal, there has been a multiplication of national strategic plans and priorities, which lack an overall sense of coherence and a clear prioritisation of objectives. As a result, research and higher education activities are weakly connected to established national goals. In an environment where public resources are limited, there have been limited attempts to engage in the difficult process of prioritising and targeting resources to create critical mass in areas where the country's research and higher education systems can excel. In essence, Portugal lacks a single and integrated strategic framework covering and creating a shared vision for the whole HERI system. Such a framework is conceived here not as something imposed top-down by government, but rather as a roadmap to guide activities and investments that reflects the ideas, suggestions and priorities of different stakeholders in the system. It should therefore follow extensive consultations with both the research and business innovation communities.

In addition to mixed messages, another consequence of the multiplicity of strategies and plans, many of which lack dedicated funding, is the instability of the funding framework, which is loosely connected to strategic orientations and subject to short term political interference. The Review team met with several hundred stakeholders across Portugal, many of them performing at a high level. However, they report that the national policy and funding environment in which they work is characterised by significant and unpredictable fluctuation in funding levels and unstable funding methodologies. Funding should therefore be more clearly linked to a strategic framework, the efficiency of spending evaluated against it. The overall HERI governance structure also needs improved horizontal policy co-ordination between ministries and more efficient vertical co-ordination between ministries and agencies.

Policy issue 3.1. There is no overarching and coherent national strategy to guide the system in the mid to long term

If well-designed, a national HERI strategy can serve several purposes:

- First, it articulates the country's vision regarding the contribution of higher education, research and innovation activities to its chosen social and economic development path. The strategic framework currently in place in Portugal falls short of achieving this function. There is no single integrated HERI strategy, but several strategies. There is a clear divide between those related to research and innovation, reflecting the silos in which the ministries in charge of these policy fields operate. The distinction between the national strategies and those related to the programming of ESIF further adds to the confusion and, therefore, to the dilution of the influence of these strategies as authoritative strategic documents to which institutions, researchers and businesses could orientate their activities. Moreover, different strategies overlap in some areas and sometimes contain different and conflicting goals.
- Second, it can set priorities for public investment in these activities, identify the focus of government reforms and include provisions for regular updates. The objectives and targets of national strategies in Portugal are often purely aspirational, without clear connection to resourcing commitments. EU-related strategies are associated to multi-annual ESIF funding, but are programming documents more than strategic documents. Furthermore, there is little formal, integrated monitoring of strategies that would make it possible to follow their implementation, and few evaluations to inform their revision.
- Third, since the added value of a strategy often stems as much from the process of creating it as from its results, strategies can engage a broad range of stakeholders, from the research community, funding agencies, business, and civil society to regional and local governments in policy making and implementation. While Portugal has made significant progress in involving and engaging stakeholders in strategy development and policy-making, consultation and engagement processes often remain confined to specific communities associated to the different ministries (academic research, business firms, etc.). Most importantly, the deliberative processes, although improving, have not yet succeeded at achieving their most important goal, i.e. contributing to build a stable consensus about priorities for research, innovation, and higher education.

The multiplicity of national agendas and plans stemming from different parts of the system does not create a consistent strategic framework

There is no clear, overarching and shared national strategy in place to provide a vision and guide the higher education, research and innovation system and its contribution to Portugal's development. Several strategic documents coexist, at different levels and covering various components of the system (research, innovation). They also belong to different institutional processes, either national or related to the strategic steering of European policies in Portugal (in relation to the EU Stability Programme or Cohesion Policy). Portugal has therefore no single specific national strategy documents for higher education, research and innovation, comparable to those developed in several other OECD countries (Box 3.3).[11] Stakeholder discussions leading to consensus and prioritisation have not taken place adequately, government policy instruments – such as research and

institutional funding – are not guided by national purposes and teaching, research and innovation-performing institutions within the country – universities, polytechnics, research units, intermediary organisations and business firms – lack a clear and stable framework within which to act. The coexistence of several distinct strategies has also led to multiple, sometimes inconsistent, messages and goals. Regarding spending targets, for instance, the strategy sets an R&D intensity target (GERD/GDP) of 1.6% in 2020, 2% in 2025 and 2.5% in 2030, while R&D intensity targets are 2.7% in 2020 in the EFICE strategy and 3% in 2030 in the recent 2018-2030 Innovation Strategy.

Box 3.3. The Long-Term Plan for Research and Higher Education 2015-2024 in Norway: an effective tool for both prioritisation and horizontal policy co-ordination

The Long-Term Plan for Research and Higher Education 2015-2024 (LTP) was launched in 2014 by the Norwegian government following a number of stakeholder consultations and inter-ministerial negotiations led by the Ministry of education and research. It covers research, innovation and, to a lesser extent despite its name, higher education policy. The LTP had proved effective to improve Norway's capacity for both priority setting and horizontal co-ordination in the context of highly sectorial policy.

- Priority setting: the LTP is built around three overarching government objectives: developing research communities of outstanding quality; enhancing competitiveness and innovation; and tackling major societal challenges. It also includes specific objectives in priority areas (seas and oceans, climate environment and energy, public sector renewal, enabling technologies). While the LTP has a ten year perspective for designing longer term avenues in broad terms, it includes a more precise four-year plan with financial commitments. It is revised every four years.
- Horizontal co-ordination: The planning process for the LTP involved high-level government meetings and summits, followed by intense interactions in a number of inter-ministerial working groups and other negotiations and hearings. These consultations fed into the strategy process and allowed for the formulation of the thematic priorities. During its implementation, the LTP also allows inter-ministerial co-ordination, for instance via the LTP interdepartmental groups set up within the different priorities ahead of budget negotiations and during annual high-level LTP workshops.

The LTP is considered a significant first step to improve prioritisation and policy co-ordination, and is expected to push these aspects further in its 2018 revisions. Its four year cycle offers the government the opportunity to add more concrete structural and programme-style policy activities to the LTP from 2018 onwards, without changing the plan's general orientation.

Source: OECD (2017a), *OECD Reviews of Innovation Policy: Norway 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264277960-en.

Regarding national strategies specifically, the government's overarching work programme provides little strategic direction for higher education, research and innovation policy. Recent versions of the GOP, for example, have contained a variety of one-off policy measures in the fields of higher education, research and innovation, focusing increasingly on support to innovation, but with virtually no thematic or sectoral priorities.

The recent medium- and long-term vision for the Portuguese HERI system, structured along 14 thematic research agendas (MCTES, 2017b), has added to an already long list of strategic documents. Although this document marks a change in relation to the 'neutral' (i.e. not explicitly prioritised) research policy traditionally in place in Portugal, it remains provisional and no information is available on how it will be used to guide research funding allocation. As for the new knowledge strategy for Portugal (MCTES, 2017d), although a laudable initiative, it appears to be a package of on-going and new flagship measures initiated by the MCTES (scientific employment, CoLABS, GoPortugal, Atlantic International Research centre, etc.) to be financed via additional funding from the European Investment Bank (EIB). Regardless of the intrinsic relevance of each of these initiatives, it seems clear that this document – still informal at this stage – falls short of the overarching strategy needed to provide a vision and stable inter-ministerial framework to guide the future development of the HERI system.

The 2018-2030 Innovation Strategy adopted by the Council of Ministers in March 2018 is a positive development as it covers the research and innovation policy fields and sets economic development targets, although not always precise. However, the document is very short and broad, being only available as an annex to a resolution of the Council of Ministers. Apart from referring to already existing programmes and initiatives, it does not provide information on actions and resources. These features make it unlikely that the Innovation Strategy will provide either the overall vision or the roadmap of future actions. It could however, if implemented and monitored,[12] be useful as an inter-ministerial co-ordination tool.

Strategies and plans guiding Structural Funds allocation do not compensate for the lack of a national strategy.

The design and implementation of policy initiatives and actions foreseen in the Major Options of the Plan in the HERI policy fields are increasingly influenced by the strategies and plans related to the provision of the Structural Funds. However, the latter only imperfectly compensate for the lack of a national strategy.

The most influential strategic documents guiding the allocation of the COMPETE 2020 funds during the period 2014-20 is the national Smart Specialisation Strategy. Smart Specialisation is conceived as a means to allow EU countries and, especially, regions to develop and consolidate new specialities or activities based on their comparative advantage (Foray, 2014). However, as in several other countries, the Portuguese Smart Specialisation strategy has proved difficult to implement and the overarching strategic principles have been difficult to translate in practice into a smart specialisation policy (Maroulis and Reid, 2017). Even more fundamentally, this strategy is too narrow and connected to the allocation of structural funds to provide a comprehensive vision for the development of higher education, research and innovation. Moreover, it is not clear how policy initiatives in the field of higher education and research have been, in practice, aligned with the goals of the Smart specialisation strategy.

Existing strategies are insufficiently supported by monitoring, evaluation and foresight

The analytical and intelligence base for strategy setting in higher education and STI policy in Portugal is comparatively weak. Pressure on public spending has limited capacity to develop additional analytical capacity in the MCTES or its dependent agencies. In the wake of the crisis and ensuing fiscal consolidation reforms, the ministry has lost a significant part of its policy analysis capacity. Moreover, the limited co-ordination between government departments means that research and analytical capacity are not shared or pooled.

The lack of a budgetary function that would consolidate all appropriations for research and innovation in the National Budget (as it exists in many other countries) is also detrimental to the strategic steering of Portuguese authorities. The current annual budget for R&D is limited to the remit of MCTES' interventions, while relevant expenditures from other ministries (related to the State Laboratories for instance, or the funding of IAPMEI to support entrepreneurship) are not or only partly accounted for. The government budget appropriations for R&D (GBARD), calculated for the sake of international comparisons, cannot be used for *ex ante* strategic steering of the research and innovation policy, as they are also reconstructed *ex post* and, furthermore, imperfectly comply with the international standards set by OECD (OECD, 2015a).[13]

There are few evaluations of previous or existing policy initiatives to develop an evidence base that could guide the design or re-orientation of policy initiatives. Besides a few exceptions, all evaluations are conducted in the framework of the structural funds governance and, as such, suffer from the same limitations as the programmes they focus on: they are often procedural, centred on execution issues rather than results and impacts, and lack the strategic dimension that could help guide future policy actions.

Recent initiatives demonstrate progress in stakeholder engagement

Although it is too early to assess whether these mark a breakthrough compared to past practices, several recent policy formulation initiatives have relied on a bottom-up participatory approach and could be considered good practices. The 2014 Smart Specialisation Strategy, adopted in 2014, was based on significant analytical work and wide stakeholder consultations to identify strengths and challenges of the system at regional and national levels. The 2017 National Plan for Science and Technology involved extensive consultations with various stakeholders in 14 areas to develop thematic research agendas.

The Laboratory for Public Participation launched by MCTES in collaboration with *Ciência Viva*, could also be instrumental to allow the participation of stakeholders in higher education, research and innovation policy. Even more innovative is the participatory budget mechanism launched in 2017. Citizens throughout the country chose 38 projects, among which eight in the areas of Science, Scientific Culture and Technological Innovation. A competition was then organised by FCT and *Ciência Viva* which selected R&D units, higher education institutions and private non-profit institutions to implement the winning proposals in these areas.

Policy Issue 3.2. The capacity to develop an overarching strategy and set priorities is hindered by insufficient co-ordination across government

The absence of an overarching national strategy, and more generally the weak priority setting tradition in Portugal, is in part linked to a lack of horizontal policy co-ordination, i.e. the mechanisms that ensure coherence of decisions between policy areas. A lack of co-ordination between research and innovation policies is compounded by the lack of a high-level advisory body.

Policy silos hinder horizontal co-ordination

Portugal has expanded the number of institutions involved in its HERI system since the beginning of the 1990s. Despite the increased number of bodies involved in the system, there is a clear division of responsibilities between the different policy-making and funding organisations. This is particularly the case in the higher education and research areas, where the MCTES is the main policy-making body and the FCT the main policy implementation agency. The latter concentrates most of the research funding instruments, including funding to individuals, advanced training, research projects, infrastructure and internationalisation.

However, there is a lack of horizontal co-ordination between government departments and policies dealing with higher education, research and innovation and between these departments and those responsible for broader economic, social and regional development policies. The fact that political responsibility for science and technology has not historically been the responsibility of the same minister as higher education (under the Minister of Education) or innovation (under the Minister of Economy) has had long-lasting effects on the co-ordination of relevant policy initiatives.

Even when the policy domains of science and technology and higher education were brought together in a single ministerial portfolio, the original boundaries between higher education and research policies remained. This appears clearly, for instance, in the co-existence of two distinct advisory councils, the CCES and the CNCT, in charge of higher education and research, respectively. This situation has sometimes led to a duplication of efforts, inconsistent measures and a lack of co-ordination between distinct funding streams, notably for research and higher education. While public funding of education is allocated to public HEIs, public funding for research activities is allocated directly to distinct research units, hindering the development of institutional profiles by HEIs which have little strategic leverage on research activities.

As in many countries, the divide is even more prominent between research and innovation policies. MCTES is responsible for higher education and science and the Ministry of Economy is responsible for support to the demand of knowledge in firms and entrepreneurship. This separation is also reflected at the level of implementation agencies, with the FCT funding academic research, ANI funding collaborative research led by industry, and IAPMEI and, to a lesser extent, AICEP, supporting business innovation and entrepreneurship. The joint participation of the MCTES (via the FCT) and the Ministry of Economy (via IAPMEI) in the joint board overseeing of ANI theoretically allows for some co-ordination between the two ministries in the area of innovation. Interviews conducted among agency staff and members of its governing bodies tend to show that this hybrid governance of ANI has in practice had little effect on bridging the gap between research and innovation policies. The lack of co-operation between the two ministries and limited formalisation of the vertical relationships between the ministries and the agencies does not allow this channel of co-ordination to work effectively.

Another divide lies in the fact that some other ministries have direct competence in the area of R&D, in particular via the State Laboratories under their direct control. However, this fracture is attenuated by the fact that some state laboratories are jointly co-ordinated with the MCTES and the sector has been significantly reduced in recent years.

The strategic and operational bodies that administer ESIF have also been criticised for a lack of co-ordination between related themes (competitiveness, human potential and territorial valorisation). These bodies include the dedicated high-level bodies for inter-ministerial and multi-level co-ordination as well as the Agency for Development and Cohesion and the Managing Authorities for the management of the relevant national and regional operational programmes. In response to this repeated and shared diagnosis, this dedicated ESIF governance structure in Portugal has evolved over time and significantly improved its horizontal co-ordination capacity, in particular since the adoption of NSRF (2007-2013), when research and innovation activities have for the first time been dealt with together within the same programme: COMPETE 2020. Further improvements in that direction were made in the subsequent generation of structural funds, Portugal 2020 (2014-20).

At the same time, as the research and innovation support initiatives are becoming more prominent in regional operational programmes, representatives of the Portuguese regions are members in these governing bodies or regularly meet with these. This facilitates multi-level governance against a backdrop of the growing challenge of vertical co-ordination among the European, national and regional levels.

There is no high level advisory body to foster horizontal co-ordination across ministry boundaries

While administrative and policy silos can be found in many countries, Portugal stands out due to its absence of clear formal institutional arrangements that could support high-level, cross-ministerial co-ordination, planning or decision-making. Traditionally, the main ministries in higher education, research and innovation were supported by advisory bodies (*Órgãos consultivos*), but these only had limited roles in practice. Currently, the two advisory bodies respectively in charge of research and innovation are the CNCT and CNEI. These two bodies were initially chaired by the Prime Minister, which gave them a stronger legitimacy and some transversal dimension, and their mandate included supporting inter-ministerial co-ordination of science, technology and innovation policies. However, under the current government, the two councils have met infrequently and they currently lack a clear mandate and plan of work. The CCES is *de facto* the only active advisory council to the MCTES and its contributions touch on subjects that go beyond the theme of teaching and learning, providing advises on issues pertaining to the mandate of the 'dormant' CNCT. However, the CCES meets infrequently, works mainly on the basis of specific demands from the Minister and has no budget or dedicated analytical or administrative staff to support its work. It therefore lacks the capacity to act as an independent advisory body which combines higher education, research and innovation.

The considerable volume of resources from European Structural and Investment Funds in Portugal dedicated to higher education, research and innovation means that the strategic and operational bodies to administer these funds are important actors in the strategic governance and implementation of policies in these fields. However, the governance structure set up for structural funds primarily ensures effective disbursement of funds in line with operational programmes, which have been agreed with the European Commission, and does not provide a strategic framework to guide HERI activities.

Policy Issue 3.3. The future role of State Laboratories in Portugal's research system is unclear

Over the last 20 years, the importance of state laboratories in the Portuguese research system has been reduced, as staff numbers and budgets have fallen. Some state laboratories have been merged; others have become associated to universities. The state labs that remain active focus on servicing the knowledge needs of the state or wider society in areas such as weather forecasting, civil engineering, agriculture, energy and geology, nuclear technology, biological resources and health.

Despite these changes, state laboratories still received operating budgets from their parent ministries amounting to a total of EUR 139 million in 2015: a significant investment of public resources. However, there is no overall strategy guiding the work and future development of state labs and limited co-operation between them. Rigid staff regulations also hinder their ability to respond rapidly to changing requirements.

Many countries have reformed their government research sectors in recent years – either by significantly reducing or abolishing them or by changing the status of public entities to allow them to function more effectively. Several countries have also redirected part of their government research sector, notably in agriculture, environment, health and social sciences, to better address the systemic issues related to climate change, ageing, food security and other societal challenges. The ability of the government to steer research institutions, mainly through competitive funding incentives, is limited, especially when it comes to contributing to high-risk and system-transition projects. Addressing the mounting societal challenges might therefore require that the government preserves its own research capacity through government laboratories.

In Portugal, proposals for reform of the State Laboratories were made more than 10 years ago by an international working group (International Working Group on the Reform of the State Laboratories, 2006). However, the crisis meant that the recommendation to set a new strategic framework of the laboratories was never implemented and recent reforms have focused solely on cost-reduction. The role and future development trajectory for state labs in Portugal should be clarified in order to ensure public investment in these bodies is used effectively and their potential contribution to Portuguese science is realised.

Policy Issue 3.4. The resources allocated to higher education, research and innovation are not aligned to an overall strategy or the level of ambition of the government

Once an overarching strategic framework has been set, policy implementation comes down to the commitment of financial resources that are commensurate with the level of ambition and in line with the strategy in place. While government expenditures for HERI activities in Portugal have risen in the last two years, after a period of drastic budgetary restrictions, these funding increases appear far from sufficient to meet the very ambitious objectives related to European convergence recently set by the government (Government of Portugal, 2018). This goal would require multiplying public R&D expenditures by two and private R&D expenditures by four. Experience shows that setting R&D intensity targets that engage actors is a delicate process, where ambition and realism must be balanced. However, meeting the targets will call for more than an increase of public spending on TERI. In particular, it will also require changes in the structure of industry and the nature of the labour force (expanding R&D intensive sectors and increasing the number of highly

skilled workers and researchers). Many countries have found it difficult to achieveR&D targets in the past (Sheehan and Wyckoff, 2003).

Of equal importance is the stability of the funding being allocated, so that HERI actors can plan their activities in confidence. Not only have funding levels in Portugal proved unpredictable, but funding methodologies and criteria change frequently, complicating planning and access to finance for research organisations and firms.

Finally, funding schemes should be accessible without disproportionate costs and administrative efforts. There was clear consensus during interviews in all parts of the system that the complexity of the management of the R&D funding programmes and the administrative burden for the applicants has increased significantly, notably due to the requirements related to ESIF co-financing. The increased efforts needed to participate in competitive schemes combined with decreasing success rates act as a deterrent to participation in public support programmes.

Drastic reductions of state funding for R&D, in contradiction with national and European spending targets

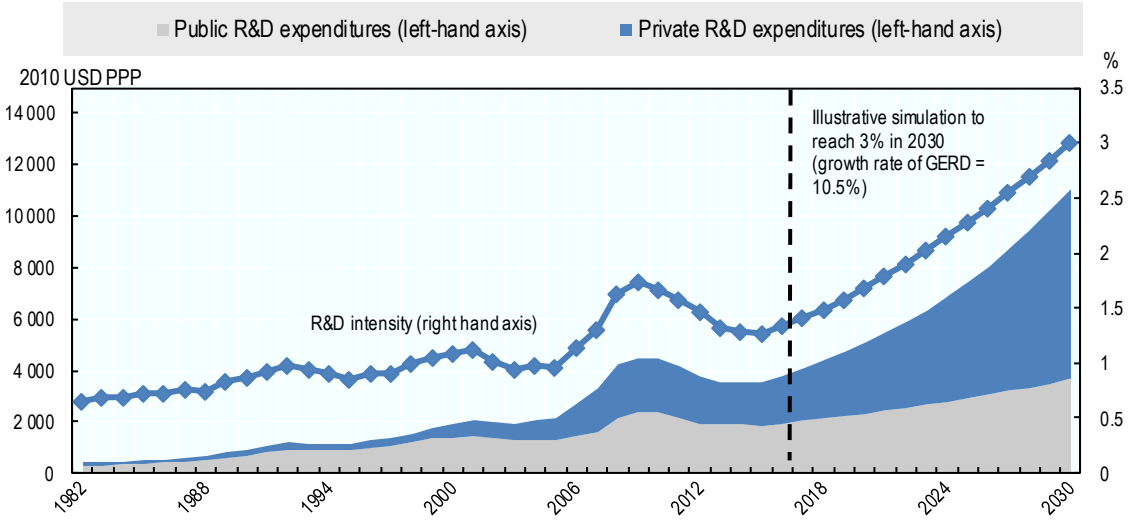
The crisis brought a sudden halt to the very strong and unprecedented increase of public and private R&D investment between 2000 and 2009. Gross R&D expenditures (GERD) that had reached the historical level of 1.58% of GDP in 2009 (above the R&D intensity of Greece, Ireland and Spain, for instance) decreased to 1.27% of GDP in 2016 (DGEEC, 2017b). While this is a slight improvement relative to the previous year (1.24% of GDP in 2015), this level is far below the R&D intensity set in the "National Digital Skills Initiative" INCoDe.2030 Strategy (1.6% in 2020, 2% of GDP in 2025 and 2.5% of GDP by 2030), the Industrial development strategy for growth and employment 2014-2020 (2.7% of GDP in 2020) or Portugal's European 2020 national target (3% of GDP by 2030, of which two third should come from private sector spending). The latter objective is considered by the current government as a desirable scenario to ensure European convergence by 2030 (MCTES, 2017d; Government of Portugal, 2018).

Based on OECD long-term forecasts of the Portuguese GDP growth (OECD, 2018c), achieving this objective would require, if the private business sector bears two thirds of this R&D investment effort (which is currently not the case), a twofold increase in public expenditure and an increase of private expenditures by a factor of almost four (Figure 3.7).

This raises two main challenges:

- It represents a level of growth of funding over a duration that Portugal has not previously achieved.
- While such growth would be beneficial to the nation in theory, it would not consistently contribute to innovation and productivity growth if made using existing governing mechanisms and allocation processes. OECD experience shows that meeting ambitious R&D targets is far from being solely a financial challenge. Major reforms will be required to change the structure of industry and services, as well as to reform the governance of the public research sector.

Figure 3.7. R&D expenditures and R&D intensity 1982-2016 and simulation 2017-2030 of EU convergence scenario



Source: OECD (2018b), MSTI database *GDP long-term forecast*. doi: 10.1787/d927bc18-en (Accessed on 07 March 2018).

Instability of funding hinders the ability of HERI organisations to make ambitious mid- to long-term plans

While the agencies tasked with supporting innovation in businesses (ANI, IAPMEI, AICEP) have been somewhat shielded from budget cuts by their reliance on structural funds resources, the FCT budget was drastically reduced in the wake of the crisis, following an almost two-fold increase between 2005 and 2009. Although funding has now stabilised, this fluctuation has created instability for research and development organisations, reducing overall funding available and, through frequent changes to funding instruments, increasing the administrative complexity of obtaining funds. Moreover, as in several other countries severely hit by the crisis such as Spain (Cruz-Castro and Sanz-Menendez, 2016), budget cuts were not implemented following a strategic plan, but rather where it was politically and administratively most expedient to reduce expenditure, notably activities with shorter term budgetary commitments.

The funding rules and procedures have also changed frequently. Interviewees consulted during the Review complained about regular modifications to funding conditions, or the unpredictability of calls for proposals from FCT and ANI. While these changes reflect exceptional measures taken to reduce public spending, they also relate to the absence of a multi-annual funding framework of agencies and the limited autonomy of agencies in relation to their line ministries. Although the announced inter-ministerial working group (Government of Portugal, 2016c), which was supposed to develop a multiannual financial framework was not set up, the contracts signed in July 2016 between all the HEIs and the government that ensure the stability of funding can be considered a first step in the direction of a multi-annual HERI budget.

The EU and national procedures associated to the management of structural funds create a heavy administrative burden and limit flexibility

The ways in which EU Cohesion policy and domestic policies in a wide array of policy fields are co-ordinated differ according to countries (Polverari, Michie, 2011). Portugal has adopted an integrated approach, whereby the domestic and EU co-funded policies are co-ordinated through increased operational integration at the level of policy instruments. EU funds are frequently used to co-fund national policy instruments, such as the doctoral studentship programme run by the FCT. This close integration of EU funds and national policy activities was, in part, driven by the need for fiscal consolidation, meaning European funds were called upon to replace national funding.

Interviews with both FCT staff and applicants to research funding calls suggest that the integration of two different funding streams in single support instruments, with different rules and diverse conditions for eligibility (depending on geographical locations, types of expenditures and beneficiaries, etc.) has created significant operational and management difficulties. Portugal 2020, with a stronger regionalisation of the funding activities related to STI has opened new funding channels, but has also increased the management complexity of the R&D funding programmes and the administrative burden for the applicants.

Policy issue 3.5. Funding allocation processes at agency level are not adequate to implement national priorities

To have an effect, the research and innovation priorities set at the system level – by government in consultation with stakeholders – need to be translated into relevant activities on the ground. One key transmission belt of these priorities is the funding allocated by agencies.

A number of factors limit the ability of the FCT to translate national priorities efficiently into action. Inadequate institutional arrangements governing the relationship between the agency and its parent ministry (MCTES) and internal organisational issues also mean that the FCT lacks the autonomy to act effectively.

Agencies mainly allocate their funding in a bottom-up way without explicit priorities

In recent years, intermediary funding bodies (agencies) have become more important in the Portuguese research and innovation system, while ministries have concentrated their activities on upstream co-ordination and policymaking tasks. In Portugal, the FCT has been an influential actor from the very early years of the development of the system. This role is formally acknowledged in the mission and responsibilities of FCT which include the "co-ordination of public science and technology policies". However, to a large extent, the dominant approach, in the system as a whole and within FCT more specifically, has been bottom-up. Research proposals are selected based primarily on merit, without any *ex ante* prioritisation of research domains and disciplines. The severe budget cuts that the FCT has experienced since 2011 have further limited the scope to allocate additional resources to fields and projects identified as strategic priorities. Despite some formal linkages to the Smart Specialisation Strategy, funding allocation by the FCT occurs without any explicit and transparent prioritisation of research areas.

Although selection based on excellence is a feature of the most efficient research system around the world, the lack of explicit allocation criteria for the resources among thematic

areas results in a scattering of resources, including those dedicated to innovation support (see Chapter 8.). It also makes the overall process less transparent and accountable. Above all, it does not allow the government to support the transformation of the HERI system in line with national development goals, since the process of selection based on excellence naturally favours the strongest actors and areas, to the detriment of emerging ones, which is essential for the future diversification and knowledge-based growth of the economy.

The internal organisation of FCT hinders the co-ordination of the different funding instruments

The measures taken in response to the economic crisis in 2011 in the context of the Plan for reduction and Improvement of the Central Administration (*Plano de Redução e Melhoria da Administração Central* – PREMAC) also affected the organisational structure of FCT. The agency was integrated with two other independent agencies, the Agency for the Knowledge Society (UMIC - *Agência para a Sociedade do Conhecimento*) and FCCN (Foundation for the National Scientific Computing) (FCT, 2014). These mergers have further broadened an already wide portfolio of responsibilities, which has again rendered more complex the FCT's operations as some of these activities have little synergies in research agencies' traditional tasks. The evaluation of the FCT conducted by an international panel in 2015 recommended that the missions of the agency be reconsidered and refocused on its core competencies (FCT, 2015).

The FCT is structured in line with its portfolio of instruments (support to institutions, support to projects and programmes, advanced training, etc.) (FCT, 2017c). This traditional instrument-driven structure has some disadvantages and creates inefficiencies, the most important being the internal difficulties in co-ordinating the use of the different funding instruments and developing integrated strategies across the different research themes and communities. To alleviate these problems, some newly created funding agencies across Europe have adopted a different organisational model, structured around the successive stages of the funding process: application, evaluation, funding and monitoring (Box 3.4).

The framework within which FCT interacts with its line ministry and its beneficiaries hinders its autonomy to act effectively

The autonomy of implementation agencies is important for their efficiency and effectiveness in implementing the policies formulated at higher level. Numerous authors have documented that inter-organisational arrangements between implementing agencies and parent ministries based on clear mandates, an adequate degree of operational autonomy and strong accountability make it possible to (Eisenhardt, 1989; Sumo, van der Valk and van Weele, 2012):

- Limit excessive political interference in day-to-day implementation of politically agreed programmes, hence promoting more credible and stable policy commitments, based on time longer time horizons.
- Steer policy implementation by setting performance requirements, rather than the processes and resources to be used. Democratically elected governments must be able to give clear strategic guidance to the agency.
- Allow more flexibility for the agency to adapt to and innovate in the way the service is delivered by the agency and.

- Increase trawnsparency and accountability in policy implementation. The agency must have effective reporting systems in place to ensure the political level is informed about implementation progress and potential problems.

Good practices established in several countries include providing the agency with an appropriate status (e.g. a private company with majority ownership from the state that clearly distinguishes ownership and control); a formal process by which the ministry or ministries provide(s) a clear mandate to the agency (objective-based contracts, letters of assignment, etc.), which then has the autonomy to implement this guidance without unnecessary micro-management. This is not currently the case in Portugal, where there is no clear functional separation between the policymaking and policy implementation levels, in particular when it comes to research policy.

Box 3.4. Three examples of alternative organisational models for research funding agencies

Some newly created research funding agencies are structured around instrument implementation processes (application, evaluation, monitoring, etc.), shared by different funding instruments with the aim of providing consistent operational support throughout the whole process of funding decision and allocation. This is an alternative to the traditional organisational model of agencies, whereby divisions are dedicated to specific funding instruments, which makes it necessary to replicate the same implementation processes for each instrument.

The European Research Council (ERC) was established by the European Commission in 2007 in order 'to encourage the highest quality research in Europe through competitive funding and to support investigator-driven frontier research across all fields, on the basis of scientific excellence'. Its governing body is an independent scientific council, composed of 22 eminent European scientists. The operations of the ERC are supported by the ERC Executive Agency, the ERCEA, which is in charge of implementation. The ERCEA has three overarching departments: i) scientific management; ii) grant management; and iii) resources and support. The scientific management department has five units, dedicated to process management and review, call and project follow up co-ordination; and the other three on one specific broad scientific areas (life sciences, physical sciences and engineering; and social sciences and humanities). The grant management department has four units. The first three are focused on specific grants and the fourth on audits and ex-post controls. Finally, the resources and support department has three units, dealing with IT and support services, human resources, and legal affairs and internal control.

In Poland, the National Science Centre (NCN) was created in 2011 with the aim of supporting basic research. Its executive agency (the NCN Office), under the aegis of the Ministry of Science and Higher Education, has departments in charge of research projects administration, project monitoring and analysis and evaluation. The Council of the NCN is a policy body consisting of 24 distinguished researchers from Polish institutions. They are in charge of electing the members of the proposal evaluation committees and appointing the NCN director and discipline co-ordinators.

In Spain, the (Sociedad de Artistas Intérpretes o Ejecutantes de España - AEI) was created in November 2015 to foster scientific and technological research in all disciplines through the competitive and efficient allocation of public resources, monitoring of the activities funded and their impact, and to provide assessment in the design of R&D public policies. It has a simple structure organised around two divisions: i) Programming, economic and administrative management; and ii) Co-ordination, evaluation and scientific and technological monitoring. The director of the agency oversees both divisions and reports directly to the president of the agency, who is highest authority on science and technology policy in Spain, the Secretary of State on Research, Development and Innovation.

Sources: European Commission (2016), ERCEA Organigramme, https://ec.europa.eu/info/sites/info/files/organisation-chart-ercea.pdf. National Science Centre of Poland (2018), NCN Organisational Structure, www.ncn.gov.pl/o-ncn/struktura?language=en. Ministry of Economy and Enterprise (2018), www.mineco.gob.es/portal/site/mineco/idi (accessed in February 2017).

The current legal framework characterises FCT, as a "public institute with a special regime", integrated into the state administration under the supervision and political direction of MCTES, with administrative and financial autonomy and its own property. However, in practice, external evaluators (FCT, 2015) and many of the public and private entities consulted in the course of this review highlighted the high dependence of the FCT on the Ministry and its low level of effective autonomy. The absence of a formal process for the ministry to convey strategic orientations and targets to its research agency undermines this necessary condition for an effective and transparent principal-agent relationship. MCTES provides policy guidelines to its agency (the last time in 2016), but these are closer to a general political declaration than to a set of clear objectives and instructions for the mid-term development of the FCT. Moreover, the appointment of the four FCT Council members by MCTES is potentially a source of instability and the head of FCT is also the Director General for Research at MCTES. Several research agencies, such as the French National Research Agency (*Agence Nationale de la Recherche* , ANR), are separated organisationally from their line ministry and are governed via four-year performance contracts negotiated between agency and ministry. The contract defines the objectives, actions (with a timeline) and monitoring indicators for the agency (ANR, 2016).

The independence of the FCT from the scientific communities represented in its Scientific Councils is undermined by the agency's internal governance arrangements. These are characterised by fragmentation between disciplines and the absence of strong power at the strategic management level of the agency. While involvement of the main stakeholders is an essential attribute of good governance of research agencies, better alignment with the national objectives would require broadening the set of actors represented in the FCT advisory bodies. The FCT needs a governing body through which stakeholders, other than researchers represented in the Scientific Councils, could provide strategic advises to the Board. Currently, the FCT Advisory Body (*Conselho Consultivo*) limits its advisory activities to the area of scientific computation. This provides the main beneficiaries of the funding activities with a strong position inside the agency and hinders the possible reallocations of funding between disciplines according to evolving national priorities. It also runs the risk of capture by specific interests within the scientific community.

The creation of specific research agencies in specific fields can create additional co-ordination challenges and reduce funding efficiency

Portugal intends to create a dedicated agency to fund clinical and translational research (i.e. activities to create new therapies based on scientific research) in order to take better into account the specific features of this area (Government of Portugal, 2018; MCTES, 2017a). Although several countries have created distinct organisations which fund all or part of health R&D activities (as in Sweden, for instance), this approach is not without risk.

The Review Team was told by researchers in the health sector that FCT funding practices and policies have been poorly aligned to the timelines and outputs of clinical and applied research. Clinical researchers in medicine, for example, report that clinical research priorities are not adequately recognised within the FCT's scientific panels and in its funding policies. While support to clinical and translational research and innovation is a positive step (along with the recently set up Clinical academic centres), the limited scale and scope of operation of this new agency could lead to additional fragmentation of the funding and priority-setting process. In addition, the efficiency of such a small agency is questionable given the unavoidable fixed costs its creation and management would involve. Other options building on a reformed FCT and improved co-ordination between MCTES and the Ministry of Health could be envisaged.

3.4. Recommendations

Recommendation on establishing an overarching national strategy

3.1. Adopt an overarching National Strategy for Knowledge and Innovation covering and providing clear guidance to higher education, research and innovation funding and steering organisations

Based on an appropriate bottom-up consultation and engagement process, a dedicated high-level task force should oversee preparation of a formalised National Strategy for Knowledge and Innovation for Portugal. This strategy should not only make it possible to set priorities in line with socially desirable goals, but also set a predictable and stable funding framework (see recommendation 4 below) and improve the co-ordination and communication among the main government bodies. This document should include:

- A vision of how the Government wishes to see the Portuguese economy develop through innovation in the next decade, including identification of sectors with greatest growth and innovation potential.
- An assessment of the broad skills and education attainment profiles, research capabilities and collaboration with firms and non-profit organisations that will be needed to support the development trajectory the government wishes to see.
- An account of the regional and social dimensions of education, research, innovation, and on the prospects for the benefits of increased productivity and innovation to be shared.
- An assessment of the capacity of Portugal's higher education, research and innovation actors to support the nation's innovation policy goals.
- Identification of the overall funding levels that the nation's higher education, research, and innovation actors are likely to need to achieve. The initial timeframe for the actions could be four years, with a broad multi-annual budget allocation attached.
- Specification of procedures for monitoring progress against the goals for the strategy and for periodic revision of both global objectives and specific actions (after the initial four-year timeframe).

The national Knowledge and Innovation Strategy should provide a clear framework to guide the internal strategies of implementing bodies and funding agencies under the MCTES and Ministry of Economy (such as the FCT and ANI), while leaving these bodies adequate room to devise the best policy tools and precise prioritisation of actions to achieve the overall goals. The Ministry of Planning and Infrastructures should also be involved to establish effective linkages with EU Cohesion Policy.

The timing of the Strategy should make it possible to set long-term orientations as well as actions required in the short- and medium term. Following the example of the Norwegian Long-term plan for research and higher education, a national strategy could have an eight to ten-year time horizon, with a rolling cycle of revision every four years. Another option, similar to the Spanish National strategy for research and innovation, would be to have an overarching strategy with an eight to ten year time horizon, with four-year research and innovation implementation plans providing more detail on specific objectives, defining the instruments, and funding, etc.

The timing of the Strategy should also be properly aligned with the ESIF programmes. The main orientations included in the new Knowledge and Innovation Strategy should be the basis for the development of the content of the next generation of Operational Programmes for EU Structural Funding for the period 2021-2028, in particular in the 'competitiveness' and 'human capital' areas.

Recommendations to strengthen national co-ordination

3.2. Establish a high-level task force at inter-ministerial level to take political responsibility for development of the shared national knowledge strategy, taking into account stakeholder input

Establish a task force at the inter-ministerial level bringing together, at a minimum, the Ministers for Science, Technology and Higher Education; Economy; and Planning and Infrastructure, to take responsibility for the development of the new national Knowledge and Innovation Strategy. Direct involvement of the Minister of Finance would be beneficial, providing the body with input with respect to macroeconomic and fiscal constraints.

The high-level task force with the initial task of developing and adopting the Strategy should be established for a fixed length, meeting formally every few months. A secretariat of policy and analytical staff drawn from respective ministries should support the task force.

While principally responsible for the development of the Strategy, the task force could be a first step toward a permanent inter-ministerial co-ordination council that would provide orientations of the higher education, research and innovation policies in a horizontal setting.

For a national knowledge and innovation strategy to be effective, it must be informed by the expertise and perspectives of those working directly in knowledge-intensive sectors of the economy and those who carry out research and education, taking into account the views of a wider range of relevant stakeholders.

To engage knowledge and expertise in the country – and to ensure a future knowledge strategy has wide support – the high-level ministerial task force should organise a wide-ranging consultation and engagement exercise, going beyond the sectoral consultations so far undertaken on elements of current strategy. Existing sectoral advisory groups, including the Co-ordinating Council for Higher Education can play a key role in convening stakeholders and providing input to this process. The secretariat supporting the task force should prepare a consultation document – equivalent to a green paper – outlining initial proposals and options for the priorities and action lines for a national knowledge strategy, to which stakeholders can react. The consultation exercise could involve a combination of moderated discussion events and written submissions. The process of preparing the consultation document, undertaking the consultation and collating input is likely to take at least 12 months.

3.3. Strengthen analysis, foresight and management capacity in government

The development and monitoring of a national strategy should be informed by accurate information on what is happening in innovation, research, and education, and by foresight on developments in the international economy and technology. To meet these needs, an analytic unit drawn from ministries responsible for the strategy's development and implementation should be established. This unit should provide ministers a detailed report every two years. These reports should inform the process of periodic revision of the national knowledge and innovation strategy, every four years, for example. The monitoring of public expenditure related to the strategy would be facilitated by the creation of a specific budget category in national accounting protocols, consolidating spending on Higher Education, R&D and Innovation.

Recommendation to ensure the contribution of state Laboratories to the national strategy in HERI

3.4. As part of the renewed national knowledge strategy, define the future role of the state laboratories with a view to maximising their contribution to Portugal's development and addressing societal challenges.

The development of the new national knowledge strategy (Recommendation 1) should include a comprehensive review of the role of the State Laboratories and the formulation of a clear development strategy for these bodies. Portugal can seek inspiration from other OECD countries in its efforts to steer and modernise its public research sector. In Spain, for example, state laboratories have been brought under the direct supervision of the ministry in charge of research and the researchers were integrated into a single research professional group in order to favour inter-organisational mobility. In Sweden, government research institutes have been transformed into non-profit companies and all their shares transferred to a common umbrella body, itself a non-profit company (RISE – Research Institutes Sweden). The role of the umbrella body is to maintain a dialogue with business and the co-owners, steer the RISE institutes, allocate strategic development funding, represent the institute sector in various contexts, lead the branding effort in Sweden and internationally and to evaluate the benefits and impacts of the state's investment in RISE. Another option would be to established performance contracts for all the state laboratories.

Recommendation to ensure predictable and strategic funding environment for the HERI system

3.5. Use the Portugal Knowledge and Innovation Strategy to set a predictable funding environment for the nation's higher education, research, and innovation system.

The analysis and advice of task force – based upon wide engagement across relevant Ministries within government and careful wide public consultation – should provide government, with the endorsement of Parliament, with an opportunity to establish a high-level, multi-year commitment of public funding in support of higher education and research. With this funding framework agreed, MCTES can deliver multi-year research funding through FCT and educational funding through its institutional subsidies in ways that predictable, aligned to national priorities, and at a level adequate to achieve needed reforms identified in the review.

While the Knowledge and Innovation Strategy would have a long-term time horizon, the funding framework linked to it would be for a shorter duration, such as four or five years. In Norway or Spain, for example, a national strategy contains a long-term perspective for and a mid-term rolling plan with financial commitments. The strategy is revised every four years for instance, adapting the long-term orientations as needed, and agreeing upon a new funding framework for the four years to come.

3.6. Reform the FCT, increasing its capacity to effectively balance national research priorities and the priorities of the nation's scientific research communities.

The institutional arrangements between FCT and MCTES should allow the ministry to provide clear guidance and associated resources to the agency on a multi-annual basis and monitor the performance of the agency in implementing these orientations. Such arrangements could take the form, for instance, of multi-annual letters of assignment or performance contracts negotiated between FCT and MCTES, setting out clear objectives and planned resources in line with the national knowledge strategy.

The independence of FCT in the fulfilment of these objectives should be strengthened by institutional reforms such as the dissociation of the roles of Director General for Research Planning and President of FCT. More radical reforms could also be considered, including a change of the current 'Public Institute' status of FCT, which provides only limited administrative and financial autonomy, into a public Foundation status. The latter option would also increase its operational flexibility.

The capacity of FCT to put in place the necessary measures to fulfil the objectives assigned to it should be also strengthened by changes of its internal organisational structure to ensure increased autonomy vis-à-vis the scientific communities it funds. A key condition of this autonomy is a clear separation between the "scientific evaluation" bodies and the "decision making" bodies that assign the indicative allocations of resources per areas, instruments. Potential options include notably the creation of an FCT "General Advisory Council", with a broader scope and stronger role than the current *Conselho Consultivo*, and changes to strengthen the FCT "Governing Board" (*Conselho Directivo*) with the appointment of additional members.

Wider autonomy vis-à-vis funded scientific communities should be complemented by a review of its scientific panel structure, to ensure that the FCT is capable of responding effectively to new knowledge needs, and to a range of research communities that are applied, clinical, or transdisciplinary.

Notes

[1]. This has been the case since the early days of the Portuguese system, when the task of policy co-ordination was mainly handled by the FCT predecessor, i.e. the Junta Nacional de Investigação Científica e Tecnológica (JNICT), then under the tutelage of the Ministry of Planning (FCT, 2013; Brandão, 2017; Conceição P. and Heitor M., 2005).

[2]. For instance, the Higher Council for Science and Technology, created in the early 1990s to follow the requirements of the first generation of structural funds (inactive in 1995), the Higher Council of Science, Technology and Innovation between 2003 and 2005, and the Advisory Council for the Technology Plan and Inter-ministerial Committee for the Technology Plan in the mid-2000s.

[3]. For the 2007-2014 Structural Funds period, it was the case of the evaluations of the measures to support innovation and internationalisation (NSRF Observatory, 2013a) and poles and clusters (NSRF Observatory, 2013b).

[4]. The updated GOPs for 2017 and 2018 have streamlined the 30 main policies into six policy domains. (Government of Portugal, 2016e; 2017a).

[5]. The 15 areas are: agri-food, forests and biodiversity; Portuguese architecture;urban science and cities for the future; culture and cultural heritage; circular economy; space and earth observation; social inclusion and citizenship; industry and manufacturing; ocean; health, clinical and translational research; cyber-physical systems and advanced forms of computing and communication; sustainable energy systems; labour, robotisation and employment qualification in portugal; tourism, hospitality and leisure management.

[6]. A few Portuguese regions had already developed regional innovation strategies in the past twenty years to support the implementation of the EU cohesion policy. The Norte region in particular had developed in 1996 a Regional Innovation Strategy (RIS Norte, covering the period 1998-2001), the Regional Programme of Innovative Actions (NORTINOV, 2002-2004), the regional strategy Norte 2015 in 2006 (2007-2013); the Regional Innovation Plan 2008-2010 (an output of the Norte 2015 regional strategy). These initiatives paved the way toward the Norte 2020 strategy, which includes the Norte smart specialisation strategy (RIS3 Norte).

[7]. For instance, in 2017, the Instituto Nacional de Investigação Agrária e Veterinária (INIAV) received EUR 29.6 million from the Ministry of Agriculture, the Laboratorio Nacional de Energia e Geologia EUR 17 million from the Ministry of Economy and the Instituto Nacional de Saúde Dr. Ricardo Jorge, EUR 28.5 million from the Ministry of Health. These budgets items are included in different budgetary programmes.

[8]. It is important to note that the funding to support the social services is only known ex post since it is included without earmarking in the total amount of institutional funding that HEIs receive, which then decide upon its internal allocation.

[9]. In 2015, the share of teaching staff integrated in a FCT research institution is identical regardless of the career position of the teaching staff (full professor, associate professor or adjunct professor), but was far lower for Polytechnics (35% of FTE in average). Only three polytechnic institutions had more than 60% of their staff in a research institution.

[10]. The innovation support policy instruments are analysed in more details in the Chapter 8.

[11]. The Netherlands, Ireland, United Kingdom, Norway, Sweden, France.

[12]. ANI, in co-operation with IAPMEI, is in charge of producing on a biennial basis a National Innovation Report to present the country's progress towards the strategy's goals.

[13]. In particular, the large discrepancy between the government-financed GERD and the GBARD raises some questions about the accuracy of the GBARD. The GBARD as a percentage of GDP in Portugal (0.98%) is well above the level of the EU28 average (0.62%) in 2015. Another striking indicator is the share of R&D policy in the total government expenditure, which is highest in Europe (2.03%, to be compared with 1.36% for the EU28). Efforts are on-going in Portugal to revise these figures.

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Chapter 4. Missions, profiles and resource use in HEIs

Portugal has a diverse system of higher education with a mix of public and private institutions, and university and polytechnic institutions. The legal framework of higher education has been re-oriented with the aim of providing wider scope for institutional autonomy and innovation, while reserving a steering role for the government. In practice, however, the nation's public higher education institutions have overlapping and weakly differentiated missions that are insufficiently aligned to national and regional needs. Institutional autonomy and responsibility have expanded, but legal provisions governing public sector employment, public procurement and financial management limit the ability of institutions to plan and manage their operations efficiently and effectively. Key instruments of government steering most especially institutional funding do not encourage higher education institutions to identify and pursue their distinctive strengths, leading to duplication of effort and missed opportunities for collaboration. This chapter examines these challenges, and presents policy options to address them.

4.1. Introduction

Universities, polytechnics and publicly supported research centres form the backbone of the national and regional higher education, research and innovation systems in Portugal. These institutions play an especially important role in research and innovation, not only in equipping people with high-level skills and performing fundamental research, but also in creating, sharing and exploiting knowledge of direct benefit to the wider economy and society around them.

The work of staff and students in higher education and research institutions – and the quality and impact of this work – both influence and are conditioned by the institutional environment in which it takes place. In sectors like higher education and research, which are highly regulated and dependent on public funding, institutional environments and the way institutions function are strongly influenced by external legal, regulatory and financial conditions that ultimately emanate from government policy, as well as internal factors lying within the control of institutional leadership.

Three of the most fundamental external conditions affecting how individual institutions define their purpose and implement their activities are:

1. The missions assigned to different types of higher education institutions by relevant legislation and public policy. This sets the basic parameters of what institutions are authorised, forbidden, and expected to do, and underpins more detailed specifications of goals, profiles and responsibilities within individual institutions. In some OECD countries, the missions of higher education institutions are not legally differentiated. In other countries, including Portugal, the distinct roles of different types of higher education institutions are prescribed by law. Legally-established differentiation of missions is based on the assumption that the many and varied missions of higher education – ranging from lifelong learning and regional engagement to theoretically-driven research – cannot be performed well if every higher education institution attempts to perform each mission. Instead, a differentiation of institutions by mission will best permit each task to be performed to a high level.
2. The degree of autonomy or discretion that government, regulatory authorities and relevant rules leave institutions and staff in the design and implementation of their activities (in learning and teaching, research or engagement with the wider world, for example). In recent decades, governments across the OECD have tended to grant public higher education institutions increased operational and financial autonomy in matters such as institutional strategy, infrastructure and staffing. With a view to augmenting the capacity of higher education institutional leaders to plan and prioritise the activities of institutions, public authorities, including those in Portugal, have also supported the consolidation of internal bodies – faculties, schools, or "organic units" – or a reduction in the scope of authority that these bodies exercise. In contrast to these developments, the implementation of external quality assurance systems in teaching and research has, in many cases, created new forms of external control and accountability.
3. The level and type of funding available to institutions to pay staff, provide buildings and equipment, and implement their activities. In Portugal, as in most OECD countries, a majority of higher education and research institutions are highly dependent on public funds, meaning that the level of government resources available and the mechanisms through which these resources are distributed in the system have a significant impact on institutional activities and behaviour. Fees paid by students, although nominally a

form of private funding, are strongly influenced by government policy and regulation, in Portugal, as elsewhere in the OECD.

Within the framework of these external conditions, the operating environment in individual higher education and research institutions also depends on a range of internal factors, specific to the institution in question. Crucial among these are the specific profile and development strategy adopted and pursued by the institution, the quality of institutional leadership and management capacity.

Governments in many OECD countries have taken steps to encourage higher education and research institutions to focus on and profile themselves in areas of activity where they are strong – or have clear potential to be strong – and to differentiate themselves from other institutions with like missions in the system. Common objectives include ensuring adequate diversity in the types of education provided, allowing institutions to respond effectively to the distinctive needs of their localities and regions, avoiding unnecessary duplication in teaching and research to increase efficient use of resources (particularly in comparatively small systems), or encouraging concentration of activities to create internationally competitive centres of excellence.

In evaluating Portugal's policy framework for higher education and research institutions we focus on the capacity of organisations and individuals to differentiate their teaching, research and innovation-related profiles to respond to the needs of community, regional, or global knowledge partners. Further, we focus on legal, regulatory, and funding frameworks within which organisations and businesses operate, examining whether they permit them to work with agility, and permit individuals and organisations to adapt their activities to changing circumstances

In light of these considerations, this chapter examines two main questions in relation to the situation in Portugal:

1. Do the *legal, regulatory and financial frameworks* in which higher education institutions operate create conditions (notably, clarity of missions, adequate institutional autonomy, adequate resourcing and incentives for good performance and accountability) that allow them to define differentiated profiles, and work effectively to achieve their goals? Do these frameworks provide institutions with incentives to *engage with external partners at regional, national or international level*, in ways that are aligned to their mission and profile?
2. To what extent have higher education institutions organisations *defined relevant profiles and development* strategies *in practice* and to what extent do they have the *leadership and management capacity* to implement these strategies?

This chapter focuses on higher education institutions. In analysing their performance we examine the relationship of higher education institutions to publicly supported research organisations: R&D units and associated laboratories that either function *inside* higher education institutions, or operate *in parallel* with them, hosting leaders on their boards, and university instructors in their research proposals and projects. Specifically, we focus on the implications of separate and largely autonomous research organisations for higher education institutions.

State labs are not examined here: they currently play a small role with the nation's public research system, they operate outside of the guidance or supervision of Ministry of Science, Technology, and Higher Education (*Ministério de Ciência, Tecnologia e Ensino Superior)*

(MCTES), and they are rarely critical collaborators in research carried out by higher education instructors and institutions.

4.2. Context

4.2.1. Higher education institutions and their missions

The 2007 Legal Regime for Higher Education Institutions (*Regime Jurídico das Instituições de Ensino Superior)* (RJIES) defines the missions and the scope of autonomy enjoyed by higher education institutions in Portugal. Within the binary system of HEIs, polytechnics are distinguished in the legal framework by their focus on professionally oriented studies and targeted research (*investigação orientada*) and the fact they are only entitled to award bachelor and Master's degrees, but not doctorates, which can only be awarded by universities. The legal framework recognises the inter-dependency of education, research and innovation in the wider economy, as well as the broader cultural role of higher education, assigning the same basic roles to all higher education institutions, within the limits of the vocation of each sub-system (DRE, 2007). As the Portugal Country Background Report notes:

> *"Portugal has a higher education [system] "with two pillars, one organised by areas of conceptual knowledge (universities) and the other driven by professional knowledge (polytechnics). Both pillars are equal in importance for policy and the Government refuses to consider any one of them higher than the other. Although equal in importance, they have different public missions and should not converge in only one of the models. Differences between both pillars should be based on their different missions and their capacity to answer different societal needs." (MCTES, 2017)*

Notwithstanding these binary principles, Portugal has seven public universities that contain polytechnic programmes, most notably the University of Algarve, in which just over one-half of students (51%) are enrolled in polytechnic programmes (MCTES, 2017). Polytechnic programmes and their university hosts do not function as single entities in which students, instructors, or courses are shared. Rather, only basic business operations – such as IT, accounting services, and physical infrastructure – appear to be shared or co-ordinated across the binary divide.

While all 14 public universities are endowed with the legal authorisation to award doctoral degrees, in practice the training of doctoral students is concentrated in a small number of research-intensive public universities located in the nation's two principal metropolitan areas. The three public universities located in Porto and Lisbon together account for half of all doctoral training. Six public universities account for about eight in ten doctoral graduates, while the nation's remaining eight public universities account for fewer than ten percent (9.68%) of doctoral degrees awarded – ranging in absolute numbers from 62 doctoral awards per year at Beira Interior to seven per year at Madeira (Table 4.1).

4.2.2. Regulation of study places and programmes

For both universities and polytechnics, there is a strong regulatory process rooted in the use of enrolment capacity planning and the setting of *numerus clausus* admission ceilings for all first cycle programmes that was first introduced following the 1974 Revolution and the massification of Portuguese higher education (Fonseca et. al., 2014). Its principal purpose today is not to balance aggregate demands and supply of study places. Rather, it aims to manage the regional balance between the demand for and supply of study places. The Agency for Assessment and Accreditation of Higher Education (*Agência de Avaliação e*

Acreditação do Ensino Superior, A3ES) sets enrolment capacity limits for all higher education institutions, public and private, based upon teaching inputs (instructors and physical infrastructure), for all three cycle of higher education (bachelor, master, doctoral).

For first cycle (and integrated master) programmes in public higher education institutions these limits are reviewed and (possibly) modified by MCTES, and set forth in a notice, the *despacho orientador*.

The number of study places available to all higher education institutions for students admitted outside the General Access Stream, i.e. through special access competitions (principally international students and those over 23 years of age) is also set by government, as a ratio of the institution's national competition to special access study places.

This regulatory process has permitted the Ministry to plan capacity contraction in response to demographic decline and to include a regional dimension to the management of the higher education system by protecting, to the extent possible, student enrolments at universities and polytechnics in the interior and on the islands. The numbers of students at these 13 public institutions (almost half of the public institutions) have declined by an average of 6.5% between 2005 and 2016 (DGEEC, 2017b; 2011). As the government currently funds higher education institutions on a historical basis, rather than through a formula based on enrolments and graduations (see below), interior institutions have been protected from the full potential financial impact of declining student numbers.

Portugal has established an exclusive legal basis for the location of some programmes in polytechnic institutions, most notably nursing and accountancy. However, Portugal does not manage or support its binary divide through the articulation of general guidelines promulgated by the MCTES about the sectoral appropriateness of new bachelor and integrated masters' programmes. The Ministry does not have a process of review and approval of new programmes in public higher education institutions with a view of their alignment to institutional profiles and missions. However, the Ministry does appear to consider sectoral appropriateness when annually allocating additional study places (*vagas*) to public higher education institutions.

4.2.3. Quality assurance

A3ES – Portugal's independent quality assurance agency for higher education – began its activities in 2009, establishing criteria and procedures for accreditation of new study programmes and launching its first cycle of reviews of programmes already in operation (completed in 2016). These processes have led to a significant reduction in the number of study programmes being offered in the higher education system, notably in the private sector. Most stakeholders consulted in Portugal agree that the implementation of the external quality assurance process has been successful in eliminating low quality programmes and the work of the A3ES is highly regarded in Portugal. Recognising that the current programme-level accreditation process is both administratively burdensome and intrudes on institutional autonomy, A3ES plans to move to a system of self-accreditation of programmes at institutional level, accompanied by periodic institutional reviews (A3ES, 2017). Under this arrangement the accreditation of new programmes will remain, but the process to accredit them will be differentiated across institutions depending on the results of institutional reviews. Where institutional reviews provide evidence that higher education institutions have strong internal quality assurance processes, will become self-accrediting with respect to programmes, rather than subject to A3ES programme-level review.

4.2.4. Institutional autonomy

In 2007, the OECD Review of Higher Education in Portugal offered governance recommendations which were largely accepted by the Portuguese government and incorporated into the new legal regime for Portuguese higher education institutions ("RJIES", approved by Law 62/2007). The high-level objectives and recommendations of the proposed governance reform were as follows:

> *"... [G]overnment must disengage from the detailed control of the system and must give the institutions greater freedom to regulate themselves and to innovate. The guiding principle should be to provide greater scope for autonomy and innovation at the institutional level while reserving the steering role for the government. ... Portugal is ready to move towards greater differentiation of governance, with the national government more squarely focused on policy, and institutions given wide latitude for accomplishing public priorities consistent with their missions. This significant increase in institutional autonomy should be introduced differentially and progressively, depending on the capacities (including capacities for internal governance and management reform) of the institutions and the extent of their challenges. ... [N]ew legislation should establish institutions as self-governing foundations. Still supported financially by government, they would operate within the private sector. They would have managerial freedom and finances separately accounted for outside the state system. The civil service designation would be removed from all employees of the higher education institutions. The institutions must satisfy government that they are prepared to accept this freedom and that they are willing to confront the difficult leadership and managerial decisions that are an inherent part of such an arrangement." (OECD, 2007)*

RJIES established the organisational principles of the higher education system, enhanced the autonomy and accountability of institutions, introduced new or revised governance structures with significantly increased external participation (minimum 30%) on the 15-35 person General Council (the highest decision making body), provided for greater diversity of the organisational form and legal status of public institutions (namely the option of public universities and polytechnics becoming public foundations governed by private law), and made provision for the establishment of consortia of institutions.

RJIES also changed the procedures for the appointment of University Rectors and Polytechnic Presidents: they are elected in a secret ballot for a four-year term (renewable once) by the General Council (which is chaired by an external member) following a public call and public hearings. The position is open to candidates from outside of the institution: in the case of Rectors, academics from other universities (in or outside Portugal) and in the case of Presidents also suitable candidates from outside of higher education.

RJIES aimed to move the higher education system from elected to selected leadership; to simplify internal governance in terms of levels and structures; to reduce the size of key governance bodies; to increase the participation of external stakeholders significantly; to enhance institutional autonomy; to place universities and polytechnics within the same overall regime; and, potentially crucially, provide the opportunity for universities and polytechnics to apply to become public foundations governed by private law – a move that would significantly expand their flexibility in human resource management, the spending of non-public resources, and the disposal of assets.

The RJIES (article 129, nº2) introduced the possibility for public higher education institutions[1] to become public foundations under private law. The objective was to give

HEIs greater operational autonomy, particularly in the areas of financial management and staffing, by allowing them to make use of the greater flexibility afforded by the employment, accounting and procurement legislation applicable to the private sector in Portugal. Foundation status is awarded by decision of the Council of Ministers on the recommendation of MCTES (DRE, 2007).

The law required only that institutions seeking foundation status report on the potential implications of foundation status for the organisation, management, financing and autonomy of the institution, and describe the advantages of adopting this model for the pursuit of the institution's objectives. However, at the request of the Finance Ministry, institutions have also been obligated to demonstrate financial sustainability and sound financial management, which they do by providing three years of consolidated financial statements demonstrating that approximately half of revenues come from their own financial resources (Barrios, 2013). By the start of 2018 five out of 15 public research universities and university institutes[2] had adopted foundation status. No public polytechnics had yet adopted foundation status.

4.2.5. Funding public higher education institutions

Public funding for the core operations of public higher education institutions in OECD member countries – excluding competitive funding for research – is delivered, in varying combinations, though three main pillars: basic funding, performance-oriented funding, and profile-oriented funding. Basic funding is often delivered on an input basis, whether through an enrolment-based formula or student voucher, though sometimes on an historical basis. Performance funding is typically delivered through output or performance-oriented formulas, while profile-oriented funding is usually provided through performance agreements or contracts, competitive funds, or excellence schemes. The first of these pillars typically provides 75-90% of institutional funding, while the latter two often comprise somewhere between 5-20% and 1-10% of institutional funding, respectively (Ziegle, 2017).

In OECD countries implementing multi-year funding, funds are typically delivered to higher education institutions through a contract signed by the ministry responsible for higher education and by public higher education institutions, and approved by the Ministry of Finance and the Parliament. The contracts contain funding commitments from government and the reciprocal public obligations of higher education institutions, and are accepted as a framework for yearly budgets.[3]

Core institutional funding for public HEIs in Portugal in support of education and infrastructure is delivered through one pillar: basic funding allocated on an historical basis. In 2006 a complex formula-based institutional funding model was proposed by MCTES and the Finance Ministry, in which institutional subsidies were to be based principally based on enrolments by field of study, though the model was supplemented by other non-enrolment parameters, such as a graduation efficiency rate (Portaria no. 231/2006). The model has not been updated since its introduction. Instead, institutional subsidies have been made upon that original funding base, with annual incremental modifications that are not formula-based. The institutional subsidy delivered to public higher education institutions comprises approximately one-half of total income obtained by all public higher education and publicly funded research institutions (principally associated laboratories), with the balance of funding coming principally from tuition fees and competitive research grants (Table 4.1).

Table 4.1. Total income of public higher education and publicly-funded research institutions, 2011-2016

	2011	2012	2013	2014	2015	2016
1. Direct Public funding to HEIs: Operating budget, including infrastructures	1,071	871	1,003	1,007	980	1,022
2. Direct Public funding to HEIs: social support services	30	25	28	29	28	27
3. Competitive public and private funding for R&D (includes national and EU funds)	713	754	816	769	769	737
3.1. Competitive funding from the Portuguese S&T Foundation (FCT) to HEIs	108	108	83	75	74	77
3.2. Other competitive funding from the Portuguese S&T Foundation (FCT) to higher education and scientific systems (includes grants, fellowships, infrastructures, international co-operation)	285	289	320	309	281	280
3.3. EU competitive structural funding (ERDF/ESF: NSRP 2007/2013(QREN); ESIF 2014/2020 (PT2020)	79	90	127	131	134	95
3.4. Direct EC competitive funding (includes FP7, Horizon 2020)	51	66	78	64	82	80
3.5. Other sources of funding (services providers: industry; environment; health; studies and consultancy, rentals)	190	202	206	189	198	205
4. Public funding for HEIs and all research institutions (1+2+3)	1,814	1,650	1,846	1,806	1,777	1,786
5. Other funding (private funding)	315	327	328	323	331	335
5.1. Funding associated with support services (includes meals, accommodations)	24	23	21	20	21	20
5.2. Student tuition fees paid to public institutions (2)	291	304	307	303	310	315
6. Total income of public higher education institutions and all research institutions (4+5)	2,129	1,977	2,175	2,129	2,108	2,121
7. Government funding for direct social support to students (student fellowships) (1)	130	122	127	126	140	133
8. Total income of public higher education institutions and all research institutions + government funding for direct support to students	2,259	2,099	2,302	2,255	2,248	2,254
% (8) / GDP	1.28	1.25	1.35	1.30	1.25	1.22

Notes:
2016 figures are provisional;
1. includes students at public and private higher education institutions;
2. includes 1st cycle, 2nd cycle and PhDs
Source: INE; MCTES/IGeFE; DGES.

Research funding for higher education institutions and publicly funded research institutions is obtained from national funding sources, international funding sources, and from firms. Core institutional funding for public higher education institutions in Portugal does not contain direct and explicit funding in support of research. However, the annual operating grant to higher education institutions provided through the core institutional funding model includes an *implicit* subsidy for research as it funds facilities in which research may be conducted. Further, core funding pays for the time of instructional staff, part of which is expected to be committed to research. MCTES does not provide dedicated institutional funding in support of research to higher education institutions; however, it did provide institutional subsidies to Associated Laboratories from their inception (in 2000) until 2013.

National research funding obtained by higher education institutions and publicly-funded research institutions is awarded principally by FCT, which employs competitive processes and criteria of scientific merit to award funding for research and development (R&D) centres and individual research projects. R&D Centre funding is allocated through multi-year block funding allocated directly to research groups based within higher education institutions and associated laboratories – rather than allocated to the core budget of higher

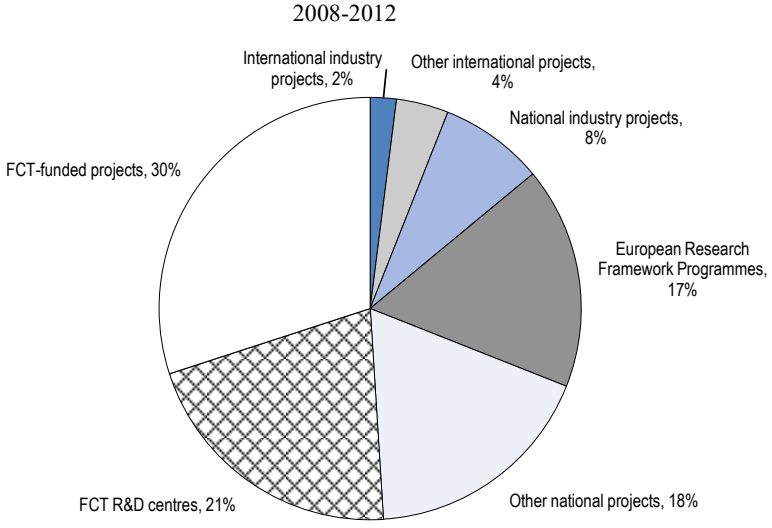
education institutions. Approximately 21% of research income obtained by higher education institutions and public research organisations is provided by R&D Centre funding. An additional 30% of research income reported by universities and publicly funded research organisations is provided by FCT funding of research projects. In total, about one-half of research revenue for higher education and publicly-funded research organisations is obtained from the FCT (Figure 4.1).

About 17% of reported research income is directly provided by EU funds, by the Commission on a project basis, most recently through Horizon 2020 (17%). EU structural funds also complement national funds in other research funding categories, such as "other national projects (18%), "FCT-funded projects" (30%) and "FCT R&D centres" (21%). Industry funding comprises a more modest 10% of research income reported by higher education and publicly-funded research institutions, and is obtained principally from national industry projects.

As Table 4.1 indicates, public higher education institutions raise revenues from private sources, including tuition fees paid by students (which comprise about 15% of institutional income); from rental and consultancy income; from services sold to firms; and other ancillary sources of income.

Private higher education institutions in Portugal are teaching-oriented and tuition dependent. They rely principally on income obtained from tuition fees, other sources of private income, and, infrequently, income obtained from competitive research funding. The research profile of the private sector in Portugal is modest. In total private institutions awarded 5.7% of doctoral degrees in 2015/16, and hosted 11% of the nation's 307 R&D Centres, only two of which are in STEM fields. Of the 28 associated laboratories in Portugal, only one is hosted exclusively by a private higher education institution: the Centre of Biotechnology and Fine Chemistry at the Catholic University of Portugal.

Figure 4.1. Research income for higher education institutions and publicly-funded research institutions, by source



Note: Self-reported research income received by higher education institutions and institutional consortia, fiscal years 2008-2012. "Other national projects" refers to EU structural funds as well as other public/non-profit funding sources (e.g. other government departments). "FCT-funded projects" and "FCT R&D centres" may also include structural funds that complement national funds.
Source: Fundação para a Ciência e a Tecnologia (n.a, unpublished), Research income sources of FCT-funded organisations, 2008-2012, data provided by FCT, Lisbon

4.2.6. Higher education system-level governance and steering

Portugal's Co-ordinating Council for Higher Education (CCHE), established in 2016, is an advisory body for higher education, rather than a body that is authorised to set plans for the nation's higher education system or engage in system steering through oversight or use of budgeting and regulatory policy instruments. Comprised of stakeholders from each sector of the Portuguese higher education system and augmented by (international) higher education experts, the body has neither a staff nor dedicated budget, and has a legal mandate to examine issues submitted to it by government, and give advice on questions of public higher education institution closure, merger or federation, or situations of "serious institutional crisis."

4.3. Assessment

Policy issue 4.1. Portugal's balance of higher education institutional missions is not fully aligned to its national and regional needs

Higher education systems that have a network of higher education institutions with strategically differentiated missions are best able to meet a wide range of national needs, including diversified educational provision, high quality research activity, and regional engagement (OECD, 2007b).

Portugal's modern higher education system was planned to have a clear binary line, organized by areas of conceptual knowledge (universities) and professional knowledge (polytechnics). However, in the decades since the inception of its binary system the missions of Portugal's higher education institutions have become overlapping, and less productively differentiated than is possible.

There is a tendency for institutions in Portugal to attempt to offer a wide range of disciplines, rather than specialising. Many institutions also aim to offer instruction across a range of study levels, rather than concentrating on one part of the study cycle. This is driven, in part, by pressure to maximise enrolment and the fee income that comes with each enrolled student, and by a desire on the part of institutions to shape and enhance their reputation. And it is made possible by the limited use of ministerial steering to maintain and shape the nation's binary divide, either through its funding methodologies for the core operations of higher education institutions or their research activities, or the review and approval of new programmes with regard to their sectoral appropriateness.

Research universities offer programmes that, in light of their professional orientation, one might expect to be provided exclusively in the polytechnic sector. For example, the Universities of Coimbra, Évora, Lisbon, Porto,Trás-os-Montes and Alto Douro (UTAD), among others, all offer first and/or second-cycle programmes in the field of tourism and leisure.[4] A recent study estimates that 25% of first degree programmes are offered by institutions in both sectors (FFMS, 2017).

At the time of the review the nation's higher education system contained some polytechnics institutions that were eager to offer doctoral degrees, but unwilling to offer short-cycle, professionally-oriented higher professional education (*Cursos Técnicos Superiores Profissionais*, CTeSP) qualifications, fearing these would interfere with their desired profile as research-oriented institutions suited to university status. Conversely, some universities with flagging enrolments and a more strongly practice-oriented profile were keen to offer short-cycle vocationally oriented CTeSP qualifications. However, the

Ministry has not permitted this, reserving CTeSP programmes solely for polytechnic institutions, and by this means policing the boundaries of its binary system.

An issue raised by the review team in visits to polytechnic institutes and schools is whether the accreditation criteria used by A3ES are sufficiently differentiated to cater for both university and polytechnic programmes. Most respondents in the polytechnic sector expressed the view that the criteria are too university/academically orientated. The Agency's response was that the sectoral location of the programme is considered in the evaluation, which in the case of polytechnic programmes, means recognising that practice-oriented teaching and high levels of professional activity with industry partners are an essential part of the polytechnic mission. An institution's capacity in these areas is however more complicated to assess than traditional research performance where there are accepted bibliometric indicators. This is an issue on which the Agency is currently working.

One important initiative by the Ministry is helping to renew and update the binary divide. In 2015, MCTES established the Programme for the Modernisation and Valorisation of the Polytechnic Sector (*Programa de Modernização e Valorização dos Institutos Politécnicos*), which aims to improve the public perception of the sector and to modernise the model of polytechnic higher education and applied research using the most advanced and successful experiences in Europe and the United States. The programme has a budget of EUR 65 million for its two major components: EUR 48 million has been allocated to cover the operational and equipment costs of the Higher CTeSP and EUR 17.5 million to fund the first FCT call for financial support of practice-based R&D activities in consortia of polytechnics, launched in May 2016.

The programme's focus on the development of modern methods of career-orientated teaching and learning is being driven through linkages, study tours and joint programmes with European and United States systems with strong university of applied science or college sectors. Visits of polytechnic leaders to Finland and Switzerland took place in 2016 and missions to the Netherlands and Ireland took place in 2017. A call for joint programmes between Portuguese polytechnics and their equivalents in these countries was launched in 2017. One of the major points of attention is the participation of polytechnic students in all years of study in practice-based R&D projects. The programme has also organised a series of workshops on practice-based R&D and a Forum Polytechnic, which presents the experience and competence of polytechnics to develop solutions in particular professional fields to companies and other social actors.

Table 4.2. Public Polytechnic academic staff holding PhDs in 2005/6 and 2015-16, and participating in FCT R&D units in 2015/16

	Percent of academic staff with PhD		Percent of academic staff part of FCT R&D units
	2005/06	2015/16	2015/16
Total public polytechnics	11.1	41.1	31
Total public universities	56.9	73.4	65
Total public sector	37.3	61.3	47
Total private polytechnics	11	34	19
Total private universities	26.2	59.3	41
Total private sector	20.5	50.3	20.3
Total	32.3	58.8	48

Source: DGEEC (2016), Perfil do Docente do Ensino Superior – 2015/16. DGEEC (2012), Docentes do Ensino Superior [2001/2002 a 2011/2012, DGEEC (2017a?), Docentes Do Ensino Superior Integrados Em Unidades De I&D Financiadas Pela FCT.

Over the past decade, there has been a striking increase in the number of polytechnic academic staff that hold PhD degrees and who participate in FCT R&D units (Table 4.2). The former trend is directly related to a 2009 policy decision that a PhD should be a requirement for a polytechnic academic career *(docentes de carreira*) and the introduction of programmes enabling existing staff to obtain this qualification. The increasing number of PhD holders has led to an increasing number of polytechnic academic staff interested in participating in an FCT R&D unit, and who are qualified to do so.

Many in the polytechnic sector aim to increase their focus on research, and wish to obtain the right to award doctoral degrees. While universities tend to defend their exclusive right to award PhDs, representatives of polytechnics tend to see PhD-awarding powers as a necessary step to allow them to fully fulfil their roles in applied research, as broadly comparable institutions – such as Institutes of Technology in Ireland and University Colleges in Norway – do elsewhere in Europe.

The review team posed three questions relating to the possible provision of doctoral programmes by the polytechnic sector. First, is there an economic and social rationale for the targeted extension of this degree awarding authority – would it contribute to Portugal's strategy of higher education and research stimulating high skill employment and productivity growth? Second, is there the capacity on the part of some polytechnic institutions, schools, or programmes to offer doctoral education at suitable level of quality, and for its graduates to find employment using their skills? Third, should polytechnics be permitted to offer "traditional" research-based PhD programmes given that these clearly fall outside of their core mission as currently understood?

The impact of polytechnic doctoral programmes and applied research on regional economic and social well-being is not well documented in peer-reviewed research. However, in

dozens of meetings held across the country by the review team, representatives of firms – almost invariably from small or micro enterprises – consistently stressed the beneficial impact that applied research had for their enterprises. They noted that their collaboration with researchers based in polytechnics permitted them to improve production processes, and to develop new products – often in traditional industries such as food products, textiles, and ceramics – of higher value and profitability.

The capacity to offer doctoral education at a suitable level of quality appears not to follow precisely the legal structure of a "two pillar" system of universities and polytechnics. While Portugal has many outstanding researchers in its universities, many of the nation's 14 public universities have, a modest research profile, and award few doctoral degrees in a limited number of fields. Conversely, some programmes or schools within polytechnics have significant research programmes.

Some polytechnic schools and programmes visited by the review team appear to already have sufficient human and physical resources to provide doctoral training. They currently provide doctoral training through partnerships with Spanish Universities or host PhD students from Portuguese universities in their laboratories and research groups. One example of the latter form of engagement in PhD training that the review team encountered in its visits is the *Centro de Investigação de Montanha* (Mountain Research Centre) of the School of Agriculture at the Polytechnic of Bragança. The Centre collaborates with more than 70 PhD candidates from Portuguese and foreign universities, some of whom are visitors carrying out research projects, and others of whom are co-supervised by Bragança faculty (and faculty at their PhD awarding institution). Researchers who have collaborated with the Centre have produced more than 1 100 publications. Other polytechnic researchers also collaborate in research activities with universities and associated laboratories through their participation in FCT Research and Development Labs.

Growing relationships between universities and polytechnics in the training and hosting of PhD students and the widening participation polytechnic researchers in R&D Centres and Associated Laboratories together point to emergent model (or models) of doctoral education for polytechnic institutions. For example, one model would authorise doctoral awarding authority for selected polytechnic programmes or colleges. To ensure the quality of provision, the government could establish a process conferring doctoral authorisation to programmes or colleges that participate in a multi-institutional doctoral programme with a public research university, whose researchers have a record of research performance in R&D Centres and/or Associated Laboratories. To ensure the relevance of provision and an appropriately professional profile to the programme, it could require that authorisation of doctoral programmes be subject to review external stakeholders – including relevant firms, professional associations, and public sector bodies.

Box 4.1. Authorisation to Award Doctoral Degrees in California's Public Higher Education Institutions

The state of California has had a widely studied and highly developed structure of higher education governance, the California Master Plan. In the original 1965 Master Plan public universities focused on wide access and regional engagement, the California State University System, were authorised to offer joint doctoral programmes in partnership with the state's research universities, the University of California System. Approval of a joint programme requires a "lengthy and complex" process that includes governing boards of both higher education systems, and approval of external accreditation bodies (Williams, 2017). In 2017 there were a total of 23 academic PhD programmes offered in collaboration between California State Universities and University of California institutions.

In 2005 and 2010 the state legislature additionally authorised California State University institutions to offer a focused set of professional practice degrees, principally doctor of nursing practice (DNP), doctor of physical therapy (DPT) and doctor of education (Ed.D) programmes.

Jointly awarded PhD degrees and PhD professional practice degrees awarded by California State University institutions together comprise 6% of all doctoral degrees awarded in the state's public university system.

Source: Williams, J. (2017), "Collaboration, alliance, and merger among higher education institutions", *OECD Education Working Papers*, No. 160, OECD Publishing, Paris, http://dx.doi.org/10.1787/cf14d4b5-en.

OECD member countries follow a range of policies with respect to the degree awarding authority of polytechnic, "applied science" or comparable institutions. Some universities of applied science, such as those in the Netherlands and Finland, are authorised to award practice-oriented degrees at the masters' level, but not at the PhD level. Elsewhere in Europe, in Institutes of Technology in Ireland and University Colleges in Norway, this is permitted. In California's public higher education system the state's regional and practice-oriented universities in the California State University system are permitted to independently award professional doctorate degrees, but offer PhD degrees only in collaboration with its public research universities, the University of California institutions (Box 4.1).

Box 4.2 outlines current developments in the area of professional doctorates which are a growing phenomenon internationally, as many countries recognise the need for doctoral candidates to be trained for careers outside of higher education and research. The professional doctorates discussed in Box 4.1 are predominantly aimed at experienced professional practitioners, but there are other variants. For example, the three Dutch Technical Universities (Delft, Eindhoven and Twente) offer professional doctorates in engineering (PDEng), a full-time post-Master programme, and graduate students who are able to produce high level, creative designs for complex issues with a multidisciplinary character. Their capstone design projects are typically identified in consultation with the organisation sponsoring the candidate. Professional DEng programmes with similar aims are also offered in the United States, United Kingdom and Australia.

Policy issue 4.2. Institutional autonomy and responsibility have expanded, but remain insufficient

Governments across the world have aimed to nurture the development of higher education institutions that operate with responsible autonomy. To this end they have awarded institutions substantial autonomy to manage their own resources and affairs, and established a legal basis that permits them to make effective use of their autonomy. At the same time, they have charged institutions with taking wide responsibility for the quality and relevance of the education programmes they offer, and the research they conduct. These trends have been under way in Portugal as well. However, they remain less developed than in higher education systems that are highly regarded for their performance in teaching, research, and in stimulating innovation.

On balance, public HEIs in Portugal enjoy a moderate degree of autonomy in organising their internal management and structures in comparison to those in some other European countries.[5] The EUA's 2017 Autonomy Scorecard places Portugal's university institutions 7/29 for "organisational" and "financial" autonomy. However, the level of institutional autonomy in many other key areas remains limited in Portuguese universities and polytechnics, particularly in public institutions that have not transitioned to foundation status.

National legislation governing public sector employment, public procurement and financial management are burdensome, and limit the ability of institutions to plan and manage their operations efficiently and effectively. This is reflected in EUA scores of 18/29 for "staffing" autonomy. The EUA score for "academic autonomy" is a relatively low 20/29, reflecting the impact of the *numerus clausus* and a centralised entry regime in constraining institutional decisions about student numbers and conditions of entry, and the impact of programme-level accreditation on areas of educational offer.

The goals underlying the 2007 legal framework for higher education institutions, the RJIES, have been only partly realised. One decade after the law's adoption, Portuguese higher education institutions remain – on average – less autonomous, more inwardly-oriented, and less capable of providing agile and flexible support to innovation than those in leading higher education systems – such as the Netherlands, Finland, or Switzerland. Foundation status, expected to transform institutional autonomy, has accomplished less than expected.

Take-up of foundation status has been slow and limited. Ten years after the adoption of RJIES, five public universities have obtained foundation status – three in 2009, and two others in 2015 and 2016. No polytechnic institutions have obtained foundation status. A few other public higher education institutions, both universities and polytechnics, were exploring the option of foundation status at the time of the review (Público, 2017). However, at the start of 2018 foundation institutions employed fewer than three in ten (29%) of the public higher education faculty workforce. Article 129. º, n. º 2 RJIES requires that institutions seeking foundation status obtain the support for the proposal by an absolute majority of the General Council, and present to the government, through MCTES: (a) a report on the implications of this institutional transformation on the organisation, management, financing and autonomy of the institution; (b) a document describing the advantages of adopting this model for the pursuit of the institution's objectives. An informal requirement was later added to the process of review and approval in government: institutions seeking foundation status must demonstrate in a consolidated institutional audit that its own revenues exceed 50% of total revenues.

Box 4.2. What is a Professional Doctorate?

Professional doctorates (PDs) have a long history, particularly in US higher education. A professional doctorate in education (Ed.D) was introduced at Harvard in 1921, but significant expansion only started in the 1960s in the US and two decades later in the UK United Kingdom and Australia. There are no comprehensive statistics on the numbers of PDs worldwide, as there is no generally accepted definition of what a PD is and policies and practices vary across higher education systems. There are probably close to 100 PD programmes in Australia, around 400 in the United Kingdom (50 distinct programmes in 2005) and many more in the United States (a firm distinction is not made in national statistics). In the United States and the United Kingdom, PDs account for some 10% of all doctorates awarded. In continental European higher education policies, professional doctorates have not been as widely adopted as in the United States, United Kingdom and Australia. The major fields in which PDs are offered are education, medicine and a wide range of other health professions, law, engineering and more recently business. Professional doctorates in business administration (DBA) have seen exceptionally fast expansion: the 2014 DBA survey identified 300 programmes, 64% of which were introduced in the last decade.

There is not yet an internationally accepted definition of a professional doctorate. It is commonly understood that, "Whereas the 'traditional' PhD degree is intended to develop professional researchers; the professional doctorate is designed to develop researching professionals." (Bourner et al., 2001)

A recent English study (CRAC, 2016) found professional doctorates to be distinctive from the PhD on the basis of their:

- Purpose – PDs aim to develop the capacity to make a significant original contribution to professional practice through research. They are targeted at experienced professionals and practitioners working in a professional context and, therefore, are a research-based element of professional training and/or development of practitioners.
- Research focus – The research within a PD directly relates to, and is rooted in, the professional practice of the candidate, and its output should not only contribute to knowledge but have a significant impact on professional practice.
- Structure – PD programmes are more structured than many PhD programmes, with taught components as well as supervised and cohort-based experiences, and they are often offered on a part-time basis.

Sources: Chiteng Kot, F. & D. D. Hendel (2012), Emergence and growth of professional doctorates in the United States, United Kingdom, Canada and Australia: a comparative analysis, Studies in Higher Education, 37:3, pp. 345-364; Thomas Graf /DBA Compass (2014); Bourner, T., R. Bowden, and S. Laing (2001), Professional doctorates in England. Studies in Higher Education, 26, no. 1: 65–83; CRAC (2016), Provision of professional doctorates in English HE institutions, Careers Research Advisory Centre HEFCE; CHEPS (2013), Policy Challenges for the Portuguese Polytechnic Sector, A report for the Portuguese Polytechnics Co-ordinating Council (CCISP), Centre for Higher Education Policy Studies (CHEPS).

When RJIES was adopted – and in the early years of its implementation – the law aimed to permit foundation institutions to operate with far wider financial and managerial autonomy than was previously the case, and created a new framework financial management that was substantially "outside the fiscal perimeter of the state." Key aspects of this wider autonomy included:

1. exemption from the Public Procurement Code for the acquisition of goods and services below EUR 200 000

2. exemption from the Public Procurement Code for the contracting of works below EUR 5 000 000
3. authorisation to manage real estate, physical assets, and financial assets in accordance with private financial management rules
4. exemption, in part, from the obligation to render accounts according to the Official Plan of Public Accounting for the Education Sector (POC-Educação)
5. authorisation to make to make financial investments according to the best offers on the market (rather than holding assets in cash or government bonds)
6. exemption from the requirement of annual budgetary balance, permitting the institution to carry forward a surplus or deficit from on fiscal year to the next
7. permission to borrow without authorisation by joint dispatch of Minister of Finance and MCTES, thereby permitting additional financing to meet matching requirements in EU-funded activities
8. authorisation to hire teaching and non-teaching staff under private law and
9. authorisation to buy and sell real estate with the approval of the institution's Board of Trustees, in place of approval by the Ministry of Finance.

The global recession that started in 2008 led Portuguese authorities to adopt heightened public sector financial controls that sharply reduced the financial and managerial autonomy first envisioned for foundation universities. By 2012, foundation universities maintained their authorisation to hire under private law and manage real property under the authorisation of the institution's trustees – but the other authorisations were effectively rescinded by changes to law and regulation. Foundation universities were effectively "integrated again into the state budget perimeter" (CCHE, 2017, unpublished).

Universities have made limited use of the legal opportunities that foundation status provides to develop a workforce and career structure under private employment law, most especially among academic staff. Although foundation status provides public universities with the opportunity to develop an institutionally-based career system governed by private rather than public employment law, foundation universities have done so in a "timid and belated way" (CCHE, 2017, unpublished).

At the three public universities that were the first to adopt foundation status – Aveiro, Porto, and ISCTE – by 2016, 38% of staff holding appointments as technical staff and 94% of all career researchers (*investigadores*) were employed under private law contracts, while about 12% of instructional faculty (*docentes*) held contracts under private employment law. Foundation universities vary in their willingness to use private law hiring with their *docentes* workforce – in some institutions it is effectively unused. The University of Minho, though awarded foundation status in 2015, appears to have made fuller use of its legal possibilities with respect to employment. For example, when its faculty members have obtained external offers that exceed the public sector salary scale, the Minho administrators have been able to retain faculty by creating teaching and research posts under private employment law, and thus outside public sector salary limits.

Legal uncertainty persists concerning key aspects of foundation status that impair its wider adoption and effective use. Legal uncertainty exists concerning both human resources and financial resources, and it has led universities to use, according to one university trustee, "perhaps fifteen percent of the potential of foundation status". Uncertainty about the extent to which staff working under public and private labour law must have parallel conditions

for advancement and compensation has led institutions to eschew private law hiring. Uncertainty about which revenues can be considered private revenues and which are state revenues – most notably, concerning tuition fees – has led to confusion about which institutions have sufficient non-state funds to satisfy the Finance Ministry's informal requirement that institutions seeking foundation status obtain one-half of revenues from non-state sources. Additionally, some foundation universities report that uncertainty about the status of private donations to universities – whether private donations are treated by state budget authorities as fully fungible with public funds, and therefore subject to "captivation" – has hampered the development of private donations to universities.

MCTES and the Co-ordinating Council on Higher Education have recognised the limited impact of foundation status on the public university system, and a Rapporteur Group within the Co-ordinating Council has provided an *Assessment on the Public Foundations under private law in the universe of Portuguese Higher Education* (CCHE) (2017, unpublished). The group recommends, among other measures, that the State Budget Law immediately "place HEIs outside the state budget perimeter," permit "multiannual management of budgets," and exempt foundation universities "from the procedures related to public procurement activities up to European Union limits."

Policy issue 4.3. Public spending is provided in a way that does not support sound institutional financial management

It is widely recognised among leaders in Portuguese higher education that core public funding for education and operations that is delivered to higher education institutions on an historical basis makes the funding of institutions opaque, and establishes a weak relationship between the money received by individual institutions and their level of effort and performance.

Further, the same leaders broadly acknowledge that annual funding – with frequent "captivations" to balance public accounts and lengthy periods within the year during which institutions are not permitted to commit public funds allocated to them – is harmful in the short run to sound and efficient institutional management, and in the long run, to the development of institutional strategy and close collaboration with commercial and community partners.

In recognition of the shortcoming of historical funding, there have been repeated efforts to develop a budget framework that is pluri-annual and systematically linked to past performance (e.g. degrees awarded) and current activity (e.g. enrolment by study field). For example, a highly detailed proposal for reform of institutional funding was developed by the Ministry for Education and Science (*Ministério da Educação e Ciência*) (MEC) in July 2015 in close consultation with The Council of Rectors of Portuguese Universities (*Conselho de Reitores das Universidades Portuguesas*) (CRUP) and the Portuguese Polytechnics Co-ordinating Council (*Conselho Coordenador dos Institutos Superiores Politécnicos*) (CCISP). The 186-page document contains a funding model in which a set of educational services are agreed with each institution and the cost factors are parameterised, establishing a baseline allocation for this set of services. The baseline funding would then be adjusted for quality factors such as the quality and efficiency of the educational process; knowledge production (with different indicators for universities and polytechnics); transfer of knowledge; and improved management (based on an improvement plan proposed by the institution of higher education). The authors recognised that the model would "strongly penalise institutions located in regions with less demographic pressure and, therefore, with a reduced number of enrolments and where gains in scale cannot be expected." They

suggested a factor to correct this, by increasing the notional or weighted number of students in the model for regions where the courses will have lower enrolment rates and little expected growth.

Pluri-annual, transparent and performance-based funding plans have either been adopted in law but not fully implemented, or proposed but not adopted. Three basic obstacles, described below, hamper improvements to core institutional funding.

- MCTES is not well endowed with performance-monitoring capabilities and funding expertise, and thus it is not fully equipped to manage a funding process that includes (past) performance components or forward-looking and profile-oriented performance agreements.
- Changes to funding methodologies used by governments are typically implemented, in part, through the addition of new resources, not purely through the redistribution of resources among higher education institutions according to a new set of rules, since this latter path creates clear 'losers' and precipitates more conflict than can be managed. Portugal's fiscal crisis and subsequent public austerity have left it with little capacity to dedicate the *new* resources that would be needed for the reform of higher education funding.
- Multi-annual budgets cannot be achieved by the efforts of education ministries alone. Rather, experience in OECD member countries shows that education ministries rely upon parliaments and finance ministries to establish predictability in the funding envelope which they, in turn, allocate to research and teaching. Multiyear performance-related funding for higher education in Baden-Württemberg, for example, is based upon a five-year commitment by the State to 3% increase per year, as well as additional funding costs related to any salary increases resulting from collective bargaining that exceed 1.5% per year (Box 4.3).

The overall funding level for higher education and research that the Finance Ministry provides to MCTES for allocation to higher education institutions and FCT may be subject to substantial year-to-year variation. This, in turn, can yield large variations in either educational or research funding, or both. For example, between the 2011 and 2012 fiscal years core operating funding for higher education institutions fell by nearly 30% – before rebounding in fiscal year 2013 to about 94% of its 2012 levels (Table 4.1).

Funding decisions may not only be uncertain, but their resolution may be delayed. While spending levels for the a fiscal year commencing in January are to be transmitted to line ministries in August, in some cases agreed spending levels may continue to be disputed until after the conclusion of a fiscal year. In January 2018, for example, the 2017 state budget for higher education remained under negotiation (Público, 2017).

Although the overall funding level available for MCTES to distribute among public higher education institutions has been unstable, institutional autonomy in the management of public finances has been enhanced. In 2016, a formal agreement between public HEIs and the government – including MCTES and the Ministries of Finance, Planning and Infrastructure, and Administrative Modernization – introduced important new financial flexibility to HEIs. Key measures included: a) lump sum rather than line-item appropriations to institutions; b) exclusion of HEI appropriations from "captivations" in return for an agreement that annual deficits incurred by any single institution would be offset by the shared contributions of all other institutions in their sector; c) authorisation to carry forward surplus public funds from one fiscal year to the next; and d) an agreement,

in principle, of budget increases sufficient to reimburse institutions for cost increases they experience as a consequence of policies adopted by Parliament. Because this agreement falls outside the State Budget Law, it has not created a fully predictable and persistent basis for financial management. And, even if it were included in the State Budget Law, it would nonetheless have to be annually reauthorised.

Box 4.3. Multiyear Performance-Related Funding for Higher Education in Baden-Württemberg

In Germany, as in many other OECD countries, there has been a recurring discussion among policymakers about the optimal balance between the core funding state government allocates to higher education institutions – in the form of basic operating grants – and competitive project-based public funding, primarily awarded for research or other specific purposes, such as infrastructure development. In a 2011 position paper, the German Council of Science and Humanities (*Wissenschaftsrat*), a publicly funded advisory body, argued that increased basic funding for higher education institutions was needed to allow the kind of long-term planning in recruitment and infrastructure investment necessary for competitive and effective institutions.

In 2015 the Federal State of Baden-Württemberg adopted a five-year 'higher education financing agreement' (*Hochschulfinanzierungsvertrag*). The agreement guaranteed public higher education institutions in the State an average 3% increase in basic funding over the period 2015 to 2020. Following a period of rapid expansion of higher education in the State, the main objective of the agreement was to create a stable funding environment in which institutions could plan further development and create more permanent staff positions. The agreement commits to increasing the basic operating grant to all institutions from a total of EUR 2.5 billion in 2014 to almost 3 billion in 2020. In addition to the average 3% increase per year, the State additionally commits to funding costs related to any salary increases resulting from collective bargaining that exceed 1.5% per year.

The budget increases are to be funded by a combination of new money and transferring pre-existing programme budgets for higher education into the basic operating budget allocation. All institutions will receive the same basic funding guarantee (based on their 2014 budgets), they maintain full discretion in the use of the basic operating grant and are able to retain and transfer surpluses accrued in one financial year to the next. In return for the funding security, higher education institutions are called on to:

- Create additional permanent staff posts funded out of the basic operating grant, through new posts and transferring temporary project-funded posts into the 'regular' staff budget.
- Maintain the number of study places and programmes at the 2014 level as a minimum.
- Increase study success, through better taking into account the needs of diverse student body.
- Develop new and existing strategic partnerships with business.
- Develop and promote open access to research results.

In the agreement, the State Science Ministry and higher education institutions committed to working jointly to develop new performance indicators to measure the qualitative development of the higher education sector and feed into a new performance related funding component. The existing performance-related component in the state funding model was suspended pending this work.

Sources: Wissenschaftsrat (2011) Neuere Entwicklungen der Hochschulfinanzierung in Deutschland – Bericht des Vorsitzenden zu aktuellen Tendenzen im Wissenschaftssystem, Wissenschaftsrat, Berlin, 08 07 2011 https://www.wissenschaftsrat.de/download/archiv/VS_Bericht_Juli_2011.pdf. Land Baden-Württemberg (2015) „Perspektive 2020" Hochschulfinanzierungsvertrag Baden-Württemberg 2015-2020, http://www.lrk-bw.de/images/PDF/Anlage_zu_PM_003_Hochschulfinanzierungsvertrag.pdf.

The FCT is not part of this agreement, and it has therefore remained subject to "clawing back" (withholding or *cativação*) of funds. This uncertainty, in turn, is felt by higher education researchers supported by FCT funds.

Policy issue 4.4. Funding and steering policies do not encourage institutional profiling and division of labour

In high-performing higher education systems, higher education institutions develop and refine institutional profiles. These profiles are a strategic document that lay out the distinctive features and commitments of their institution. They typically identify:

- **Priority research areas** – what are the institution's priority research areas and their related teaching programmes? Where and how do they propose to achieve critical mass and excellence? Depending on mission this will include an account on how the institutions envisions its balance between theoretically led and applied research.
- **Teaching priorities** – what are the priority teaching fields, depending upon mission, professional programmes that are critically linked to national or regional needs; and, where appropriate, the institution's distinctive pedagogical commitments, e.g. an orientation towards problem-based learning?
- **External impact and engagement –** how are the research and teaching activities of the institution linked to regional and national needs? How does the institution intend to link its teaching and research to business, public and voluntary sectors – supporting their undertakings and drawing upon their capabilities in meeting its mission?
- **Internationalisation** – what internationalisation strategy is appropriate to the institution's profile? In what ways and to what degree does the institution wish to be internationally engaged?

Although higher education institutions bear responsibility for developing profiles, governments support and co-ordinate the development of profiles through funding and steering. They do so in the expectation that a higher education system with a planned and co-ordinated division of labour and institutional specialisations will perform more effectively and efficiently in meeting national needs with respect to education, research, and innovation.

Institutional profiling and development plans have been implemented successfully in a number of other OECD countries, often those with higher education systems of a broadly comparable scale to Portugal – including Austria, Denmark, Ireland, and Finland. In

Finland, for example, national authorities have chosen to support profiling of universities into distinct areas of strength, according to strategies developed by institutions, and reviewed by external panels convened by government. Profiling plans are expected to commit to areas of research strength through the targeting and reallocation of resources and to "promote collaboration and division of work between universities, research institutes and universities of applied sciences." Universities apply for competitive profiling funding by submitting institutional plans for high-quality/high-impact research, outlining what steps they will take and when, and identifying how they will reallocate institutional resources to achieve their profile (Makarov, 2015).

More generally, profiling initiatives create greater transparency about the specific goals of different types of institutions – such as research-intensive institutions with a global reach or universities of applied science with a strong regional focus – and leads to greater recognition of value of different types of institutional activity and performance.

Higher education institutions in Portugal are not required by the government to identify areas of strength and weakness, to link those to the distinctive regional, national, and international engagements they wish to pursue, and to reallocate resources that permit them to build upon areas of strength in service of their external engagements. The funding, regulatory, and steering arrangements with which higher education institutions operate provide few incentives for specialisation or improvements in performance.

The national policy framework does not support institutional profiling

There is no clear national policy framework within which institutions are expected to develop their own profiles, nor a developed mechanism to help co-ordinate profiling between institutions to ensure the system as a whole delivers what Portugal needs. This is not a new problem. In 2007 the OECD envisaged a higher education co-ordination body (CCES) that would be responsible for developing:

- strategic goals and priorities for the development of Portuguese higher education including the relationship of the goals for the university and polytechnic sectors
- a higher education planning framework flowing from these strategic goals and its subsequent monitoring and adjustment on an annual basis
- a broad set of objectives based on this higher education planning framework to provide the basis for the ministry's negotiation of performance agreements with individual institutions (OECD, 2007).

These needs remain in the nation's higher education system. Moreover, if Portugal is to benefit from a national body that takes a strategic and long-term view of higher education, research, and innovation needs of the nation, grounded with a wider view of the nation's economic needs and regional priorities – as we propose in Chapter 3 – it equally needs a CCHE with steering capabilities to link a "whole of government" view to a vision of the higher education sector. The CCHE has a critical role to play in informing national deliberations at the whole of government level, as long-term plans are set, and in aligning the higher education system to national purposes. It should be a critical intermediate actor between the whole of government and individual institutions, taking a genuinely "higher education system view."

Additionally, if there were there a clear framework of national policy commitments – translated into priorities for the higher education sector by the CCHE — higher education institutions would have a set and stable set of priorities against which they could debate

and formulate their institutional profile, confident that their institution's efforts would not be wasted by short-term changes in government priorities.

As discussed above, institutional core funding in support of education and infrastructure is provided on an historical basis, without taking into account directly the specific missions and potentially differentiated needs and objectives of different institutions. There are no ongoing funding streams provided by MCTES to public higher education institutions that encourage institutions to engage in profiling their institution.

The delivery of research funding for PhD study by FCT has also limited the development of institutional responsibility and profiling among public higher education institutions. Public funding for PhD study and, historically, post-docs is principally allocated by the FCT to individual applicants proposed by programmes, rather than to institutions whose graduate profile is co-ordinated by, for example, a Vice-Rector or Dean of Graduate Studies. The direct line of national funding to research groups – and the absence or weakness of institutional governance with respect to research and graduates studies – prevents higher education institutions from setting an institutional research strategy that is aligned to their institutional profile.

FCT funding for research and development centres has led to the progressive development of a dense network of research units across different universities and, to a lesser extent, polytechnics. While the size of this network has varied over time according to government priorities, the network is shaped by the bottom-up priorities of researchers, without obvious reference to either institutional or national priorities for knowledge development. The fragmentation of research activities across a multitude of research centres has also limited the capacity of individual HEIs to formulate coherent profiles and development strategies covering teaching, research and engagement with society. The situation also creates asymmetry between the legal responsibility of HEIs for employment in research units and real influence they have over their research strategies.

Associated Laboratories, many of which are autonomous research organisations based outside of higher education institutions, establish their own research profiles, funding stream, and staffing arrangements, and through their independence impose further limits on research leadership and strategy in the nation's higher education institutions.

More generally, the limited autonomy of Portuguese higher education institutions with respect to human resource management hinders the development of institutional profiles. National legislation governs the structure of careers, staff workload, and staff compensation, setting sharp limits on the ability of leaders to reallocate resources in light of a new profile. If profiling is to raise the effectiveness and efficiency of the higher education system, institutions must have the capacity to implement the plans, reallocating human and financial resources against the profiles they have set. Higher education institutions have little capacity to do so, apart from the limited scope of autonomy achieved in foundation universities.

Internal constraints limits profiling

Apart from these external and systemic factors that inhibit the development of a suitably profiled network of higher education institutions, internal factors may constrain the ability of institutions to develop and implement profiling and development strategies.

The first relates to the ability of institutions to engage effectively with relevant external stakeholders. Institutional profiles and strategies should be informed by the views and needs of the different populations institutions serve, whether this is particular student

groups, regional, national or international employers, research and innovation partners and so forth. While some institutions with which the review team met, such as the Polytechnic Institute of Bragança and the University of Minho, appear to have well-developed processes for consultation, engagement and co-operation, others have far less capacity and experience in this respect.

Second, non-academic professional positions (in financial management, facilities management, marketing, etc.) in Portuguese higher education institutions tend to have a lower status and fewer resources attached to them than equivalent positions in higher education institutions in many other OECD countries. As qualified professional staff with adequate authority and resources are crucial to the development and implementation of effective institutional strategies, this comparative under-resourcing is problematic.

Weak profiling limits the performance of the nation's higher education and research system

The weakness of institutional profiling and development strategies in Portugal has a number of consequences for the performance of the higher education, research and innovation system as a whole. Teaching, research and innovation activities in individual departments and institutions are, to a large extent, planned and implemented in isolation, without reference to the goals of the institution as a whole, to the activities of other institutions in the system and broader national development goals. While this situation may leave room for the professional creativity of individual staff members and teams (notwithstanding the broader constraints discussed), the lack of strategic steering can also lead to inefficient duplication, missed opportunities for collaboration and a weak alignment of activities on the ground with the needs of particular localities, population groups or the nation as a whole.

With respect to the education mission of higher education institutions, the absence of clear profiles and strategies for each institution makes the system as a whole less readable or transparent, particularly for students looking to choose an institution and institutions looking to differentiate themselves from – or partner with – peer institutions in other locations.

With respect to the research missions of higher education institutions, the absence of targeted policies supporting institutional profiling has led to a higher education system in which research capacities are not strategically concentrated. Consider, for example, doctoral training. In recent decades rather small doctoral programmes have multiplied in Portugal with little strategic co-ordination, and relatively little collaboration (Chapter 5). In contrast, doctoral education in the Netherlands is organised by research schools, including national research schools. National research schools are typically organised along disciplinary lines, and bring together funding and researchers from many participating universities. The Institute for Programming Research Algorithmics (IPA) is a national inter-university research school with nine participating universities. In the field of sustainability and environmental research, the Wageningen University hosts the SENSE research school, in which nine universities (and two public research institutes) participate. All Dutch research universities participate in one or more of these schools, and most participate in many of them (De Boer, 2017). This collaboration among universities, joined up to national lines of policy about research priorities, has assisted the Netherlands in achieving a global research profile.

4.4. Recommendations

Recommendations on modernising the diversification of institutional missions

4.1. Rebalance the missions of Portugal's higher education institutions to ensure that nation has a diversified network of institutions, the missions of which are well-aligned to national and regional needs.

Continue lines of policy from the past decade that have been effective in developing diverse capacities, including establishing a PhD requirement for polytechnic academic careers, supporting applied research through the Polytechnic Modernisation and Valorisation Programme, and awarding R&D centre designations to leading polytechnic research groups. International experience with initiatives such as the Modernisation and Valorisation Programme suggests that about five years of support are required to achieving substantial and lasting change through targeted grant making.

Develop a regulatory capacity in MCTES to systematically review and approve new educational programmes at the bachelor level and integrated master degree levels to ensure they are well-aligned to the mission of institutions in each sector, and to the institution's own strategic profile. This process should be clearly differentiated from (though complementary to) external or internal quality assurance procedures, and operate with clear and simple rules that permit institutions to take forward new programme proposals with confidence that alignment to mission and profile will result in swift approval. Alternatively, MCTES could continue rely upon the annual allocation of additional study places to public higher education institutions through the despacho orientador to ensure that programmes offerings are aligned to national policies. It could make this a more effective instrument of steering by providing public and prior guidance to institutions about its allocation priorities, and grounding these priorities in the nation's education, research, and innovation policy framework.

Modify, as necessary, the legal basis of accreditation and quality assurance processes administered by A3ES to ensure that its reviews adequately differentiate between theoretically-oriented university study programmes and practice-oriented professional education.

Review the organisation of postgraduate and its relationship to the knowledge and innovation needs of the country. Reassess responsibility for the conducting postgraduate education, for its funding, and for the assurance of its quality.

As part of this review, consider revising the legal basis for polytechnics, permitting the carefully controlled award of doctoral degrees by polytechnics. This should be permitted in applied research fields where institutions have a clearly demonstrated capacity to do so, and where there is a strong economic rationale for the offer of doctoral awards. Where there is a close connection between the work of polytechnics and universities – in fields such as agriculture – consideration should be given to joint doctoral programmes between universities and polytechnics.

A strictly controlled and strategically guided process of doctoral authorisation at the level of school or faculty -- rather than the polytechnic as a whole -- is advisable. The authorisation process should require a clear demonstration of capacity for high quality doctoral training, evidence that the programme is aligned to the institutional profile and mission, and relevant to the economic and social needs of external stakeholders served by the institution. A programme approval process could require, for example:

- Approval by the polytechnic's President and General Council, in which the proposed doctoral programme is clearly linked to the institution's profile;
- Review by A3ES (as is done for university PhD programmes);
- Participation of the programme's academic staff in R& D centres recognised as very good, excellent, or exceptional by the FCT.

- Participation of the academic staff in a multi-institutional graduate school, organised along lines of discipline or professional specialisation, on the model, e.g. of doctoral training programmes in the Netherlands.
- An externally reviewed motivation for the proposed PhD demonstrating a close connection between the doctoral programme, professional practice and regional needs. This process would look for representatives of industry, the public sector, or voluntary organisations to identify how the high-level skills of doctoral recipients would be used to improve their organisation's products, processes, and practices.

A review of post-graduate education could consider applying many of these principles more widely, to university institutions.

Recommendation on strengthening the autonomy of HEIs

4.2. Strengthen the legal basis of autonomy for public higher education institutions.

Pursue full implementation of the foundational status for HEIs and take additional measures to increase flexibility in financial management and procurement for public higher education institutions.

As a matter of priority, MCTES should pursue five initiatives to deepen and widen institutional autonomy.

a. To improve the effective use of foundation status among institutions that presently have foundation status, the analysis and recommendations put forward by the Co-ordinating Council for Higher Education should be implemented. The financial management provisions originally agreed by the Ministry of Finance in 2009 when foundation status was first awarded should be put on a statutory basis though amendments to the State Framework Law.

b. To support the effective management of all public higher education institutions, the rules of financial management agreed with Finance Ministry should be put on a continuing basis, rather than subject to annual renewal in the State Budget Law;

c. The Official Plan of Public Accounting for the Education Sector and the Public Contracts Code should be appropriately modified so their provisions do not apply to institutions with foundational status.

d. In near to mid-term future, Portugal should aim to extend foundation status to all of its higher education institutions. This will require that it revisit the criteria that it uses when proposing institutions for foundation status.

e. New tests for sound financial management should be adopted that permit all well-managed public higher education institutions to achieve foundation status. Revenue diversification is an unnecessarily restrictive proxy for an institution's capacity to manage soundly their finances; it effectively prevents many of Portugal's higher education institutions obtaining foundation status. With sound tests for financial management capacity and wise hedges against risk – such as requiring institutions to carry a reserve or "rainy day fund" -- budgetary balance need not be put at risk.

Recommendation on reforming public funding of HEIs

4.3. Reform public funding for higher education institutions, strengthening transparency and providing incentives for good performance.

Ensure a properly balanced institutional funding regime. The regime should (a) predictably funds the core activities of institutions, (b) reward institutions for performance in a way that is recognised to be fair, and (c) provide incentives for the development of forward-looking institutional profile. Portuguese authorities should aim for the development of a funding methodology that allocates approximately 80%-15%-5% of institution resources across these three funding pillars (activity; outputs; and future profile).

Funding to support core activities (80%) and performance (15%) could be delivered based upon agreed models that contain methodologies common to institutions within a sector. Funding to support institutional profiling (5%) could be based upon a multi-year performance agreement between the higher education institution and the Ministry of Science, Technology, and Higher Education.

Institutional profiles would necessarily vary, focusing in some cases principally on research and innovation, while in other cases on professional education and regional engagement. Profiles focused on research could be used, for example, to allow HEIs to better integrate R&D units into the institution's research strategy.

Each funding stream would, preferably, be based upon a multi-year agreement that is agreed between Ministry of Science, Technology, and Higher Education and the nation's public higher education institutions.

In order of sequence Portugal should introduce:

a. A profiling instrument providing funds to: a) set up profile and plan and b) report on annual progress on plan implementation, with 5% funding conditional on progress assessed on a multi-year basis. An MCTES-convened panel could review initial profiling agreements with international experts drawn from systems that have experience of well-functioning profiling instruments, such as Finland. International experience demonstrates that Ministries can adopt a profiling funding stream even on fixed funding levels, since it results in the near term in a modest redistribution of funding levels.

b. Performance-related funding based upon a formula that reflects a combination of agreed outputs appropriate to all institutions, and other output indicators calibrated to the sector. Examples of the former include number of graduates, while the former would reflect, for example, PhD job placement for institutions with a focus on doctoral education, and work-based learning placements for professionally oriented institutions. MCTES can implement performance-related funding by channelling annual, incremental growth into this funding pillar.

c. Activity-related institutional funding (e.g. enrolments by field of study) is needed to create fairness and transparency and provide stability. This aspect, while fundamental, should be the last feature of funding reform implemented, and adopted when non-incremental new funds are available to limit disruptive redistribution of budget shares among institutions.

Recommendations to strengthen the HEIs in making responsible use of autonomy within a framework of national priorities

4.4. Strengthen the capacity of higher education institutions to make effective use of expanded autonomy and responsibility.

If higher education institutions are to be provided wider autonomy and responsibility, they must have the capacity to effectively put them to use. There are two ways in which institutional capacity can be strengthened.

First, the capabilities of professional and administrative staff in higher education institutions can be augmented. Government should consider providing financial support for the training of professional managerial staff through higher education and management training programmes and opportunities for staff to participate in secondments to key partner institutions with robust management systems in, e.g., the United Kingdom, Switzerland, and North America.

Second, steering and funding policies should be evaluated – and revised – to ensure that they support institutional responsibility, rather than diminish it. For example: MCTES should revise FCT research funding policies so they support the capacity of institutional leaders to set and implement a co-ordinated research profile. While applications for research funding – whether for individual projects, R&D Centres, or Associated Lab status – should be evaluated on their scientific merit, proposals should also be evaluated with a second criterion: their alignment to the institution's vision of its distinctive profile as a research organisation. When funds are awarded to research organisations within the higher education institution, whether Associated Labs or R&D units, a share should be set aside at an institutional level – and matched by local resources – to support the development and implementation of an agreed institutional profile.

4.5. Strengthen the CCHE

Strengthen the CCHE, along the lines of the OECD's recommendations of 2007, so that it can function effectively in bringing sector priorities to national debates and priority-setting for science, technology and higher education, and provide a stable framework of national priorities against which higher education institutions can expected to develop institutional strategies. This strengthening should include the addition of a budget for research and analysis, and a professional staff adequate to its expanded mission.

Notes

1. State labs may also seek foundation status from government.

2. As of January 2018 foundation status had been obtained by: University of Porto, University of Aveiro, ISCTE Lisbon (2009), University of Minho and Universidade Nova de Lisboa (in 2015 and 2016, respectively).

3. See, for example, Hochschulfinanzierungsvertrag Baden-Württemberg, 2015-2020.

4. The universities of Algarve, Aveiro, Azores and Madeira are among the public universities that offer tourism programmes; however, these may be offered through their polytechnic schools.

5. The EUA's 2017 Autonomy Scorecard places Portugal 7/29 for 'organisational' and 'financial' autonomy; 18/29 for 'staffing' autonomy and 20/29 for 'academic' autonomy.

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Chapter 5. Higher education provision, access and support mechanisms

This chapter examines how Portugal might further widen access to higher education. It finds that that higher education programmes and their modes of provision are not sufficiently differentiated or flexible to meet the needs of all students, especially mature learners. Pathways that permit students to move from secondary to higher education are not yet adapted to the needs, interests and learning experiences of students enrolled in secondary professional education, limiting the continued widening and social diversification of higher education access. Student support – financial, academic, and social – is less developed than best practice found across the OECD, and adversely affects both entry into and success in higher education.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

5.1. Introduction

An adequate supply of individuals qualified at higher education level is widely recognised as a key factor in enabling economies to shift towards higher levels of knowledge intensity and allowing industries to move up the global value chain. Internationally, increases in higher education graduate rates have typically gone hand in hand with improved adoption and absorption of technological and process innovations, advances in productivity and the wealth creation associated with this. These developments are driven not only by the advanced subject knowledge students acquire through higher education, but also the wider transversal skills sets they are able to develop through pursuing their education to a higher level.

Notwithstanding years of growth in higher education participation in Portugal, higher education attainment rates remain below the OECD average, and below EU and national targets for 2020 and 2030. In this context, the Portuguese system needs to widen access to higher education further, while also ensuring as many students as possible successfully complete their studies.

Effective higher education systems with high levels of participation and completion support and encourage diversity and flexibility in the provision of study programmes, while also ensuring their quality. Greater institutional and programmatic differentiation ensures that institutional profiles and activities respond to the varied needs and interests of their student population and society at large, and support the development of a broad range of skilled individuals.

In light of these considerations, this section of the review examines three important issues:

1. Is the education provided in Portugal's higher education system adapted to the different needs of a broad range of student types?
2. Do admission procedures provide suitable pathways into higher education that are adapted to the needs, interests and learning experiences of different student populations?
3. Are there adequate financial and pastoral supports in place to help students complete their studies and to encourage young adults to return to education?

5.2. Context

5.2.1. Higher education provision

Portugal's higher education system is based on a well-established binary system where polytechnics provide professionally-oriented study programmes and universities offer more traditional academic programmes based on the Bologna three-cycle system. Additionally, the introduction in 2014 of short-cycle post-secondary higher-education programmes, the *Cursos Técnicos Superiores Profissionais* (CTeSP), created an additional vocational learning pathway.

Few undergraduate programmes are offered on an evening or weekend schedule, or on either an accelerated or extended basis, particularly in public institutions. In total, 5.5% of seats accessible through the national entry regime are offered on an after-work or night-time basis.

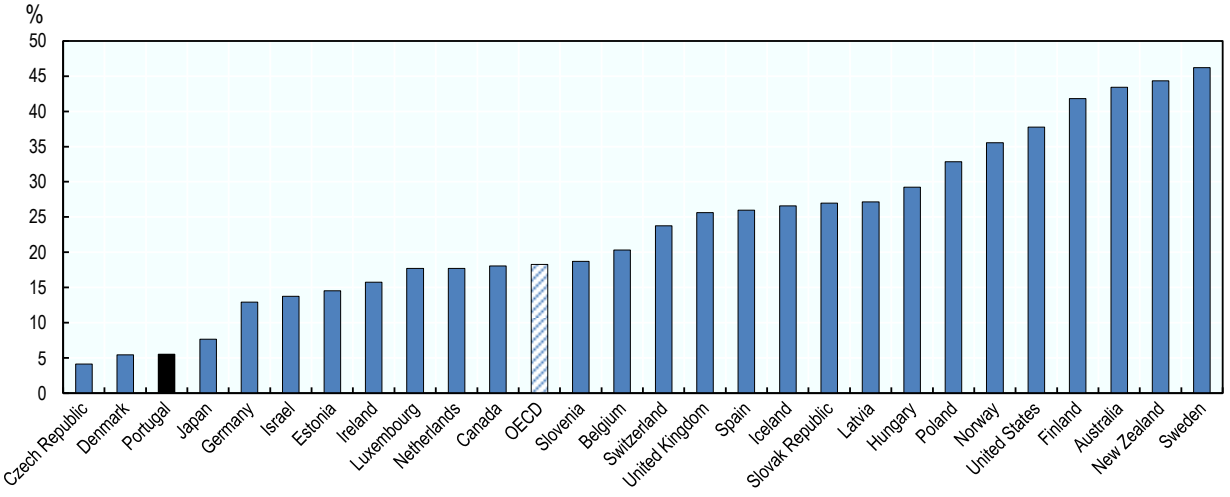
Distance education programmes are offered both by individual higher education institutions and by the nation's Open University, established in 1998. In 2015/16 the Open

University offered 12 distance-learning undergraduate programmes and enrolled 4 820 students in first-cycle bachelor programmes, about 2.3% of the nation's 211 600 undergraduate students (MCTES, 2017), while Portugal's public polytechnic institutions offered another eight distance education programmes (DGES, 2018). In comparison, the Open University of Catalonia in Spain enrolled about 16% of its higher education students (IDESCAT, n.a), while the United Kingdom's Open University enrolled about 7.5% of the nation's 2 317 880 higher education students (Open University, n.a).

Few students are enrolled in part-time study, and few combine study and employment. In 2015, only 5.5% of higher education students (ISCED Levels 5 to 8) in Portugal were enrolled on a part-time basis compared to 18.3% on average across OECD countries (Figure 5.1). Across OECD countries it is common for student enrolled in higher education to combine academic and professional activities. Among countries participating in the OECD Survey of Adult Skills – PIAAC (OECD, 2013a), 39% of 16-29 year-old students combine both activities (OECD, 2015). Portugal also has a small number of higher education students who combine work and study – 8.5% in 2015/2016 – and this share has declined since 2012/2013, when this group represented 11% of all students (MCTES, 2017).

Figure 5.1. Share of part-time higher education students

Percentage of total students, total tertiary education (ISCED2011 levels 5 to 8), 2015.



Source: OECD (2018), OECD.Stat, Enrolment by gender, programme orientation and mode of study: Share of part-time students, http://stats.oecd.org/ (accessed 5 January 2018).

Portugal has established alternative pathways for mature students (over 23-year-olds) to enter higher education, which take into account students' previous academic and professional experience. Mature students comprised a larger share of total enrolments in 2015 (5%) than they did prior to the programme's adoption in 2005 (1.1% in 2004-05). However, the number of mature students enrolling for the first time – through the special examination, which includes an assessment of the candidate's previous professional and academic experience, his/her motivation letter and his/her outcomes in exams set by each programme – has declined from over 10 000 students in 2010 to 4 680 in 2015/16 (MCTES, 2017). Thus, Portugal continues to have a distinctively small share of mature students entering its higher education system. On average, 18% of new entrants in higher education

were older than 25 across OECD countries, compared to only 9% in Portugal (OECD, 2017a).

Study programmes in Portugal typically require extensive instructional contact. The 2011 Eurostudent Survey found Portuguese undergraduate students had the highest number of weekly instructional hours in Europe – 26 hours per week of taught studies,[1] compared to the average of 18.5 hours. And while, on average, most Portuguese students are dissatisfied with their time schedules, this is particularly true for mature students. Only 14% of mature students (30 years old or older) indicated being (very) satisfied, compared to 31% of students under the age of 24 (Orr et al., 2011).

In stakeholder meetings, the Review team was told that instruction is often more flexibly organised and adapted to student needs in private higher education than it is in the nation's public higher education institutions. However, the decreasing number of programmes offered by private institutions – and the concentration of this offer in Portugal's principal metropolitan centres – limits the availability of these study options (MCTES, 2017).

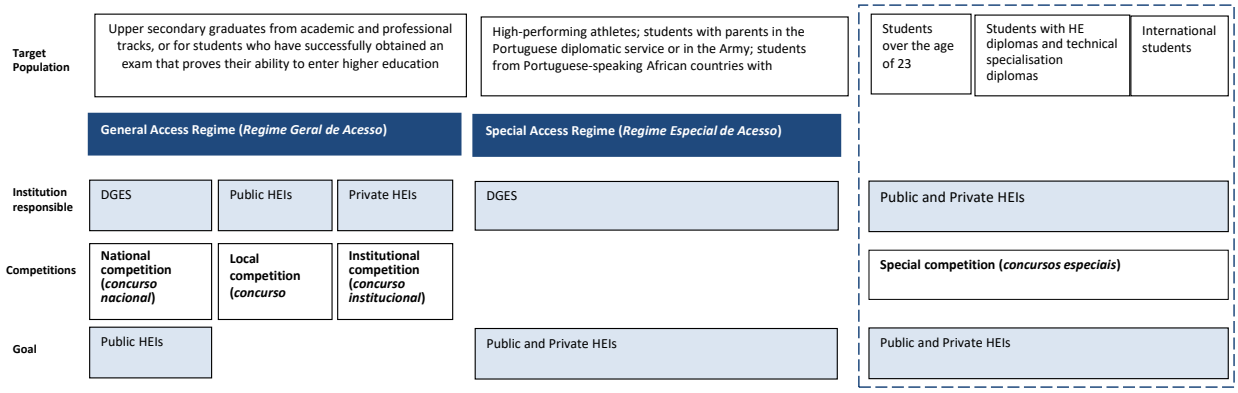
5.2.2. Admission system to higher education

The Agency for Assessment and Accreditation of Higher Education (*Agência de Avaliação e Acreditação do Ensino Superior*, A3ES) assesses programmes' and institutions' teaching and physical capacity and the number of vacancies offered in previous years to set a maximum enrolment capacity for private and public institutions. In addition, the MCTES is responsible for setting the number of study places in public institutions offered through the General Access Regime (*Regime Geral de Acesso, RGA*). This decision takes into account the A3ES assessment. The number of vacancies available through the General Access Regime is then used as a reference point for determining the number of study places available for students entering via alternative pathways.

The *numerus clausus* instrument was implemented in the late 1970s to manage high demand for study places in higher education programmes (Fonseca et al. 2014). However, currently the number of vacancies in the system as a whole exceeds the total number of applicants due to the expansion of the system's capacity and a decline in demand due to a declining young adult population (Teixeira et al., 2012; DGES, 2016). Therefore, the *numerus clausus* instrument no longer creates an aggregated cap for the system. Nevertheless, at the institutional and regional level, they may still impose a cap, in particular in prestigious programmes, institutions and most desirable regions in the littoral, where demand exceeds the number of study places.

Prospective students access undergraduate and integrated masters' programmes (Figure 5.2) and post-secondary non-higher-education programmes through a number of different pathways – the General Access Regime, the Special Access Regime (*Regime Especial de Acesso*) and a number of special entrance competition (*Concursos Especiais*).

Figure 5.2. Pathways to higher education programmes (ISCED Level 6)



Source: DGES (n.d), Formas de Acesso – Diagrama, Direção-Geral do Ensino Superior, https://www.dges.gov.pt/pt/formas_de_acesso?plid=593 (accessed 5 January 2018).

The most common pathway for secondary education graduates or for those students who have successfully obtained an exam that proves their ability to enter higher education is theNational Entrance Competition (*Concurso Nacional de Acesso*), which is managed by the Directorate General of Higher Education (*Direção Geral do Ensino Superior*, DGES). 83% of students enrolled in universities and 65% in polytechnics were matched to their programmes through this stream (MCTES, 2017) (Table 5.1).

Table 5.1. Students enrolled in first-cycle degrees the first year for the first time, by type of entry

Percentage, 2014/2015

Type of entry competition	Public Universities	Private Universities	Public Polytechnics	Private Polytechnics	Total
National competition	83	-	64	-	61
Local competition	1	-	2	-	1
Institutional competition		62		47	11
Special comptetion for over 23 year-olds	4	13	7	23	7
Change of degree	7	16	11	19	10
Special competition for those with a higher education degree	3	4	4	4	3
Special competition for those with a Technology Specialisation and TESP	1	6	10	6	5
Others	1	-	2	1	1

Note: First-cycle degrees include bachelor degrees and CTeSP.
Source: MCTES (2017), Country Background Report, Ministério de Ciência, Tecnologia e Ensino Superior, Lisboa.

Through the General Access Regime, students take national entrance competitions (Concursos Nacionais) to access public institutions. Each higher education institution determines up to two secondary school leaving and higher education access exams (*Exames finais nacionais do ensino secundário e acesso ao ensino superior*) that are required per programme (except for Medicine, which can determine up to three exams). Candidates must obtain at least a minimum score in each examination, which is established by the

institution. Additionally, the MCTES may also require students to take specific examinations for certain programmes; for example, physics and chemistry are required for engineering programmes.

Within the General Access Regime, private institutions and specific programmes in public universities, such as music, dance, theatre and cinema, may set their own entrance examination as part of the Institutional and Local Competitions (*Concurso Institucional* and *Concurso Local*, respectively). The institutional competition (*Concurso Institucional*) is the main pathway to access private HEIs – 62% of students in private universities and 47% in private polytechnics accessed higher education. On the other hand, few students enter public institutions via the local competition (*Concurso Local*) – 1% in universities and 2% in polytechnics (MCTES, 2017).

As part of the National Entrance Competition, students apply for study places through a central admissions portal and indicate up to six different pairs of programmes and institutions by order of preference. Based on these choices, students will select up to three subjects (out of 19) in which to be assessed. The content of the national entrance examinations is based on the upper secondary academic track curriculum, even though students from both academic and professional tracks are eligible to take the examinations.

Student selection for higher education entry is based principally upon grades and entrance examination results. Between 50 and 65% of a student's admission score is based upon the student's secondary school grades. Higher education institutions determine weights based on their overall priorities and the specific demands of the study programme. In addition, students' scores on the entrance examination account for between 35 and 50% of their admission score. Importantly, students whose grade in a specific required subject falls below a minimum score cannot be admitted to the programme even if their average is above the threshold and there are vacant places in the programme. Another element to take into account is students' ordered list of preferences (MCTES, 2008). In 2017, 70.6% of applicants were admitted to their first or second preference (DGES, 2017).

The Special Access Regime (*Regime Especial de Acesso*) covers exceptional cases for Portuguese and foreign diplomats, civil servants abroad, high-performing athletes, East-Timorese, and Lusophone African students with scholarships.

Special access routes to higher-education degrees also exist for adults over the age of 23, holders of Technological Specialisation degrees, Technical Professional degrees and other higher education diplomas. In these specific cases, public and private institutions organise their own admission processes and examinations. These access routes allow for students' different needs and past experiences to be more adequately captured and recognised. In 2014/15, around 25% of enrolled first-time higher education students accessed their programmes via these special access routes (MCTES, 2017).

For graduate levels and short-cycle higher-education programmes, including the CTeSP, higher education institutions have discretion in the admission of applicants, who are required to have successfully completed lower education levels.

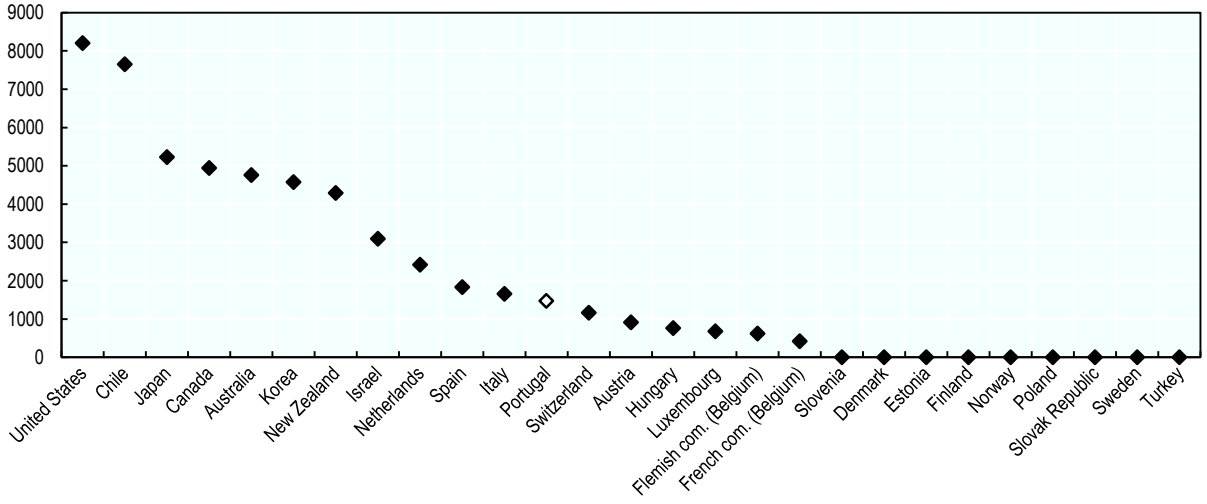
5.2.3. Support for higher education students

In addition to providing equitable and flexible pathways into to higher education, effective higher education systems subsequently support students – financially, socially and academically – as they progress in their studies.

Students are charged a tuition fee to study in public and private higher education institutions in Portugal. Tuition fees charged by public higher education institutions are set by government, and in 2017-2018 minimum fee was set at EUR 689 and the maximum fee at EUR 1 063,47 per academic year for full time study, according to the nature and quality of the programme (DGES, n.a.). Among the 27 OECD jurisdictions reporting tuition fee data for public higher education institutions, tuition fees for public higher education institutions in Portugal were 12th highest (measured in PPP): slightly lower than those in Spain and Italy, though marginally higher than those in Switzerland, Austria, and Hungary (Figure 5.3) (OECD, 2017a).

Figure 5.3. Tuition fees charged by public institutions at bachelor's or equivalent level

Current PPP prices, 2015-16



Note: For countries and economies for which only a range was available, this figure plots the average between the minimum and maximum tuition fee levels: Flemish Com. (Belgium), Latvia, Luxembourg and Portugal. Year of reference is 2011/12 for United States. Year of reference is 2013/14 for Israel. Year of reference is 2014/15 for Australia, Austria, French com. (Belgium) and Italy.Year of reference is 2016 for Korea. For New Zealand Estimates include short-cycle higher education and bachelor's or equivalent programmes in universities only and exclude second programmes at ISCED 6, such as postgraduate certificates and diplomas. Data include goods and services tax (15%).For Austria, Flemish com. French com. (Belgium) and Switzerland, private institutions cover government-dependent private institutions only.
Source: OECD (2017a), Education at a Glance 2017: OECD Indicators, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2017-en.

In 2016, 21% of students in public higher education institutions were beneficiaries of a needs-based scholarship (*Bolsa de Estudo*, BE) granted on the basis of students' financial need, compared to 12% in private institutions (Pordata, 2018).

In 2018, students enrolled in CTeSP, Bachelors or Master degrees at a public or private institution were eligible to receive an annual amount between EUR 1 063 and EUR 5 698, the amount of which was calculated according to a formula that considers their per capita household income level and tuition fee (MCTES, 2017). Specifically, in 2017, the formula was:
Benefit = (11 * EUR 421.32 + tuition fee [up to EUR 1 063] – C [household per capita income]

Aid applicants with household per capita annual incomes below EUR 7 804 were eligible for a scholarship. However, given the phase-out of eligibility for social scholarships, a household consisting of a single person with no children earning a minimum wage from full-time work would be ineligible to receive a scholarship.

For students undertaking their studies on a part-time basis aid awards are halved (Despacho n.º 5404/2017); however duration of their awards is extended (Diário da República, 2017b). Half-time students enrolled in programmes of three years or less are permitted two times the normal programme length (6 years) plus two additional years for a total of eight years of support.

According to the MCTES, roughly 46% of students receive the minimum scholarship which only covers tuition fees. Cerdeira (2008) estimated that tuition fees only represent between 11 and 17% of students' actual living costs.

Social scholarships are awarded after enrolment decisions have been taken. Portugal uses a nationally co-ordinated and sequential process of matching students and study places which is fully completed only at the start of classes. Consequently, the awarding of scholarships does not take place until after classes have commenced, and some students are required to begin tuition payments before scholarships are disbursed.

Social scholarship beneficiaries may receive complements to cover their living expenditures (i.e. transport, and accommodation). For example, a transport complement is offered to students who must travel between continental Portugal and its insular territories (or vice versa) to study (Despacho n.º 5404/2017) (Diário da República, 2017b). Students with special education needs may also receive complements for additional services or equipment they require.

A performance-based element is built into the social scholarship system: beneficiaries who obtained high grades in the previous academic year receive an additional annual merit-based grant equal to five times the monthly minimum wage – in 2017, this amount was EUR 2 650 (OECD, 2017b).

Two additional financial support schemes for students were created in 2014:

- +*Superior* offers additional grants of up to EUR 1 500 to students who study in regions with lower demographic growth and excess higher education capacity in the interior of the country. Scholarships were initially allocated based on merit. Since 2016, eligibility has been limited to students from disadvantaged backgrounds. 1 320 scholarships were allocated in 2016/17. Additionally, eligibility has been extended to students moving between sparsely populated regions and those wishing to study in the Algarve, Azores and Madeira. CTeSP and mature students receive a 15% supplement (MCTES, 2017).
- *Retomar* ("Retake") was established to encourage adults to return to education. Grants of EUR 1 200 per year were allocated regardless of students' financial needs. Criteria for grant allocation included a maximum age limit (29 years old) and prohibited candidates from undertaking other training (Público, 2016). In 2015-2016, there were

only 333 new applications and 154 scholarships awarded. Retomar was suspended in 2016 (MCTES, 2017). Portugal is currently reorienting the programme towards ICT fields and reassessing the participation criteria.

A system of public lending for higher education students was established in 2007, providing loans ranging from EUR 1 000 to EUR 5 000 per year with an overall maximum of EUR 25 000. The interest rate was fixed and equal to the Euro Interest Rate Swap (EURIRS) plus a maximum spread of 1%. The spread was reduced on the basis of students' academic performance (0.35% and 0.80% for the 30% and 20% best performing students). Interest was collected during the school years and repayment started one year after graduation. The government guaranteed 10% of the loans by providing EUR 150 million to the Mutual Counter-Guarantee Fund (MCTES, 2017).

Few students have taken up loans. Portugal issued 21 000 public loans to higher education students between 2007 and 2014. In 2014/15 5.9% of students participated in the public loan system, and 759 loans were originated – a decline from 4 528 loans four years earlier (MCTES, 2017). As Ministry officials have acknowledged, this reflect as weak demand for loans and a limited supply of loans. On the demand side, the mortgage-based design of the loans puts students at risk in the event of unemployment or falling incomes. On the supply side, bank lenders have been reluctant to expose themselves to loan default, a concern heightened by the financial crisis.

Student borrowers have been principally from middle-income families, and disproportionately enrolled in private higher education institutions. Approximately 40% of borrowers have been enrolled in private institutions. Loans are principally taken out by students from middle-class families, and used to complement other sources of income in funding studies. Low-income students, believed by authorities to be averse to incurring debt, participate less frequently in the programme (MCTES, 2017).

Student lending through the programme was suspended in 2015 pending negotiations between government and banks to establish new terms for the management of lender risk. The student-lending programme is planned to resume and to offer loans on terms and conditions similar to those previously in effect, offering loans on a mortgage-style" basis.

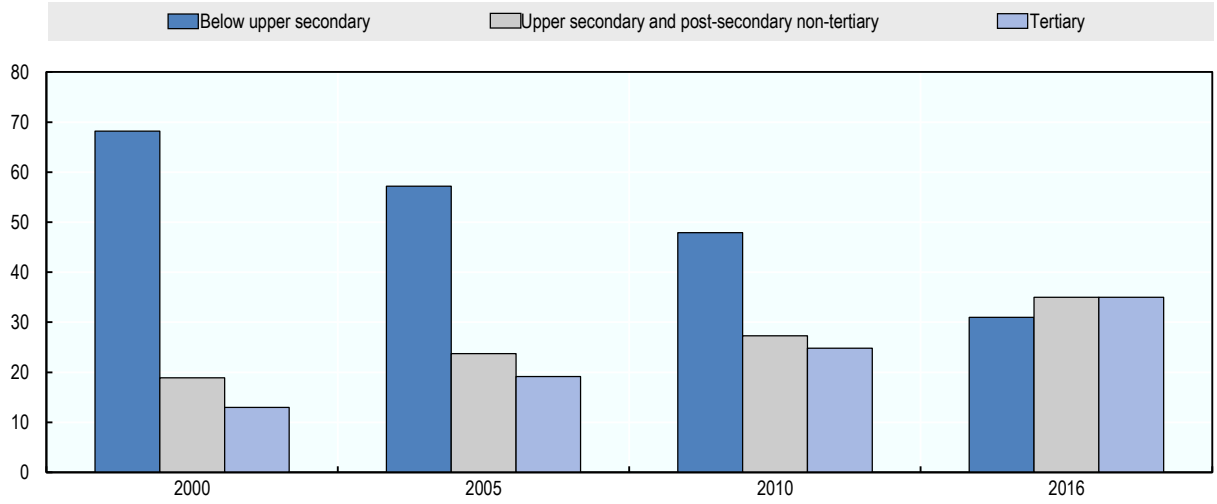
If well designed and adequately provided, social and academic support for students can help them to succeed in their studies (Bailey et al, 2016). This is especially true for students at risk of failing behind or dropping out (Williams, 2017). Social and academic support for students in Portuguese public higher education institutions is limited. A recent MCTES report noted that 16 out of 40 public higher education institutions surveyed had established programmes to tackle dropout, and that 10 out of 40 public institutions offered students tutoring services. In 2015, less than half of public institutions – and only one private institution – produced reports on student dropout (DGEEC, 2017).

5.3. Assessment: Key points

Policy issue 5.1. Differentiation and flexibility in modes of provision and pedagogical approaches remains limited, jeopardising Portugal's attainment goals

Portugal has succeeded in greatly expanding participation in upper secondary and higher education in the last decade, and as Figure 5.4 illustrates, the educational attainment profile of its young adult population (ages 25-34) has undergone a dramatic shift, with the share of the age cohort completing higher education rising from 13% in 2000 to 35% in 2016 (Figure 5.4).

Figure 5.4. Educational attainment of 25-34 year olds



Source: OECD (2017a), Education at a Glance 2017: OECD Indicators, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2017-en.

Nonetheless, Portugal's 35% rate of higher education attainment among 25-34 year-olds still trails other OECD countries, and remains below EU attainment targets that it has embraced as national policy targets, both the 2020 goal of 40% higher education attainment among 30-34 olds, and the 2030 goal of 50% higher education attainment (MCTES, 2017; Eurostat, 2018). The focus of government strategy for raising attainment in the near term is to attract to higher education young adults who completed secondary education but did not undertake higher education, and those who entered higher education but left without completing a degree (MCTES, 2017).

Effective higher education systems, most especially those that aim to engage working adults in higher education, strongly encourage diversity and flexibility in the provision of study programmes. Portugal's binary system – with polytechnics providing professionally oriented study programmes alongside universities offering more traditional academic programmes – ensures some degree of diversity in education, though less diversity and flexibility than the nation's aims for attainment warrant.

The introduction of the *Cursos Técnicos Superiores Profissionais* (CTeSP) has helpfully added a new type of short-cycle higher education educational programme to the range of course offerings in Portugal. The introduction of CTeSP has clarified and strengthened the

nature of short-cycle programmes by including a greater orientation on deepening knowledge and skills, more workplace exposure, and stronger links to the labour market needs. Additionally, the creation of new study options may prove to be particularly attractive to groups who have hitherto not pursued higher education and may help address skills gaps in the economy. Indeed, interest in CTeSP has grown fast and in 2016-17 over 11 000 students were enrolled.

When first designed, the CTeSP programmes offered a model of work-related learning that some viewed as insufficiently flexible. Some HEI instructors and administrators and their firm-based collaborators noted that polytechnics submitting CTeSP programmes were being told to concentrate student work experience in one semester. However, legislative action has since allowed work content to be distributed across the entire duration of the study programme (DL 63/2016 – article 40M).

There are risks and unknowns with respect to the CTeSP programme that merit careful monitoring. First, while CTeSP was initiated principally to provide a short-cycle qualification with recognition and value in the labour market, the students and professors with whom the Review Team met typically indicated that about half of CTeSP participants aim to continue their studies to the Bachelor level. The extent to which students who transition to bachelor-level studies are fully prepared to meet the demands of those programmes remains an open question. Additionally, it was acknowledged by HEI administrators and instructors that employers and the wider society do not yet have a clear understanding of the CTeSP credential and the labour market outcomes of initial cohorts completing a CTeSP are not documented.

Notwithstanding Portugal's binary system and recent efforts to create greater diversity, the higher education system still does not provide sufficiently flexible and innovative programme provision, structure and curriculum, especially for non-traditional student populations.

Higher education programmes, including across polytechnics, often remain theoretical in focus, with limited co-operation with the outside world and a lack of attention to developing key competences students needed for the modern economy. Programmes often have rigid structures and are oriented to specific professions, providing students with limited flexibility in combining courses.

Traditional teacher-centred methods with a large number of lecture-based contact hours still prevail. Portuguese students, especially mature students, feel overburdened by the number of instructional hours. Research indicates that difficulty balancing school and work/family schedules is the most frequently cited cause of dropout among Portuguese higher education students (Williams, 2017).

Modes of provision are not aligned to the needs and interests of a more diverse student population. Flexible, part-time, evening and distance learning options are more limited than in many OECD countries, and opportunities to study on an accelerated or an extended basis are not widespread.

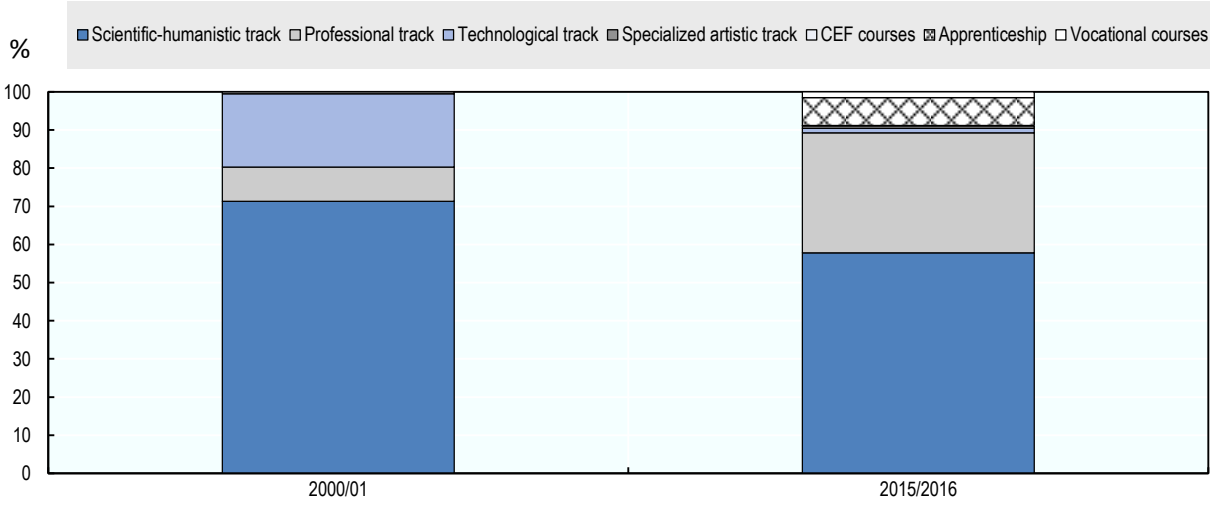
In addition to the CTeSP programme, Portugal has introduced some initiatives to widen participation in short, non-degree courses tailored to the needs of adult learners and closely connected to labour market demands (some of which can subsequently be applied to degree programmes) (OECD, 2018). However, few of these courses have been offered, and student numbers have been quite small (OECD, 2018).

A3ES has successfully established and implemented a respected external quality assurance system for higher education in Portugal, covering bachelor and master's programmes provided in universities and polytechnics which provides a guarantee of basic standards and appears to have influenced the quality culture in Portuguese HEIs. While acknowledging these accomplishments, staff in higher education institutions noted in meetings with the OECD Review Team that the current quality assurance system also deters the introduction of more flexible, innovative, student-focused and competency-based programmes. As the system is moving towards a lighter touch model of quality assurance, based upon institution-level review, this could be an opportunity to shift from a rather prescriptive approach to one that encourages greater diversification and innovation in the development of new types of programme, instruction methods, curriculum and delivery modes.

Policy issue 5.2. Pathways from secondary to higher education limit further widening and social diversification of higher education access

In Portugal, general secondary education is organised according to four separate tracks. Tracks of study include the (a) scientific-humanities track, which is geared towards further studies at the higher education level; (b) artistic tracks; (c) technological tracks; and (d) the professional track (*Cursos Profissionais*). Additionally, secondary students may opt for education and training courses (*Cursos de Educação e Formação*); vocational courses; and apprenticeships. Upper secondary students outside the academically-oriented scientific-humanities track now comprise about 43.5% of upper secondary students – as compared to 29% in 2000/01 (DGEEC, 2016) (Figure 5.5).

Figure 5.5. Distribution of secondary students by track, 2000/01 and 2015/16



Source: Direção-Geral de Estatísticas da Educação e Ciência (DGEEC, 2016), Educação em Números – Portugal, http://www.dgeec.mec.pt/np4/%7B$clientServletPath%7D/?newsId=691&fileName=DGEEC_DSEE_2016_Educa__o_em_n_meros_2016.pdf

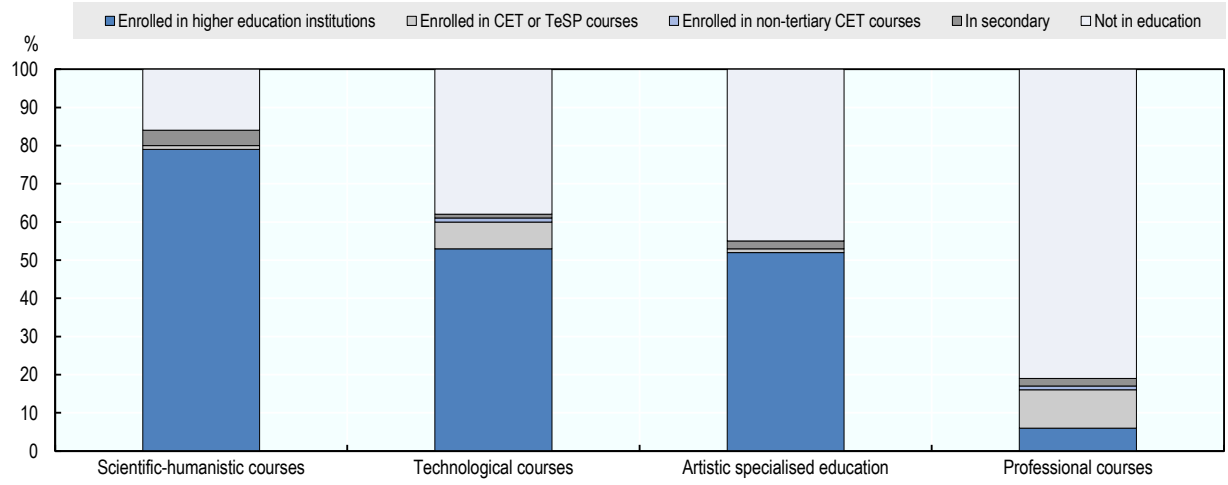
Portugal's centralised admission process to higher education, known as the *Regime Geral de Acesso (*RGA), or General Access Stream, provides students with a transparent mechanism for admission. Developing a single unified portal has also reduced the costs of

students in applying to individual institutions, and the burden for institutions to manage applications.

The rapid expansion of secondary professional education, combined with the design of the *Concurso Nacional*, which is oriented to the traditional scientific-humanistic pathway, has resulted in a higher education entry regime that is no longer aligned to the contemporary profile of upper secondary education, or to the nation's attainment goals. The RGA's national entrance competition is based on secondary leaving examinations that are aligned to the curriculum of generalist (scientific-humanistic) upper secondary education. Students in the secondary professional track who aspire to enter higher education are required to take examinations in subjects which are not part of the curriculum they have followed, putting them at a disadvantage to enter higher education.

About eight in 10 students (79%) completing the scientific-humanistic track entered higher education one year after completing their studies, while 16% of those completing secondary professional track continued directly to higher education – 6% enrolled in a bachelor programme, and another 10% enrolled in a CTeSP programme. Among students completing technological courses 53% entered higher education institutions and 7% enrolled in CTeSP programmes (Figure 5.6), though they are few in number, comprised about 1% of upper secondary students (Figure 5.5).

Figure 5.6. Situation of secondary graduates one year after graduation, 2013-14



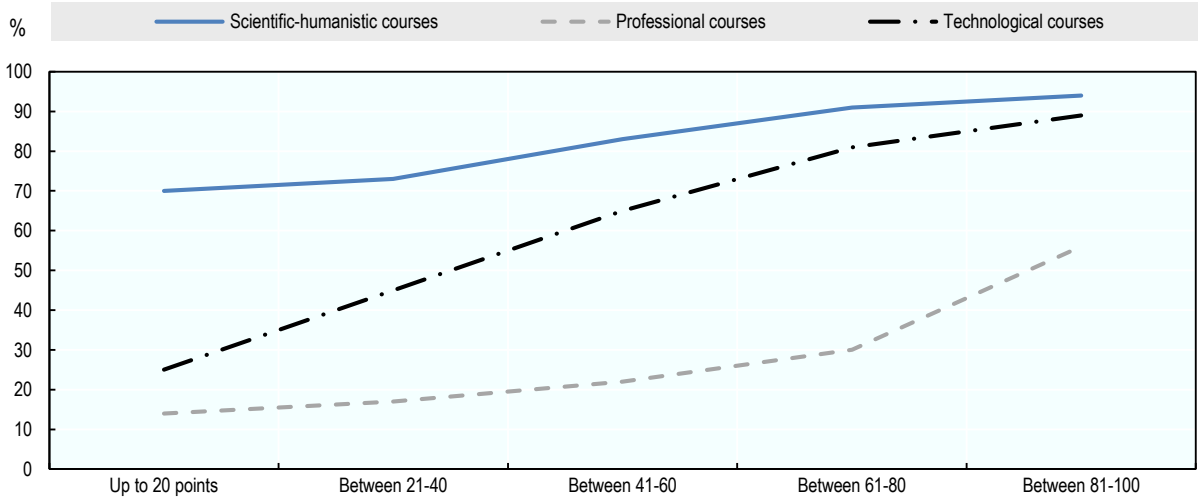
Note: CET stands for Curso de Especialização Tecnológica (Technological Specialisation Courses, in English).
Source: Direção-Geral de Estatísticas da Educação e Ciência DGEEC (2016), Transição Entre O Secundário E O Superior – Parte I, http://www.dgeec.mec.pt/np4/np4/347/%7B$clientServletPath%7D/?newsId=701&fileName=TransicaoSecundarioSuperior_DGEEC.pdf.

Wide differences in rates of higher education continuation between students in professional and scientific-humanistic tracks are likely to be the result of dissimilar interests, plans, and abilities of students enrolled in them. However, differences in academic performance may not fully account for low transition rates to higher education among secondary professional students. A DGEEC report (2016) showed that among the highest performing students in the 9th grade Portuguese language examination, only 56% of those in professional tracks progressed into higher education, compared to 89% of those in technological courses and 94% in the academic tracks (Figure 5.7).

In OECD member countries with secondary professional education programmes that are well aligned to higher education entry requirements, such as Finland and the Netherlands, rates of continuation to bachelor degree study are much higher than in Portugal. In Finland 17% of recent secondary professional graduates continued their education to bachelor degree programmes, while in the Netherlands 20% did so – principally in higher education professional institutions (OECD, 2017c).

Portuguese education authorities recognise that the current entry regime for higher education was developed during an era in which comparatively few students completed upper secondary education, and it now hampers wider access to higher education; they have organised consultation processes to identify policy responses.

Figure 5.7. Share of students enrolled in higher education institutions in 2014-15 according to their performance in 9th grade Portuguese language exam three years prior



Source: Direção-Geral de Estatísticas da Educação e Ciência DGEEC (2016), Transição Entre O Secundário E O Superior – Parte I, http://www.dgeec.mec.pt/np4/np4/347/%7B$clientServletPath%7D/?newsId=701&fileName=TransicaoSecundarioSuperior_DGEEC.pdf.

A 2016 MCTES study group (*Grupo de Trabalho para a Avaliação do Acesso ao Ensino Superior*) examined a range of impediments to raising higher education access and attainment, among them the limited pathway from secondary professional education to higher education. It outlined – without recommendation – two ways in which a "special contest for access to higher education for graduates of vocational courses" could be created. First, it noted:

> *"the use of the national examinations of the scientific-humanistic modality as a condition for the access of graduates with vocational courses to higher education could be discontinued, and instead "the curricular components of vocational secondary education" could be used as the basis of an examination that is "co-ordinated, elaborated and executed by polytechnic higher education institutions within the framework of a special competition with their own vacancies." (MCTES, 2016)*

Alternatively, Portugal could modify the existing examination framework rather than creating an entirely separate assessment framework solely for vocational students seeking

polytechnic places. Instead, a single examination with diverse content could be offered, accessible in principle to all upper secondary students, and qualifying students for designated seats at either university or polytechnic institutions. With this option:

> *"…the current final exams of secondary education [would be revised], structuring its contents in general and other specific modules, the latter focusing on the specific subjects of each modality of secondary education. This system would avoid the multiplication of [separate] examinations…and integrate in a single examination the diversity of the subjects of the various modalities of secondary education. The application grade would be calculated considering the classifications of the referred curricular components and the classification of the entrance exam (general module and specific module), reserving a quota of the vacancies approved to be affected to this modality of access."(MCTES, 2016)*

The National Council on Education (*Conselho Nacional de educação) (*CNE) has also addressed this challenge, offering broad considerations – rather than policy options – that should guide the development of proposals (Diário da República, 2017a). New entry routes from secondary professional to higher education should not, it advised, "diminish the importance of the competition for access to the newly established professional higher technical courses (CTeSP)" or diminish the status of polytechnic institutions by creating pathways that were specific to polytechnic higher education institutions.

Policy issue 5.3. Financial and academic support for students

Portugal offers need-based grant assistance to about one in five higher education students, with modest additional support through public lending and specially targeted support. Whether this support is sufficient – in amount, timing and targeting – to permit all who wish to study the opportunity to commence and successfully complete their studies has not been subject to systematic evaluation. Given absent strong evidence about the behavioural impact of student support, general conclusions about its sufficiency are not possible.

Nonetheless, some basic design features of the student support system arevisibly not fit for purpose. Ministry officials note that enrolment and attainment targets focus on encouraging adults to undertake higher education: both adults who studied and left their course without completing a qualification and those qualified to study (who completed upper secondary education) but chose not to study. For these prospective students, the current financial student support policies are ill-designed. Prospective adult students are typically employed, and many have family responsibilities. As they weigh the benefits and potential costs of higher education, they must take into account both its opportunity costs – e.g. lost wages that may result from a reduction in working hours – and its direct, out-of-pocket costs. The low threshold of eligibility for social scholarships means that a prospective adult student who had earned a full-time, full-year minimum wage – EUR 649.8 in 2018 (EUR 7 788 per year) – would have a household per capita income in excess of social support eligibility.

The +*Superior* programme, designed to encourage enrolment in non-metropolitan Portugal awards supplemental grant assistance during the school year after enrolment decisions have already been made, thereby undermining its ability to influence enrolment choices.

Portugal's discontinued *Programa Retomar* targeted at young adults showed weak take-up due to strict criteria and inadequate levels of financial support (Politico, 2016). As a result it has since been reoriented towards ICT skills, under the *Iniciativa Nacional Competências Digitais e.2030* (Portugal INCoDe.2030) which seeks to improve digital literacy and

encourage specialisation in digital technologies to move Portugal toward a higher-valued added economy.

Box 5.1. Tracking and supporting at-risk students

Georgia State University (United States) has used predictive analysis to track all its students since 2012. This system provides the university with alerts based on around 800 risk factors for over 30 000 students. Over 51 000 interventions have been carried out based on these alerts since its implementation.

Tracking students allows advisers to intervene early at the first sign of a problem. The university is informed, for example, when a student receives a low grade in a course. The student is provided with immediate support to avoid future underperformance and drop-out.

Since adopting this system, Georgia State University's four-year graduation rates have improved by six percentage points. The average time for graduating has decreased by more than half a semester. According to Georgia State University, the biggest gains have been witnessed by low-income, black students and Hispanic students. As a result, students from these minority groups now have similar or higher graduation rates to the overall student body.

Source: GSU (n.d), Leading With Predictive Analytics, Georgia State University official website, http://success.gsu.edu/approach/.

Portuguese higher education students are provided quite limited access to academic support and guidance services. Moreover, higher education institutions serving students at high risk of attrition have not yet developed institutional capabilities to systematically track, contact, and support students who experience academic difficulties. The experience of moderately selective or open access higher education institutions elsewhere in the OECD suggests that these practices make a significant difference in student success (Box 5.1).

Box 5.2. Feedback reports to high schools

A number of US states, such as Utah, have developed high school feedback reports that provide "sending" high schools with information about the academic outcomes of their students who went on to enrol in a public college or university in Utah. Others, such as Kentucky, have developed reports that provide information on both higher education and labour market outcomes. In Kentucky, for example, high schools are provided reports about their graduates that inform them of attrition, remediation rates, credit accumulation, grade point average, and other measures of academic progression and success, as well as information about labour market outcomes.

Source: USHE (n.d), 2017 High School Feedback Reports, Utah System of Higher Education, https://higheredutah.org/reports/high-school-feedback-reports/, NKYTribune (2017), New report tracks Kentucky's high school graduate and their success in college, transition to workforce, Northern Kentucky Tribune, http://www.nkytribune.com/2017/11/new-report-tracks-kentuckys-high-school-graduate-and-their-success-in-college-transition-to-workforce/.

Portugal has taken steps in recent years to develop an integrated student-level education data system that collects and disseminates data on the higher education sector, including indicators on enrolment, completion and labour market outcomes. Completion of this work is needed to ensure that students have information about the risks and benefits of higher education when making choices about what and where to study. Additionally, information on students' performance and progression can be used by the upper secondary education system to review and recalibrate its curriculum and practices to strengthen the alignment to the demands of higher education. These could be especially beneficial for Portugal's upper secondary professional programmes, which have comparatively limited experience with the preparation of students for higher education study.

5.4. Recommendations

Recommendation for improving flexibility in modes of provision and pedagogical methods

5.1. Further improve the diversity of the educational offer

Remove obstacles in quality assurance and funding systems that limit the capacity of higher education institutions to offer part-time, distance and blended short cycle, bachelor and master's programmes, and ensure that provision is adapted to a full range of students, including adult learners. Provisions in the guidelines that underpin A3ES decisions relating to quality assurance of programmes and unnecessarily limit flexible programme design and curriculum should be reviewed and eliminated.

Recommendation to widen access to higher education

5.2. Revise the higher education entrance examination system to ensure it is appropriately adapted to students from upper secondary vocational education.

To widen access to higher education, the entrance examination system for higher education should be aligned to the needs and profiles of students from both secondary professional and scientific-humanistic tracks. Following the option identified by the Working Group on the Assessment of Access to Higher Education (Grupo De Trabalho Para A Avaliação Do Acesso Ao Ensino Superior) in 2016, we recommend the addition of skills-focused examinations that reflect key aspects of the secondary professional curriculum to ensure that the knowledge and skills of students from vocational streams are properly recognised. Specifically, secondary school leaving and higher education access exams (Exames finais nacionais do ensino secundário e acesso ao ensino superior) should be designed to include additional modules that are aligned to the curriculum of the vocational stream. These should be accessible in principle to all upper secondary students, and be used to govern access to relevant programmes in polytechnics and universities. Vocational modules should be developed through co-operation between higher education and upper secondary educators. This will be essential to ensure take-up of the reform by students and higher education institutions, and the proper alignment of examinations to both the secondary curriculum and higher education programmes. It is crucial that new access routes be carefully developed and implemented with the wide engagement of HEI stakeholders.

In parallel, the Ministry of Education should ensure that the growing share of secondary professional students who continue to higher education are adequately prepared for success in their programmes, using feedback reports to equip teachers, school leaders, and families with evidence about the post-schooling trajectories of upper secondary professional students.

Recommendations for ensuring adequate financial and academic support

5.3. Improve student financial support policies

The current system of social scholarships should be subject to a rigorous review of its effectiveness in permitting all who might benefit from higher education to study.

The +Superior grant programme should be reviewed. If the programme cannot be designed so that grants are awarded prior to enrolment decisions – and therefore only subsidising enrolment decisions that have already been taken, then the programme should be discontinued, and those resources re-invested in other student support programmes.

Financial support policies for students should be adapted to the needs of working adults. For example, the aid eligibility methodology for social scholarships could adopt an income protection allowance for working adults. This allowance would permit those whose incomes are near the minimum wage to have some part of their earned income exempt from household per capita income calculations used to determine scholarship eligibility.

5.4. Adequately support students making the transition to higher education

Special attention should be given to ensuring that students are well-prepared and supported to complete higher education. Specific additional measures could include incentives (through performance agreements or other appropriate means) for higher education institutions and their staff to develop systematic co-operation and short-term staff exchanges or shadowing opportunities with upper secondary schools to help smooth and support transition to higher education. Co-operation and exchanges are potentially useful to raise awareness among students in secondary schools concerning the focus and challenges of higher education, so they can better prepare themselves. Moreover, they identify and increase understanding among teachers in both sectors of the biggest 'gaps' between what secondary education equips students to do and what higher education teachers expect them to do.

Additionally, developing and implementing systems at the higher education institutional level to monitor students' performance and to signal difficulties would be an effective way to support early intervention and promote student success. Information on students' academic performance (including particular deficiencies and gaps) could also be provided to upper secondary institutions through feedback reports, for example, to help review and recalibrate schools' curriculum and teaching practices.

5.5. Encourage higher education institutions to offer more extensive academic and social support to students, in particular for students from disadvantaged backgrounds and mature students

To improve student success and to encourage adults to return to education, higher education institutions that offer well-designed social and academic support to students, such as career guidance, remedial courses, tutoring or psychological counselling, should be rewarded through performance-based funding. The institutional support practices eligible for funding should be evidence-based, and well-adapted to the profile of students served by the HEI.

5.6. Provide targeted support to encourage pedagogical training and reward good teaching performance.

Portugal should encourage and support pedagogical training for academic staff, targeting both new and established staff members and reflecting the diversity of requirements across student groups and institutions and increasing flexibility of the educational offer. Although some countries (such as the UK) have developed national academies focused on pedagogical development, others (including the Netherlands) have provided public funding to pedagogical capacity building initiatives organised by individual or groups of HEIs. Such an initiative could initially be supported in Portugal through

pilot projects in selected HEIs. Additionally, the Portuguese government should explore ways to encourage institutions to include teaching performance as a key element in transparent, institution-wide systems of evaluation and promotion.

It is important for Portugal to include improvement of learning and teaching as a core objective in its national strategy for higher education and in institutional agreements to raise the profile of the issues at stake and incentivise action at institutional level. Key objectives should be increasing uptake of effective pedagogical approaches for skills development (problem-based learning, flipped classroom, use of technology etc.) and greater co-operation with employers and outside actors.

Note

[1]. Taught studies refer to hours that students spend on study units organised by their higher education institution; this category includes activities such as lectures, seminars, tests or unpaid jobs in laboratories (Orr et al., 2011).

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Chapter 6. Doctoral training

In recent years, Portugal has greatly increased its capacity to train high-level subject specialists, researchers and academics through expanding doctoral training. However, as the number of doctoral graduates has increased, questions have arisen about the ability of the Portuguese economy to offer suitable employment opportunities for larger numbers of highly trained individuals and the relevance of the doctoral programmes provided in the nation's universities. This chapter examines developments in the supply of doctoral training in Portugal and evidence on the destinations of doctorate holders in the country. It suggests that public investment in doctoral training can be better targeted, the quality of doctoral programmes can be improved and that there is a need to ensure the Portuguese economy makes better use of the high-level skills of doctoral graduates to support national development.

6.1. Introduction

Across the OECD, higher education institutions play a key role in training high-level subject specialists and researchers through doctoral degrees (PhDs). In Portugal, as in a number of other OECD countries, only higher institutions officially recognised as 'universities' currently have the right to award PhDs, reflecting the traditional concentration of research in this type of institution. As elsewhere, a majority of doctoral graduates in Portugal have historically gone on to work in teaching and research roles in universities or, to a lesser extent, public research. There is a certain logic to this: the higher education and public sectors accounted for 89% of total domestic expenditures on basic research in Portugal in 2015 and continue to perform a large majority of basic research activity in nearly all OECD countries.[1]

While most basic research tends to be performed in academic institutions, 70% of total research expenditure in the OECD – including applied research and experimental development – occurs in the business sector (OECD, 2017). In Portugal, where business-led research activity is less extensive than in many other OECD members, almost half of total domestic research expenditure occurs in the business sector. Although not all research-related jobs require a PhD,[2] research, research management and analytical positions in the wider economy do represent especially relevant opportunities for doctoral graduates to exploit their advanced knowledge and research skills effectively outside the academic sector. Their ability to do this depends both on the quality and relevance of their training (including the field of their PhD) and on the availability of jobs where they can actually make use of their additional knowledge and skills.

Doctoral graduates who go on to work in industry can play an important role in transmitting knowledge between the academic sector and the business sector (Stephan, 2007). They also contribute to the capacity of firms to absorb research-based knowledge, as firms learn about research and innovative approaches being produced by other actors in the economy, whether they are other firms or public entities (Cohen and Leventhal, 1989). Furthermore, a significant body of evidence identifies links between research undertaken – primarily by PhD holders – in higher education and the public sector and innovation in the wider economy (Box 6.1).

Despite the potential contribution of PhD holders to innovation and productivity growth within and outside the academic sector, questions remain in all OECD countries about the overall level of demand for PhD graduates and the best way to design doctoral training and related public support mechanisms. Undertaking a PhD – typically lasting at least four years in Portugal – represents a significant investment in terms of time, resources and foregone earnings for individuals. It is also an investment for society as a whole. Not only do many PhD candidates often receive direct financial support from the public purse, but each talented individual engaged in doctoral research is diverted from other types of productive activity in the economy. It is therefore crucial that decisions about investing in a PhD, by the individual and by the state, are made on the basis of a sound understanding of the likely costs and benefits of doing so. While the potential benefits in terms of individual fulfilment, creation and use of new knowledge and development of national research capacity are considerable, the risks – particularly in relation to doctoral graduates finding suitable subsequent employment – are also real.

Box 6.1. Public research and innovation: evidence of the links

Some of the key channels through which knowledge is transferred from the public to the private sector include publications, patents, face-to-face contacts, spin-offs and spin-outs and time spent by staff and students working in industry (Stephan, 2012). A large body of work examines how knowledge, generated by PhD holders working in the public sector, spills over to the private sector and ultimately contributes to economic growth.

In general, basic research rarely produces tangible products or direct economic benefits. Instead, it provides intermediate inputs that, are "indispensable in the further research leading eventually to commercial innovations." (David et al., 1992) Many new products and processes have grown out of research in the public sector. Examples include hybrid crops, the Internet, lasers, and bar codes (Stephan 2012). Nowhere is the contribution of public research more clear-cut than in the area of pharmaceuticals, with three-quarters of the most important therapeutic drugs introduced between 1965 and 1992 having their origins in public sector research (Cockburn and Henderson, 1998).

More broadly, researchers have sought to analyse the relationship between public research through different lines of enquiry:

1. By examining the relationship between published knowledge and productivity growth in manufacturing industries. A study by Adams (1990), for example, proxied knowledge stocks by counts of publications, discounted for obsolescence, in different fields and linked these to different manufacturing sectors. This found that the stock of knowledge directly relevant to the industry accounts for 50% of growth in total factor productivity.
2. By surveying firms about the role public knowledge plays in innovation. A survey by Carnegie Mellon (Cohen, Nelson and Walsh, 2002) found that public research – and by inference, the PhD holders doing it – is critical to R&D in a set of industries in the United States, with pharmaceuticals heading the list.
3. By linking measures of firm innovation, such as patent counts, to university research. This approach focuses on spillovers between public research and private research and the degree to which these are geographically bound. Initial research by Jaffe (1986) suggested a strong relationship, particularly in the areas of drugs, medical technology, electronics, optics and nuclear technology. Research by Acs et al. (1992), Black (2004) and Autant-Bernard (2001), among others, has found a relationship between innovation performance in firms and university research performed in close proximity.

   By examining whether firms with links to public research institutions outperform those without such links. Work by Zucker et al. (1999), for example, found that biotechnology firms that co-author with a "star" university researcher perform better than firms that do not, whether performance is measured by products in development, products on the market or employment. Pharmaceutical firms that co-author with university researchers have also been found to have a higher research performance (Cockburn and Henderson, 1998). Other work found that the market-to-book value of firms that cite published research in patent applications is greater than that of firms that do not (Deng et al., 1999).

In light of these considerations, the two closely interrelated questions examined in this section are:

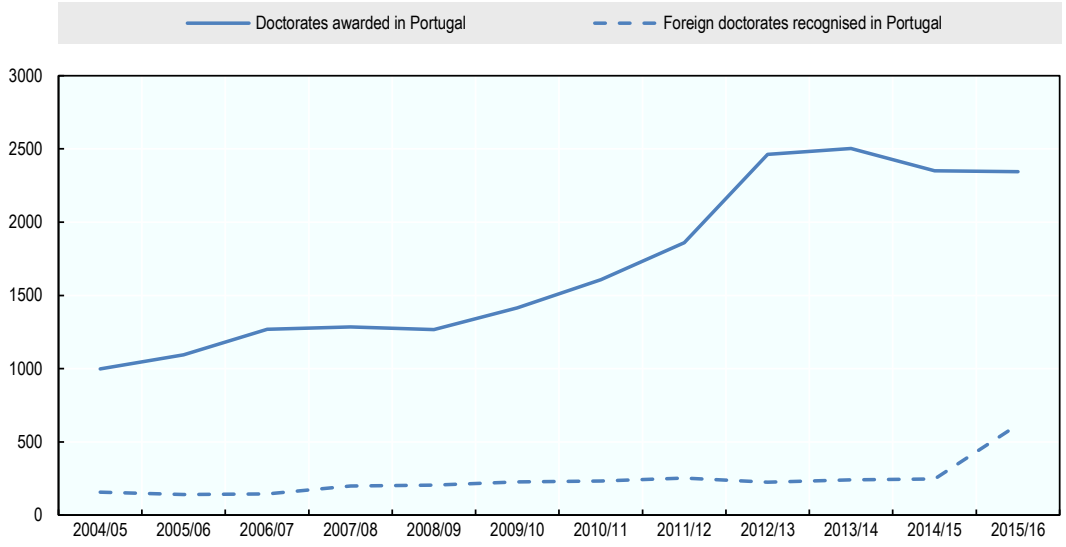
1. Are a) the current level of investment in doctoral training in Portugal; and b) the way doctoral training is organised appropriate to meet the needs of a modern knowledge economy and how could the current situation be improved?
2. To what extent are doctoral graduates able to find relevant work in Portugal, how might demand for doctoral candidates evolve and what could be done to increase opportunities for trained researchers to exploit their skills for the benefit of Portugal?

6.2. Context

6.2.1. Stock and flow of doctorate holders in Portugal

The number of PhDs awarded in Portugal has grown dramatically since the late 1970s. Slightly fewer than 1 800 individuals graduated with a PhD in Portugal during the entire decade of the 1980s. The number of graduates then rose to around 1 000 a year by 2004-05 and reached a peak of over 2 500 in 2013-14, before declining somewhat in the following two years (DGEEC, 2016). The rapid growth in the annual number of graduates from 2005 onwards is illustrated in Figure 6.1 below.

Figure 6.1. Number of doctorates awarded and recognised in Portugal, 2005-15



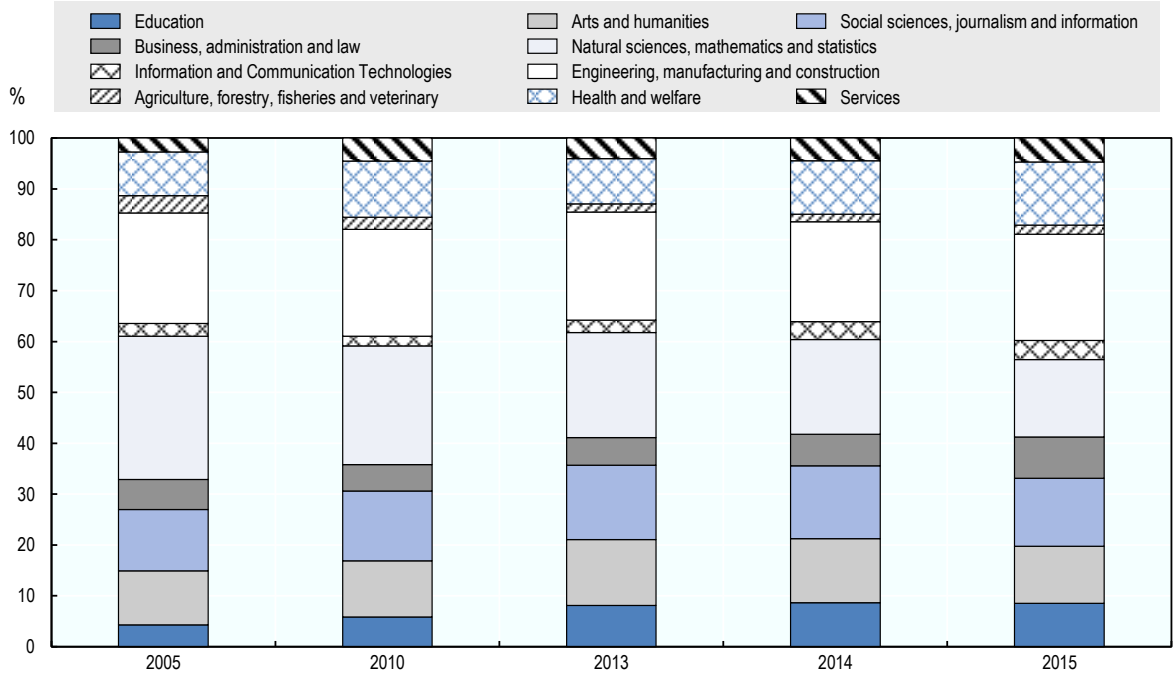
Source: Direção-Geral de Estatísticas da Educação e Ciência DGEEC, 2016.

Largely as a result of this greatly increased domestic production of PhD graduates, by the end of 2015, there were estimated to be around 30 800 doctorate holders in Portugal (DGEEC, 2017)[3]. The most recent survey of doctorate holders in Portugal (DGEEC, 2017) indicates 84% of those with a doctorate had acquired their PhD in Portugal, the remaining 16% having completed a PhD abroad and subsequently had it recognised in Portugal. 79% of doctorate holders in Portugal received their doctoral training in 2000 or later, meaning the population of highly trained researchers in the country is relatively young (an estimated 44% were aged under 44 at the end of 2015).

The stock of doctoral holders in Portugal would be larger were it not for the relatively high overall levels of out-migration experienced by the country, historically and, more recently, in the wake of the 2008 financial crisis. While anecdotal reports exist about the scale of this 'brain drain' – on occasions discussed with the Review Team in interviews – there are no reliable data specifically on the out-migration of doctorate holders. Although collecting such data can be challenging, more accurate information on the destinations and intentions of doctorate holders moving abroad would be valuable for policy-making.

Of the 2 351 doctoral candidates who graduated in Portugal in 2015, over 20% obtained their degree in the field of engineering, manufacturing and construction; over 15% in the field of natural sciences, mathematics and statistics and between 11-13% each in the fields of social sciences, journalism and information, health and welfare and arts and humanities. As shown in Figure 6.2, despite the large increase in overall numbers, the share of doctoral candidates graduating in different fields of study in Portugal has remained broadly stable for most fields since 2005. Exceptions are natural sciences, mathematics and statistics and agriculture, forestry, fisheries and veterinary, which have seen only modest increases in graduation numbers since 2005, and have thus seen their relative share of graduates fall. Conversely, the fields of education and health and welfare have seen the proportionally largest rise in graduates, with their share of total graduates increasing accordingly.

Figure 6.2. Graduates at doctoral level or equivalent by field of education in Portugal



Source: Eurostat, Graduates by education level, programme orientation, sex and field of education database.

In recent years, slightly more women than men have graduated each year with a doctoral degree in Portugal (in 2015, for example, 53.6% of doctoral graduates were women). In many of the broad fields of study used above, the number of graduates of each gender is roughly equal. The main exceptions, based on data for 2015, are education (75% were women), health and welfare (68% were women) and information and communication technologies (76% were men).

6.2.2. Organisation and funding of doctoral training in Portugal

Only universities have the right to award doctoral degrees in Portugal. In the early 1970s, the country's four oldest universities – Porto, Coimbra, Lisbon and the Technical University of Lisbon[4] – awarded all doctoral degrees granted in Portugal (Heitor et al., 2014). By 2016, the network of institutions providing doctoral training had expanded and diversified. As shown in Table 6.1, in 2016, the oldest four universities awarded just under half of all doctoral degrees, with a further 30% awarded by the three universities founded in the early 1970s: the New University of Lisbon (Universidade NOVA de Lisboa), the University of Aveiro and the University of Minho. The remaining 30% of doctoral degrees were awarded by a range of other public and private universities.

Table 6.1. Doctoral graduates in Portugal 2015/16 by awarding institution

University	Public / Private	Number of doctoral graduates	% total doctoral graduates
Universidade do Porto	Public	453	19.3%
Universidade de Lisboa	Public	447	19.1%
Universidade Nova de Lisboa	Public	283	12.1%
Universidade de Aveiro	Public	230	9.8%
Universidade de Coimbra	Public	210	9.0%
Universidade do Minho	Public	210	9.0%
ISCTE – Instituto Universitário de Lisboa	Public	91	3.9%
Universidade de Trás-os-Montes e Alto Douro	Public	83	3.5%
Universidade Católica Portuguesa	Private	79	3.4%
Universidade da Beira Interior	Public	62	2.6%
Universidade de Évora	Public	61	2.6%
Universidade do Algarve	Public	46	2.0%
Universidade Fernando Pessoa	Private	24	1.0%
Universidade Aberta (Open University)	Public	16	0.7%
Universidade dos Açores	Public	11	0.5%
Universidade Lusófona de Humanidades e Tecnologias	Private	11	0.5%
Universidade Autónoma de Lisboa Luís de Camões	Private	10	0.4%
Universidade da Madeira	Public	7	0.3%
Universidade Lusíada	Private	6	0.3%
ISPA-Instituto Universitário de Ciências Psicológicas	Private	3	0.1%
Universidade Europeia	Private	1	0.0%
TOTAL		2344	

Source: Extracted from DGEEC, 2017b: Table 1.

Doctoral training in Portugal is provided in the framework of three or four-year doctoral study programmes, which, like Bachelor and Master programmes, must be formally accredited by the ministry responsible for higher education, based on the recommendation of the Agency for Assessment and Accreditation of Higher Education (*Agência de*

Avaliação e Acreditação do Ensino Superior) (A3ES). Accreditation decisions by the Agency – and thus permission to provide doctoral training in a given specific field – are based on an assessment of the staff qualifications and training capacity of the academic department or departments proposing to offer the doctoral programme, the proposed course structure, quality of public information about the programme and other factors.[5] On the basis of the recommendations of A3ES, the Ministry accredits host departments to provide a maximum number of training places (*vagas*) each year.

Most programmes contain compulsory and optional taught modules in the first year, with the remaining (usually three) years dedicated to research and thesis-writing. Doctoral programmes are frequently provided jointly by departments or research units in different universities and sometimes in partnership with external research institutions or companies. This reflects, to some extent, the matrix organisation of research units in Portugal, with significant co-operation between researchers in different institutions. Tuition fees at doctoral level range between EUR 2 500 and 3 000 per year.

A student wishing to embark on a doctorate in Portugal must first apply to a doctoral programme in a host institution. The degree of latitude students have in defining their own research project varies between programmes, as do the mechanisms through which they can potentially receive funding for their PhD. The traditional route to access funding was for prospective doctoral candidates to apply for a scholarship once they had acceptance in principle from a host institution and a proposed research project, to either the government-funded Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*) (FCT) or to a private or foreign foundation or research council. This route remains common. More recently, however, through calls for proposals in 2012 and 2013, the FCT has also allocated some of its funding for doctoral training to academic departments – rather than individuals – to allow them to implement funded doctoral programmes for a period of four years. The co-ordinators of FCT-funded doctoral programmes are able to select candidates for funding directly, as part of the wider selection process.

FCT doctoral scholarships – whether awarded centrally through annual FCT calls or by institutions through FCT-funded doctoral programmes – are designed to cover tuition fees and living costs. In 2017, the monthly stipend for FCT doctoral scholarships was EUR 980 for doctorates based in Portugal and EUR 1 710 for doctorates based abroad. In the case of the centralised annual FCT call, scholarships are initially awarded for one year, with selection undertaken based on scientific merit by academic panels for specific scientific areas. Once awarded, individual scholarships can be renewed up to three times (providing four years of funding in total), dependent on adequate academic progress.[6]

The FCT has long been – and remains – the primary source of funding for doctoral candidates in Portugal. Comparison of the number of FCT scholarships awarded and graduation rates four years later suggests 70-75% of successful doctoral candidates in Portugal receive support from the FCT.[7] The number of individual PhD scholarships awarded by the FCT each year rose steadily throughout the 1990s to reach over 2 000 in 2007. As illustrated in Table 6.2, in the wake of the crisis, funding for individual scholarships was cut drastically in 2012 and again in 2013 – in parallel with the introduction of FCT-funded doctoral programmes – before increasing again in 2016 and 2017. The FCT selected 96 doctoral programmes for funding for a four-year period in calls in 2012 and 2013. Contracts for all these programmes have been signed between the FCT and individual institutions. In total, the FCT funding for doctoral programmes provides scholarships for 2 758 doctoral candidates for a maximum of four years, with candidates selected at

institutional level by each programme. By the end of 2016, 1 715 of these scholarships had been awarded.

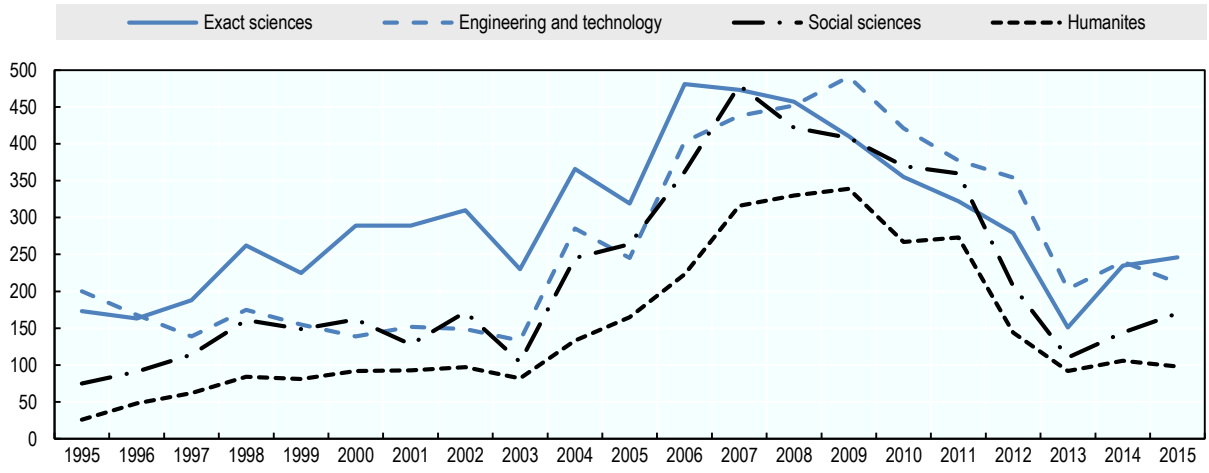
Table 6.2. PhD scholarships awarded by the FCT

Year of Application	Individual doctoral scholarships	Doctoral places awarded through doctoral programmes	Other	Total
2006	1634	0	107	1741
2007	1808	0	222	2030
2008	1734	0	228	1962
2009	1726	0	200	1926
2010	1482	0	198	1680
2011	1406	0	225	1631
2012	1103	0	149	1252
2013	421	210	54	685
2014	464	401	10	875
2015	438	437	20	895
2016	785	577	18	1380
2017*	900	533	8	1441

Note: *provisional figure.
Source: FCT (2017a), Bolsas de doutoramento concedidas por domínio científico, 1994-2015, FCT, https://www.fct.pt/apoios/bolsas/estatisticas/index.phtml.pt (qccessed 6 February 2018)

There are no pre-determined quotas for specific academic fields for FCT PhD scholarships. Figure 6.3 shows the proportion of scholarships awarded in each major field of study over time.[8] The relative weight of different fields of study has remained broadly constant over time, albeit with a decline in the relative weight of natural science, mathematics and statistics and an increase in the weight of social sciences from the early 2000s onwards. In 2015, 28% of all FCT-supported scholarships went to natural science, mathematics and statistics (exact and natural sciences); 24% to engineering and technology; 19% to social sciences and 11% to humanities.

Figure 6.3. Number of FCT-supported PhD scholarships by field of study



Note: Includes individual awards and places funded through doctoral programmes.
Source: FCT (2017a), Bolsas de doutoramento concedidas por domínio científico, 1994-2015, FCT, https://www.fct.pt/apoios/bolsas/estatisticas/index.phtml.pt (accessed 6 February 2018).

6.2.3. The destinations of doctoral holders in Portugal

The most recent survey on the Careers of Doctoral Holders (CDH), undertaken in 2016, provides the most comprehensive overview of the professional activities of the population of doctorate holders in Portugal (DGEEC, 2017). The survey results indicate that, as in other countries, the absolute employment rate of doctorate holders in Portugal is very high. Almost 93% of those responding to the survey reported that they were employed in 2015, with very little variation between those with doctorates in different fields of study. For the last quarter of 2015, European Labour Force Survey data[9] show average employment rates in Portugal for those aged 25-64 of 72% (all levels of educational attainment) and 84% (population with a higher education qualification).[10]

The CDH survey results show that the vast majority of doctorate holders (83%) work in higher education, while 10% work in other parts of the public sector, 6% in the business sector and the remaining 2% in the non-profit sector. The survey also suggests that a gradual shift is taking place in this pattern of employment, with more recent PhD graduates more likely to work outside the academic sector. While 5% of those having obtained their PhD between 2000 and 2009 reported working in the business sector and 8% in the (non-academic) public sector, these proportions rose to 10% and 18% for those having graduated in 2014.

Table 6.3. Doctorate holders in Portugal: sector of employment based on CDH results

Year degree awarded	Sector of employment								
	TOTAL	Public Sector		Higher Education		Non-profit Sector		Business Sector	
	No	No	%	No	%	No	%	No	%
TOTAL	28609	2837	10	23636	83	517	2	1619	6
1970-1979	86	5	6	71	82	3	3	7	8
1980-1989	1126	28	2	1,068	95	13	1	16	1
1990-1999	4776	309	6	4,291	90	41	1	134	3
2000-2009	11277	877	8	9,654	86	175	2	570	5
2010	1656	170	10	1,352	82	29	2	105	6
2011	1975	222	11	1,594	81	35	2	125	6
2012	2071	251	12	1,668	81	43	2	107	5
2013	2164	301	14	1,652	76	64	3	147	7
2014	1843	339	18	1,260	68	53	3	191	10
2015	1637	335	20	1,026	63	61	4	216	13

Source: DGEEC (2017), Inquérito aos Doutorados (CDH – Careers of Doctorate Holders) – Sumários Estatísticos, http://www.dgeec.mec.pt/np4/208/ (accessed 6 February 2018).

More than one in ten doctorate holders in the population with a degree in 'engineering and technology' reports working in the business sector, compared to 3.4% of those with a degree in social sciences and less than 2% of those with a degree in humanities. Among doctorate holders working in higher education, most (76%) report teaching as their primary activity, while 17% report having the status of post-doc (*bolseiro*) and 6% research as their main focus. Of the much smaller number of doctorate holders reporting they work in the wider public sector, over 30% teach at primary or secondary level, over 20% indicate research as their primary activity and around 12% say they occupy senior technical positions. Of all those working in the business sector, the largest proportion (37%) report simply that they work as company employees,[11] while only 8% indicate their primary activity is research.

A large share of the individuals who answered the CDH 2015 survey indicate that they believe their job is related to the area of their doctorate. On average, 80% of respondents say their job is 'entirely related' (*totalmente relacionada*) to the area of their degree (with little variation between fields of education), although this figure declines among the most recent doctoral graduates. Whereas 85% of those who gained their doctorate during the 1990s say their job is 'entirely related' to the field of their doctorate, this proportion falls to 75% for those who graduated between 2013 and 2015.

The median gross annual salary reported by doctorate holders responding to CDH 2015 was EUR 36 000. For comparison, the level of average annual gross earnings in Portugal in 2014 (the most recent year for which data are published) was EUR 17 208.[12] Salaries among doctorate holders are highest for those employed in higher education (EUR 38 512) and lowest for those employed in the non-profit sector (EUR 20 540) and business sector (EUR 30 800). Those qualified in the natural sciences and the humanities earn the lowest salaries across sectors. Across all age categories, only 63% of those answering the survey say they have a permanent contract. This almost certainly reflects the widespread use of temporary contracts for more junior academic positions in the higher education sector.

When asked about their level of satisfaction with their current job, 80% of respondents to the CDH who were in work reported they were 'satisfied' or 'very satisfied' with their jobs.

While the vast majority of respondents indicated they were 'satisfied' or 'very satisfied' with the level of autonomy and responsibility they enjoyed or the intellectual challenges their role offered, 56% indicated they were 'unsatisfied' or 'very unsatisfied' with their opportunities for promotion or advancement and over 40% were dissatisfied with their salaries and social benefits.

6.3. Assessment

Policy issue 6.1. Doctoral training capacity in Portugal

From a low base, Portugal has succeeded in greatly expanding its capacity to train doctoral candidates in the last two decades. This expansion has been largely driven by a significant increase in public support for doctoral education from 2004 onwards. As highlighted above, the number of PhD scholarships awarded by the FCT increased from fewer than 850 a year in the decade 1994-2003 to a peak of 2030 grants in the year 2007. Although the spending restraints associated with the fall-out from the financial crisis led to a significant reduction in state support for PhDs, particularly in the years 2013-2015, allocations from the European Social Fund (ESF)[13] have allowed the FCT to start bringing funding back to pre-crisis levels (Table 6.2).

The 2016 graduation rate at doctoral level in Portugal equates to 2.2 new doctoral graduates per 10,000 inhabitants. This rate is similar to that seen in France, Spain or Belgium in the same year, but well below the level seen in Switzerland (4.7); the United Kingdom (4.1); Finland (3.7); and Germany (3.6). The PhD cohort graduating each year in Portugal is likely to fall in the next few years, as the effects of post-crisis cuts in PhD scholarships are felt, although the recent increases in scholarship funding will help redress this in the medium term.

It would be hazardous to make any general claims about how many doctoral graduates a country 'needs' or should aim to train. This will depend, in particular, on how the purpose of doctoral training is conceived in the first place. Is it about training specialists with knowledge that they can apply in the short-term to boost innovation in businesses and organisations, or about pushing the boundaries of knowledge in a wide range of fields in the long term, for example? It is easier – although still difficult – to assess short and medium-term high-level skills needs in business, the academic and public sectors than it is to make a judgement about how fundamental science can best be promoted through doctoral research.

Despite these fundamental questions, it is important to consider how many, in what fields and in what ways doctoral candidates are trained in Portugal for at least three reasons. First, as highlighted above, despite the crisis, Portugal is spending an increasing amount of public money on supporting doctoral training. Is this money being directed where it should be and well spent? Second, most analysts agree that the developing knowledge economy will call for more high-level specialists, analysts and researchers. Is the way Portugal organises and supports doctoral training able to respond to specific and changing skills needs? And third, an increasing number of PhD graduates, combined with limited opportunities for permanent academic careers (see Chapter 7), means doctoral graduates increasingly need skills and experience they can apply in non-academic settings. How well is doctoral training in Portugal performing in this respect?

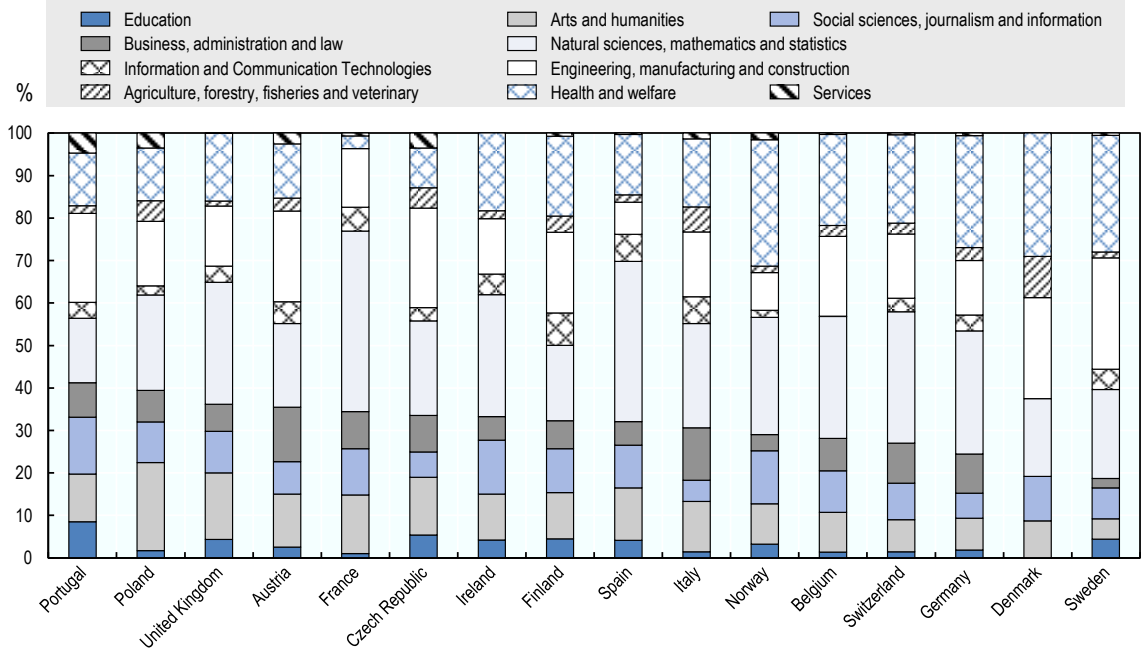
In seeking to answer these questions, it is useful to consider the factors that affect a) the thematic focus of doctoral training in Portugal (the fields and specialisations in which doctoral candidates pursue their PhDs) and b) the experiences and learning opportunities

doctoral training in Portugal provides doctoral candidates and the factors that affect this. An important aspect of the second point, particularly in a small country like Portugal, is the extent to which doctoral training offers international contacts and experience, either through the presence of international students and staff in Portugal, time spent abroad or engagement in international networks. For government, the key question is whether the instruments it uses to support doctoral training support a sensible thematic focus of training across the country and good quality training with an international dimension.

Thematic focus: diversified training capacity, but little strategic prioritisation

Portugal has a diversified system of doctoral training, with PhD programmes in wide range of institutions and a broad spectrum of scientific areas. When graduation patterns across scientific fields are compared to those in other European countries, as in Figure 6.4, two main features of the Portuguese situation stand out. First, in recent years, Portugal has trained an unusually large proportion of doctoral candidates in the field of education (8.5% of doctoral graduates in 2015, compared with 4% in Ireland, Spain or Sweden, for example). This may in part stem from the requirement, introduced in 2009 for teaching staff in polytechnics to acquire a PhD. Second, Portugal trains a lower proportion of doctoral students in the broad field of natural science, mathematics and statistic' than comparator countries (15% of doctoral graduates in 2015, compared with 40% in France and Spain and almost 30% in Belgium, Germany, Ireland or the United Kingdom). As shown in Figure 6.4, this is the field that has seen the largest decline in its relative share of graduates since 2005.

Figure 6.4. Doctoral graduates by field of study 2015



Source: Eurostat (2015), Graduates by education level, programme orientation, sex and field of education.

The graduation patterns for doctoral graduates in Portugal reflect to a large extent the historical allocation of PhD scholarships by the FCT. As noted earlier, scholarship places are distributed between fields primarily on the basis of historical trends, rather than any

clear and deliberate prioritisation of fields or sub-fields. Moreover, applications for individual scholarships are evaluated exclusively on the basis of academic criteria, without systematic assessment of the relevance of individual research projects to national research priorities and the development of institutional profiles. Despite a number of strong points, the call for doctoral programmes funded by the FCT in 2012 and 2013 used selection criteria related primarily to the academic profile of the staff and partner organisations involved and the organisation of the programmes, with no direct consideration of the way the funded programmes would align with national skills needs and research objectives.

It seems likely, for example, that the decline in the relative share of PhDs graduates in natural science, mathematics and statistics is the result of falling demand from students, rather than any conscious decision to "de-prioritise" these sub-fields. There does not appear to have been any assessment in Portugal of whether this trend is desirable in light of Portugal's top-level skills needs in bio-science, mathematics, information sciences and computing.

Research funding systems have a duty to take into account the value of all disciplines and allow adequate space for creativity and individual initiative in the way they allocate public support to research. Nevertheless, government research funding schemes elsewhere in the OECD use different mechanisms to direct a proportion of public investment in PhD training to nationally agreed priorities. Two basic steering mechanisms are used, sometimes in the same national funding system:

1. In systems where many PhD scholarships or – in countries such as the Netherlands – employment contracts for PhD researchers are awarded directly by university departments or graduate schools (using institutional funds or competitive project funding), governments have sought to encourage institutions to identify clear priorities for their research efforts – including doctoral training efforts – and to specialise in specific areas to create critical mass and/or centres of research excellence that fit within national research strategies. Both Ireland and the Netherlands, for example, have used performance agreements between government and individual institutions to encourage institutions to develop differentiated profiles in research and to link research activities to national development needs.
2. In systems which, like Portugal, have a tradition of allocating funding for doctoral training centrally through research councils, alignment to specific thematic priorities has been achieved through including these priorities in general funding calls or creating specific calls and funding instruments to promote doctoral training in priority areas. The annual call for the Government of Ireland Postgraduate Scholarship scheme,[14] for example, includes priorities from strategic funding partners (which also contribute to the financing of the scheme). In the United Kingdom, the thematic Research Councils (which will be merged in 2018), allocate funding for doctoral training to doctoral programmes, in a similar way to the FCT calls for doctoral programmes in 2012 and 2013 (supported for four years). However, while the criteria for the main funding route – Doctoral Training Partnerships (DTPs) – are comparatively broad and "demand-driven", United Kingdom Research Councils also fund Centres for Doctoral Training (CDTs) specifically to develop research capacity in predefined priority fields (Box 6.2).

A hesitant shift towards greater structure and skills focus in doctoral training

When it comes to the organisation and delivery of doctoral training, there has been a shift in many European countries from individually supervised PhDs towards more structured doctoral programmes, sometimes organised in the framework of doctoral schools; this

model is already well established in North America. This move has been motivated in part by the overall increase in the numbers of doctoral candidates and in part by a desire to ensure candidates are adequately supported to develop core research and communication skills and prepare their future careers. Training in many countries had traditionally focused almost exclusively on individual research and research-specific skills, with limited focus on helping candidates to develop their other skills sets (communication, teaching, management, etc.) for work inside or outside academia.

Box 6.2. United Kingdom government support for PhD training

In the United Kingdom, the majority of government support for PhD training is directed through the seven UK Research Councils. Funding – to be used for student stipends, coverage of tuition fees and allowances for research materials – is allocated by Research Councils through competitive calls or predefined algorithms to individual institutions (research organisations – ROs) or consortia of institutions. It is then the institutions – and not the Research Councils – which are then responsible for the recruitment of doctoral candidates. The Research Councils use harmonised funding mechanisms, with the three most commonly used funding routes being:

1. *Doctoral Training Partnerships* (DTPs): multi-annual grants to individual institutions or – more commonly – to consortia to provide innovative doctoral training that allows PhD students to undertake broader training or development opportunities. This route allows institutions and partnerships the most flexibility; in terms of the field of PhDs and modes used (some Research Councils have targets for the proportion of PhDs co-funded by non-academic partners).
2. *Industrial Co-operative Awards in Science & Technology (CASE)*: grants provided by Research Councils in the natural sciences, engineering and technology for PhD scholarships, where businesses take the lead in arranging projects with a recognised academic partner and subsequently recruit PhD students to work on the defined project.
3. *Centres for Doctoral Training* (CDTs): grants to consortia of institutions to deliver cohort-based doctoral training in emerging and multidisciplinary areas where there is demand to build capacity to address United Kingdom skills needs at the doctoral level. Research Councils provide 60 to 80% of the funding associated with the scholarships (the rest coming from institutional or business co-funding) and typically direct most funding to centres addressing predefined priority areas.

As highlighted earlier, doctoral training in Portugal is formally structured in doctoral programmes, which are accredited *ex ante* on the advice of the A3ES Quality Assurance agency. The process of accreditation focuses primarily on the qualifications and profile of the academic staff involved, the facilities available and a number of other factors related to information provision, etc. Accreditation provides a basic guarantee of the quality of the programmes, by ensuring favourable framework conditions are in place. However, the nature of PhD training is such that programme study plans (*plano de estudos*) are far less detailed than the equivalent documents for undergraduate and Master's programmes, which means any paper-based accreditation process has less to work with and fewer guarantees of quality. A review of PhD programme outlines on the websites of a number of Portuguese universities shows that programmes typically – but not always – include a number of generic training modules in the first year (dealing with research methods or core subject content) with the remaining three years simply allocated to thesis-writing.

One of the motivations, in many countries, behind moving to more structured doctoral programmes and – in some cases – the creation of doctoral or graduate schools has been to give doctoral students better access to joint training opportunities. A defined cohort of doctoral candidates pursuing training at the same time not only makes it possible for universities to provide shared training modules or co-ordinate access to internships, it also gives members of the 'cohort' the opportunity to interact and learn from one another. A positive side effect of this is that it reduces the risk of isolation for those pursuing a PhD. Cohort training requires a 'critical mass' of doctoral candidates to make it viable. In Portugal, doctoral programmes appear to vary considerably in scale and in their likely ability to guarantee good quality cohort training. Many doctoral programmes are – nominally at least – operated in partnerships between research units in different universities, external laboratories or, in some cases, companies, which increases the potential for scale, shared training and interaction between candidates.

Creating critical mass in doctoral training through encouraging greater co-operation between Portuguese universities, research units and businesses and between Portuguese organisations and institutions abroad was an explicit objective of the FCT calls to support doctoral programmes in 2012 and 2013. The calls, which covered all scientific fields, distinguished between 'national' PhD programmes (involving at least one Portuguese HEI and one research institution); programmes 'with industry' (which had to involve at least one industrial R&D partner); and 'international' programmes (linking a Portuguese HEI and a Portuguese research unit with an overseas HEI or research unit). A review of the programmes selected through this call (FCT, 2014), shows it was successful in encouraging the creation or development of interesting national and international partnerships for doctoral training, in potentially strategic fields for Portugal (see examples in Box 6.3).

Box 6.3. Co-operation with MIT in doctoral training

Through the 2012 and 2013 calls for doctoral programmes, the FCT provided funding to four doctoral programmes run by Portuguese institutions in co-operation with the Massachusetts Institute of Technology (MIT) as part of the MIT Portugal Program.[1] Each programme involves a co-operation partnership between Portuguese universities and research units and a dedicated period for the doctoral candidate spent at MIT in the US. The FCT provides funding for 10 PhD 'mixed' scholarships on these programmes each year.

The four programmes, which all focus on fields of strategic importance for the further development of the Portuguese economy, are:

1. *Bioengineering Systems* –New University of Lisbon in co-operation with University of Lisbon and University of Minho
2. *Leaders for Technical Industries* – Instituto Superior Técnico (University of Lisbon), in co-operation with University of Porto and University of Minho
3. *Sustainable Energy Systems* – University of Porto in co-operation with University of Lisbon and University of Coimbra
4. *Transportation Systems* – Instituto Superior Técnico (University of Lisbon), in co-operation with University of Porto and University of Coimbra.

Source: MIT Portugal (2018), accessible at: www.mitportugal.org/about/history.

However, two main questions remain about the doctoral programmes supported in 2012 and 2013. First, to what extent have the calls led to the creation of genuine partnerships? Many of the programmes – in engineering, for example – specify a very large number of partner organisations, which raises the question of how intensive the co-operation links really are. Second, the calls supported a large number of programmes (96 in total), some of which proposed a nominal intake of only six doctoral candidates per year. As a direct comparison, in the two calls in 2012 and 2013, the FCT supported 10 doctoral programmes in the field of 'Natural Sciences and the Environment', together providing scholarships for a total of 80 students a year (eight per programme on average). In the United Kingdom, for the last four years, in broadly equivalent fields, the Natural Environment Research Council has funded 15 Doctoral Training Partnerships offering 240 scholarships a year (16 per programme on average).[15] It is quite possible, therefore, that Portugal has been spreading its public funding for doctoral training too thinly, which risks undermining the desired scale effects of doctoral programmes.

Alongside promoting more structured training and critical mass, stimulating greater co-operation with non-academic partners – in particular with businesses – has been a priority for research funding agencies in many OECD countries. As noted, supporting PhD training in a business setting was a priority of the FCT calls for doctoral programmes. Seven of the 96 programmes funded are explicitly profiled as doctoral programmes in an 'industry setting', with industrial partners in the consortia. These programmes are focused primarily in engineering, health sciences and agronomy (FCT, 2014).

In the centralised FCT calls for individual PhD scholarships, it has also been possible to apply for a PhD in Industry (*Doutoramento em empresas*). However, relatively few such PhDs have been funded. In 2015, 16 such grants were awarded, compared to 447 'standard' individual doctoral grants. This situation in part reflects the greater difficulty inherent to organising doctoral training in a co-operative partnership with business, compared to a purely 'academic' PhD. Moreover, in Portugal, as we discuss below, the capacity of the business sector to host PhD students and participate actively in PhD training is lower than in countries with more developed high-technology sectors in the economy. Finally, a number of interviewees consulted during the Review argued that the criteria used by the FCT panels to select industrial PhD candidates remained excessively academic and failed to take into account the specificities of PhDs in the business sector.

A strong tradition of internationalisation on which to build

Doctoral training in Portugal has long had a strong international dimension. Historically, the FCT allocated a significant proportion of its PhD scholarships to individuals pursuing their doctorate abroad. As shown in Table 6.4 this was the case for over 40% of scholarships awarded in 1995. Over time, this pattern has changed, with only 2% of scholarships awarded for PhDs abroad in 2015. In parallel, there has been an increase in the frequency of 'mixed' PhDs, based in Portugal, but with part of the study/research period spent in another country. Mixed PhDs accounted for almost a third of FCT PhD scholarships in 2015. 'Mixed' PhDs offer considerable potential for doctoral candidates to gain valuable international experience and to benefit from additional international input to their work. Co-operation in PhD supervision also strengthens international links between staff and institutions. Provided such PhDs are based on a genuine partnership between a Portuguese and foreign host institution, this model is a clear example of good practice.

Table 6.4. Location of PhDs supported by FCT scholarships

Year of application	Total	Portugal	Abroad	'Mixed'
1995	554	268	237	49
2005	1 195	709	225	261
2010	1 680	1 041	207	432
2011	1 631	1 008	155	468
2012	1 252	851	92	309
2013	685	449	36	200
2014	877	556	28	293
2015	894	595	18	281

Source: Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*) (FCT).

In the years 2013-2015, around 15% of all FCT doctoral scholarships were awarded to non-Portuguese nationals, although available data does not indicate whether these individuals moved to Portugal for their PhD or where already in the country. OECD data for 2015 indicate that 21% of those enrolled at doctoral level in Portugal were international students, who had moved to Portugal to study (OECD, 2017b). This compares to 43% in the United Kingdom, 42% in Belgium, 36% in the Netherlands, 25% in Ireland and 20% in Finland. Over half of the international doctoral students in Portugal came from Brazil, with other major "ending countries" being Angola, Mozambique, Iran, the People's Republic of China, and Italy. This demonstrates that Portugal already has the capacity to attract considerable numbers of international students.

Undiversified and unstable public funding for doctoral training

The design of Portugal's funding for doctoral training has strengths and weaknesses, notably in relation to directing money to priority areas and promoting high quality doctoral training experiences. Broader concerns are the considerable instability and unpredictability in the flow of public resources for doctoral training – in volume and the type of instruments used to allocate funding – and the concentration of public funding and decision-making responsibility in the FCT.

The number of doctorates supported by the FCT fell from over 2 000 in the year 2007 to below 700 in 2013, before recovering. In parallel, the FCT 'experimented' with directing funding through doctoral programmes in 2012 and 2013 (while maintaining a smaller centralised call for individual scholarships), before progressively reverting back to the award of individual scholarships from 2016 onwards. As discussed, the FCT account for the vast majority of funding for PhDs in Portugal. Although some private or non-profit organisations, such as the Calouste Gulbenkian Foundation, fund scholarships for doctoral training, these remain limited, while there appears to be no tradition in Portugal – in contrast to many other OECD countries – of universities awarding scholarships using their own funds or funds raised through external business or non-profit partners.

The instability in the volume of funding has created difficulties for prospective students and institutions, with success rates for applications falling considerably over time. The changes in funding instruments (doctoral programmes vs. centralised calls) appear to reflect concerns on the part of government and the FCT about how much discretion should be devolved to universities in attributing funds. While doctoral programmes give institutions more flexibility, some interviewees expressed concern that selection at programme level may be less rigorous and that centralised calls based on excellence are 'fairer'. Experience

from other OECD countries suggests that Portugal is not alone in facing this question, but that most governments have opted to devolve greater discretion to institutions, even when Research Councils maintain national competitions for individual scholarships.

Policy issue 6.2. Employment opportunities for doctoral graduates in Portugal

The results of the latest survey on the Careers of Doctoral Holders (CDH) in Portugal presented above have limitations. In particular, they are likely to under-estimate the numbers of doctoral graduates working in the business sector and do not provide information about the numbers and activities of doctoral graduates qualified in Portugal who work abroad. It is harder for surveys such as CDH to identify and reach doctoral graduates working in the business sector as they are more dispersed and less readily identifiable and contactable. Nevertheless, the CDH results provide the best available information about the employment of doctoral graduates and correspond to a large extent to observed patterns and trends reported to the Review Team by stakeholders in Portugal.

Few opportunities for doctoral graduates in the academic sector

The results of the CDH 2015 survey show that the recent doctoral graduates are far less likely to work in the academic sector than those who graduated in previous years (Table 6.3). Recruitment freezes, resulting from decreased or stagnating funding, and delayed retirement have meant most PhD graduates have, at best, only been able to work in the academic sector by accessing precarious, grant-based post-doctoral positions (also funded by the FCT), the impacts of which are discussed in the next chapter. The government is in the process of creating contractual positions for post-docs (ending the previous grants-based system). However, notwithstanding this development and a likely increase in recruitment by universities, polytechnics and research centres as funding levels are increased, the academic sector will only ever be able to absorb a small proportion of those graduating with doctorates each year.

The new individual competition for post-doctoral contracts run by the FCT aims to support 500 post-doctoral positions in its first year. If the number of individuals graduating with a PhD remains stable, at around 2 300 per year, and assuming that post-doctoral positions are the main route through which new PhD graduates can enter academia and the number of junior post-doctoral contracts offered each year remains stable, this leaves at least 1 800 PhD graduates a year who will need to find work in other parts of the Portuguese economy or abroad. This calculation ignores the fact that existing Portuguese and international PhD graduates will be competing for the 500 junior post-doctoral positions and the possibility that some new PhD graduates might transition directly into an academic post.[16] Given the comparatively low probability of the latter scenario, these two factors might be assumed to cancel each other out. The question is therefore: what should the roughly 1 800 new PhD graduates a year do instead of pursuing a career in academia?

Limited absorption capacity of PhDs in the wider economy

Hitherto, PhD graduates in Portugal have found it relatively difficult to find relevant employment in the private sector and public sector outside higher education and research. This situation is primarily a reflection of the structure of the Portuguese economy, which is dominated by micro-businesses and specialised in low and medium-technology sectors. Discussions with stakeholders also suggest it reflects a tradition of limited co-operation between academic research and productive sectors and public services, which means that

many business leaders are unaware or unconvinced of the need for highly qualified research staff. Poor management skills and limited awareness of opportunities for innovation and productivity gains in the Portuguese business sector are a key issue highlighted in the most recent OECD Economic Survey of Portugal (OECD, 2017c)

In addition to these core issues, as discussed in the preceding sections, there is in many cases limited direct alignment between the thematic focus of PhDs and possible applications of this knowledge, and associated skills acquired by PhD holders, in the wider economy. Although, as noted above, any strategic prioritisation of thematic areas for doctoral training must adequately safeguard study fields without direct links to the economy (a core aspect of basic research), there is clearly scope to increase the focus on PhD training with direct application in the wider economy.

A lack of strategic focus on brain drain and its impacts

Reliable data on the level of out-migration from Portugal by highly educated individuals is not available. Data on inward migration in selected countries in Northern Europe, as well as anecdotal evidence from stakeholders in Portugal, suggest that significant numbers of highly qualified Portuguese graduates do leave the country to work in the private sector and academia elsewhere in the world.

There is a line of argument that highly skilled individuals who move abroad still benefit their home country (or the country of their education) through financial remittances and the creation of international networks which benefit the home country in the longer term. While there is some truth in this, the emigration of large numbers of highly skilled people is fundamentally problematic for countries, as skills are lost to the domestic economy and national investment in skills development by the country of origin primarily benefits the destination country.

Although the current economic recovery in Portugal is likely to increase employment opportunities in the country, the risks associated with ‘brain drain’ should not be ignored in planning research and innovation policy. Improving the availability and attractiveness of career opportunities in Portugal in the academic and private sectors must be a core element in any national response to brain drain. In addition, however, the domestic absorptive capacity for doctoral graduates should be taken into account to a greater extent in determining the numbers of PhD places to fund.

6.4. Recommendations

Recommendations on aligning PhD capacity and needs

6.1. Ensure closer alignment between allocation of PhD funding and national research priorities and skills development needs

Portugal has hitherto awarded funding for PhD training based on an assessment of the scientific excellence of applications for individual scholarships or doctoral programmes, with funding allocation between scientific fields based on historical allocations and an aspiration for balance between disciplines. Although it is important to maintain some demand-driven public support for doctoral research across fields, the current system limits the scope for the FCT to direct funding to develop Portugal's high-level skills in priority areas. Funding PhDs in areas where there is little demand for graduates is not only a poor use of public money, but encourages individuals to pursue a training and career path that diverts them from more productive options and may ultimately lead to frustration and disappointment.

It is challenging to predict the number of PhD graduates Portugal requires each year to develop research capacity further and meet the requirements of the country's science base and economy. Given available evidence on the employment outcomes of PhD graduates from Portugal, the number of graduates per capita in international comparison and the level of public funds available, it appears reasonable to continue to maintain the number of publicly funded PhD fellowships at around the current level (i.e. around 1 500 a year). There is no compelling evidence that would justify an increase in the number of grants beyond this, particularly in light of the overall constraints on public spending.

Within this overall level of public support, Portugal should ensure PhD funding is reserved for the 'brightest and the best' and target its public support for doctoral training more rigorously on fields of knowledge that have been identified as national priorities. Prioritisation of some fields will inevitably mean other fields are deprioritised. As part of a wider reform of FCT funding for PhD training (see also next recommendation), the FCT should reserve a greater proportion of its training budget for PhDs in fields which the country has identified as specific priorities or where there is an identified need to develop high-level specialists. This prioritisation should be identified in the national strategic frameworks discussed above. Priority fields could be promoted either through dedicated priorities in centralised calls for individual scholarships, or dedicated resources for doctoral programmes in priority fields (the UK's Centres for Doctoral Training (CDT) could be a useful reference model in this respect).

6.2. Direct more public funding for PhDs to higher education institutions through reformed support for doctoral programmes

Decision-making responsibility for selecting PhD candidates for public funding has historically been concentrated in the FCT. This leads to a situation where the FCT has prime responsibility for 'picking winners' by selecting the individuals best suited to pursue a doctoral degree. Other OECD countries tend to distribute responsibility for selecting doctoral candidates for funding more widely, notably by giving individual doctoral schools and departments freedom to select candidates for some or all publicly funding doctoral training places.

Portugal has experimented with providing funding to institutions through contracts for doctoral programmes, with selection of candidates devolved to institutions. This model appears to have been effective in creating innovative doctoral partnerships in areas of strategic importance to the country. Hitherto, however, these doctoral programmes have not used to support wider institutional strategies and strengthen differentiated institutional research profiles. Moreover, the calls for doctoral programmes in 2012 and 2013 almost certainly supported too many programmes, with too few students in each programme to achieve the real benefits of cohort training.

As part of the wider reform of support for doctoral training, the FCT should allocate at least half of the resources it has available to institutions to operate doctoral programmes. Funded programmes should have certain shared characteristics:

a. They involve partnerships between universities (and potentially polytechnics) and relevant research centres with developed profiles in the fields in question, allowing expertise to be pooled and critical mass to be created.

b. They have an annual entry cohort of at least 10 doctoral students (with exceptions allowed for specific niche fields where this would be unrealistic) to allow efficient delivery of common training elements and cohort benefits for candidates to be realised.

c. They include a set of relevant common training components, including a focus on transferable skills sets relevant to careers outside academia.

d. They have in place well-developed mechanisms to provide mentoring and career guidance to doctoral candidates.

Devolution of responsibility to institutions for selecting candidates for PhD funding should be accompanied by strengthened mechanisms of external quality control to ensure high standards are delivered in practice. As part of the new system of institutional accreditation, A3ES should require all higher institutions wishing to offer PhD programmes to demonstrate that they meet high quality standards for doctoral training. The standards to guide this aspect of accreditation should be devised by A3ES in consultation with FCT and institutions. The standards should accommodate different forms of doctoral training to promote diversity of provision and take into account factors including:

a. the alignment of the doctoral programme to the institution's institutional profile

b. the extent to which staff running the programme are performing with success as researchers/innovation partners, as evidenced by relevant publications, collaboration with business, etc.

c. opportunities for doctoral candidates to collaborate with researchers and research groups in other countries

d. past performance on rates of attrition and time to completion in existing or similar programmes in the institution

e. evidence of the employment outcomes of past doctoral graduates from the programmes / departments in question, including in the non-academic sector.

Recommendations on developing employment opportunities for doctoral graduates

6.3. Develop tailored selection and quality criteria for doctoral training programmes in the business or wider public sectors

Through its support to individual PhD candidates and doctoral programmes, the FCT should seek to increase the number of doctoral candidates undertaking their PhD in a business or other non-academic setting. The selection criteria and general requirements for FCT-supported doctorates appear not to be adequately tailored to the needs to PhDs that are not based in universities and research centres. As such, the FCT should review the relevant selection criteria and conditions in consultation with representatives of businesses and public sector organisations that would be susceptible to hosting PhD candidates. The CASE scholarships used by UK Research Councils could be a useful reference point.

Given the composition of the Portuguese economy and the limited number of businesses likely to be able to host PhD candidates in the short to medium-term, it is also important that adequate opportunities are given to undertake PhDs in public sector organisations (hospitals, public service organisations and ministries) which potentially have considerable capacity to provide appropriate environments for PhDs researchers.

6.4. Maintain and expand the practice of supporting 'mixed' PhD scholarships

The Review Team considers that the model of 'mixed' PhD scholarships, whereby the doctoral candidate spends part of their PhD training period abroad is an example of good practice that should be maintained and strengthened. Mixed PhDs provide individuals the opportunity to gain valuable international experience and exposure to expertise and experience that are not necessarily available in Portugal. As such, the 'mixed' model should be retained in the reformed system of FCT support, both for individual scholarships and scholarships awarded through doctoral programmes.

6.5. Improve data collection about the career paths of doctoral candidates and graduates, including those who move abroad.

The quality of date available on the academic career paths and subsequent professional development of doctoral candidates and graduates is inadequate to support effective policy making by government and strategy setting by higher education institutions. Improved information is also of vital importance to career guidance services and those considering embarking on a doctoral degree. The absence of information on out-migration by doctoral graduates from Portugal is particularly problematic.

As a first step, the Portuguese authorities should require any doctoral candidate supported by the FCT to provide regular updates on their careers as a condition of funding. A suitably simple questionnaire system, respecting relevant privacy legislation, should be developed. The system could be open to students and graduates not supported by the FCT on a voluntary basis. Data collected should be used to undertake regular assessment of the results and impact of FCT funding for doctoral training.

Notes

[1]. Basic research is the component of R&D – alongside applied research and experimental development – comprising experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. In 2015, over 60% of basic research (measured in terms of domestic research expenditures) was performed in the higher education or government sectors in all OECD countries for which data is available, with the exceptions of Chile, Switzerland, Japan and Korea.

[2]. Internationally comparable data on the level of qualification of researchers and R&D personnel are available for only a limited number of OECD countries. These data nevertheless highlight wide variation between countries in the proportion of researchers with a PhD. While in Poland and Slovakia over half of researchers had a PhD in 2015, the proportion in Austria was 27%. The equivalent figures for Spain and Portugal in the same year were 43% and 38%.]

[3]. This estimate is based on the Survey of the Careers of Doctorate Holders (CDH) undertaken in Portugal in 2016, with the reference date of 31 December 2015. Owing to the difficulty of identifying doctoral holders, the survey is likely to under-estimate the number of doctoral holders working outside the academic and public research sectors.

[4]. The Technical University of Lisbon merged with the University of Lisbon in 2013.

[5]. Accreditation decisions are published on the A3ES website: http://www.a3es.pt/en/accreditation-and-audit/accreditation-process-results/accreditation-study-programmes

[6]. Doctoral candidates in receipt of a scholarship are required to submit an application for renewal a minimum of 60 days before the beginning of the new academic year.

[7]. In the absence of data on the funding status of each PhD student and graduate, it is not possible to calculate an exact figure. Comparing scholarships and graduates is problematic, as it fails to take into account a) students with FCT funding who extend their PhD (possible in exceptional circumstances) and b) students without FCT scholarships who did not complete their PhD and thus do not appear in the graduation figures.

[8]. The classification of fields of education is that used by the FCT, which differs from the standard ISCED classification.

[9]. Eurostat – Employment rates by sex, age and educational attainment level (%), . https://ec.europa.eu/eurostat/web/products-datasets/product?code=lfsq_ergaed

[10]. Separate LFS data for doctorate holders is not available due to the small number of doctorate holders in the LFS sample.

[11]. '*Integrado em empresa/prestação de serviços*' – 'integrated into business/service delivery'.

[12]. Statistics Portugal. Average annual gross earnings (Remunerations for the entire year €) by occupation; Quadrennial – MTSSS/GEP, Complementary survey on earnings structure.

[13]. A total of EUR 61 498 324.34 have been allocated to the FCT for doctoral and post-doctoral grants from the ESF Human Capital Operational Programme, corresponding to 85% of a total planned investment of EUR 72 350 969.81 (Autoridade de Gestão do Programa Operacional Capital Humano, 2017).

[14]. Government of Ireland Postgraduate Scholarship Programme 2019, Irish Research Council, http://research.ie/funding/goipg/

[15]. http://www.nerc.ac.uk/funding/available/postgrad/responsive/dtp/

[16]. Analysis of the age profile of core academic staff in public and private universities (DGEEC, 2017 shows around 3 100 career academics are over 60 and thus certain to retire at some point in the next 10 years. This should free up around 300 positions in more junior posts each year, provided employment levels remain broadly stable.

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Chapter 7. Academic careers

Academic staff are the backbone of the higher education and public research systems across the world. This chapter explores the development of the academic profession in Portugal and the challenges faced by current and aspiring academics. Academic staff in Portugal's universities, polytechnics and research centres are better qualified than ever before. However, openings for permanent academic positions are scarce and many junior academics work in comparatively precarious post-doctorate positions with limited opportunities for career progression. Systems within institutions for evaluating and rewarding good performance by staff are underdeveloped and rigid employment rules make it harder for individuals to develop specialised professional profiles. While the Portuguese government has taken steps to address some of these issues, this chapter argues that sustained efforts are required to create conditions where academic staff can fully exploit their skills for the good of their institutions and the country at large.

7.1. Introduction

The effectiveness of the higher education and public research system depends fundamentally on the staff who work in institutions and research units. Having well-trained, motivated staff is a pre-requisite for any effective system. This chapter examines the structure and operation of academic careers in Portugal, with a focus on three key aspects: entry to academic careers; the profile of academic positions, rewards and progression possibilities; and mobility between positions, international openness and retirement.

In relation to these three areas, the key questions addressed by the review include:

1. **Career planning and entry**. Do researchers who seek higher education and public research positions have an opportunity to anticipate career openings and plan their training accordingly, and an opportunity to effectively compete for the full range of posts available across Portugal's higher education and public research system?
2. **The structure of careers**. Does the legal framework governing academic and research careers provide staff with an opportunity to choose a career profile that suits their interests and abilities; to be evaluated and rewarded for their contributions to their institution, community, and the wider society; and to advance in recognition of their achievements?
3. **Career mobility, international attractiveness and retirement**. Has Portugal established a career system that encourages beneficial mobility of researchers and academics between higher education institutions within Portugal, is able to attract researchers from outside Portugal, and can retain those who might consider leaving? Does the career system permit researchers and academics to adjust their responsibilities in the course of their career, and retire from service in a timely way?

7.2. Context

7.2.1. Entry to academic careers: post-docs and early-stage researcher posts

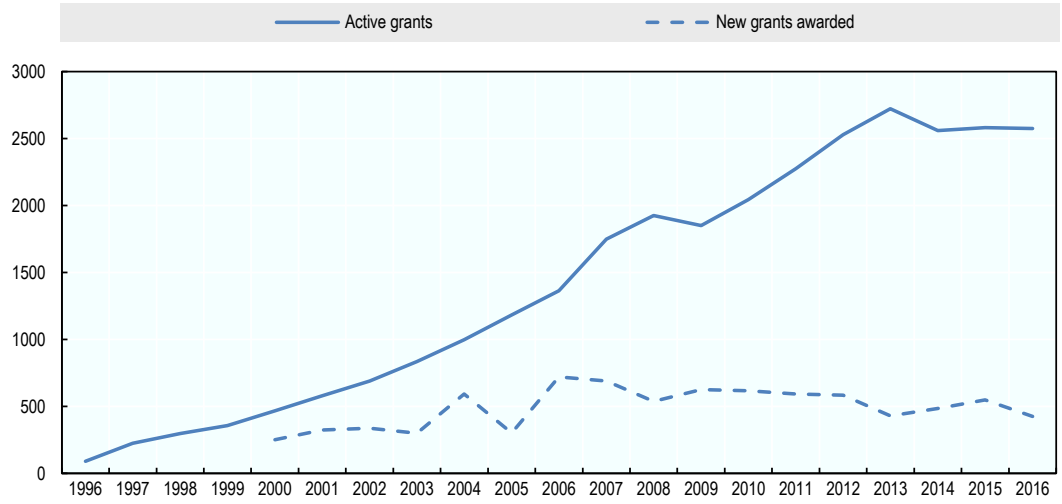
In Portugal, as elsewhere in the OECD, post-doctoral positions are a common first step in a career in academia or the public research sector. Indeed, research (and to a lesser extent teaching) experience gained through work as a post-doc has become a *de facto* pre-requisite for obtaining a permanent academic position in the higher education and research sectors.

Post-docs in Portugal have not traditionally been salaried employees of higher education or research institutions, as is the case in some OECD countries, but have rather had the specific status of research fellow (*bolseiro*) and been reliant on stipends (FCT, 2013). Until changes in 2016, the Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*) (FCT) funded a large proportion of post-doctoral fellowships in Portugal directly through annual calls for applications. FCT post-doctoral fellowships (*Bolsas de Pós-Doutoramento* – BPD) were awarded for a period of up to six years to candidates already holding a doctorate (preferably obtained within the previous six years). A mid-term evaluation of progress was required after the first three years. Additional post-doctoral stipends have also been – and continue to be – awarded *directly* to individuals by higher education institutions, FCT-supported research institutes and non-profit research institutions, often funded from the budgets of specific research projects financed by national or European programmes.

From 2004 onwards, the FCT awarded between 400 and 700 post-doctoral fellowships a year. The cumulative effect of this was a steady increase in the total number of FCT-funded

post-doctoral positions, with the number of post-docs in receipt of FCT funding reaching a peak of over 2 700 in 2013, before falling to 2 574 in 2016 (Figure 7.1).

Figure 7.1. FCT post-doctoral fellowships: number of active grants and new awards



Source: Fundação para a Ciência e a Tecnologia (FCT), 2017a.

In their responses to the 2015 survey of doctorate holders in Portugal (DGEEC, 2017a), 4 397 doctorate holders (over 15% of total respondents) stated they had the status of post-doctorate fellow (*bolseiro*), of which over 90% worked in the higher education sector. If accurate (the survey is based on self-reported information), this would mean that there were around 1 800 further post-docs working in Portugal in 2015, in addition to the 2 581 individuals with active FCT post-doctoral fellowships in that year.[1] As *bolseiros* are not counted in a separate category in centrally collected staff statistics for higher education institutions and are dispersed across a range of different types of institution in the country, it is impossible to verify the figures from the Careers of Doctoral Holders survey.

In addition to funding post-doctoral fellowships, the FCT has also run programmes to support the employment of early stage researchers already having completed a period as a post-doc. The *Ciência* programme[2], which operated between 2007 and 2009, created 1 200 posts, funded for up to five years and with hiring decisions for these posts made by institutions following conclusion of a 'programme-contract' with the FCT. In 2012, the '*Investigador FCT*' programme[3] was launched as a follow-up to *Ciência*. This supported a total of over 800 positions through four annual calls between 2012 and 2015, selection for the last of which was concluded at the end of 2017.[4] *Investigador FCT* provided funding for salaries and 'start-up' funds for early stage researchers in three categories ('initial', 'development' and 'consolidation'). Selection of candidates was based on individual research proposals and co-ordinated centrally through international panels appointed by the FCT, with five-year contracts for successful candidates signed by host institutions (either higher education institutions or research centres).

Box 7.1. New measures to promote scientific employment

The new FCT initiative to promote scientific employment launched at the end of 2017, encompassing implementation of Law 57/2017, will ultimately comprise the following components:

1. Individual competitions – funding for individual post-doctoral applicants, with annual competitions, the first of which was opened in January 2018. This follows a model similar to Investigador FCT, whereby applicants identify a host institution (an FCT-recognised R&D unit), but apply centrally to the FCT, which co-ordinates the selection process and awards funds to the host institution to cover the costs of the contracts for successful candidates. Four categories of (post-doctoral) researcher will be supported: a) junior researchers (PhD graduates without experience – previously supported by fellowships); b) assistant researchers (at least five years' experience since PhD); c) principal researchers (additionally demonstrating three years of 'scientific independence'); and d) co-ordinating researchers (additionally having successfully demonstrated advanced independent research capacity through the agregação exams and demonstrated leadership in the scientific area in which they are applying).
2. Institutional competitions – funding awarded by the FCT to institutions to support R&D activities that create contractual positions for doctoral researchers, with annual competitions and selection of candidates organised at institutional level.
3. Scientific employment plans forming part of the 2017-2018 evaluation process for R&D Units funded by the FCT.
4. Contracts established under the transitional rule of Decree Law 57/2016, amended by Law 57/2017. The FCT will finance the cost of an employment contract for each existing post-doc (bolseiros) who was in receipt of a fellowship funded directly or indirectly by the FCT on 1 September 2016 and who has completed at least three years in post. Appointments to each post created will be made through open competitions to which all eligible candidates can apply.
5. Research projects – there will be 1 618 R&D projects funded in 2017 each of which should support hiring of at least one doctoral researcher.

In 2016, the government announced its intention to replace both the *Investigador FCT* programme and the system of post-doc fellowships from 2017 onwards, with a new initiative to foster scientific employment and access to research careers in Portugal (Box 7.1). The legal framework for this new initiative was adopted by Parliament in July 2017.[5] A key objective of the reform has been to provide more stability and better social protection[6] for post-doctoral fellows by providing them with salaried positions with regular employment contracts, rather than stipends as previously. The new legal regime obliges public higher education and research institutions and those in receipt of public funds to open a competitive recruitment procedure to employ post-doctoral researchers for each post-doc who has been working in their institution (funded by a stipend) for at least three years. Funding for the new positions is initially provided by the FCT.

7.2.2. Academic careers in Portugal

The core academic workforce in Portugal is composed of professors, lecturers and researchers working in the country's public and private higher education institutions and publicly funded research units. Academics and other staff categories in public institutions have historically been – and in most cases remain – civil servants (*funcionários públicos*), with contracts aligned to the legislation covering employment in the public sector more generally.[7] Public institutions that have moved to foundation status (see Chapter 3.) can appoint academic and other staff using private law contracts, governed by the general Portuguese Labour Code[8] that applies to employees in the private sector. Staff in private institutions are employed exclusively under private law.

Specific provisions relating to the organisation of academic and research careers in public sector institutions are set out in specific legislation for university teaching staff,[9] polytechnic teaching staff[10] and researchers.[11] In 2009, a major reform of the legislation governing careers in universities and polytechnics introduced greater consistency between the two sectors, including the requirement for most polytechnic teachers to hold a PhD. The overall legal framework for higher education institutions in Portugal[12] further provides that academic staff in private institutions should be guaranteed careers that mirror those in the public sector.

The legislation on academic careers defines the roles, requirements and recruitment procedures for different academic staff categories. For university teachers, polytechnic teachers and researchers, there are three career main academic grades, which are designed to be equivalent across the three sectors (Table 7.1). Since the 2009 reforms, full-time career academics in these positions are required to hold a PhD. In the polytechnic sector, while the new default position is that teaching staff in all the core academic grades shown in Table 7.1 requires a PhD, the 2009 legislation also created the title of 'Specialist' to allow non-PhD holders with relevant professional experience to teach. To obtain this title, individuals with significant professional experience in a relevant area of polytechnic education are required to pass examinations organised by a consortium of polytechnic institutions.[13]

Table 7.1. Core academic grades in Portugal

University careers	Polytechnic careers	Research careers	Remarks
Professor catedrático (Full) professor	*Professor coordenador principal* Principal co-ordinating professor	*Investigador-coordenador* Co-ordinating researcher	Requires *Agregação* (Habilitation)
Professor associado Associate professor / Senior lecturer	*Professor coordenador* Co-ordinating professor	*Investigador principal* Principal researcher	
Professor auxiliar Assistant professor / lecturer	*Professor adjunto* Adjunct professor / lecturer	*Investigador auxiliar* Assistant researcher	'Experimental' period of five years, after which post can become permanent

Source: Sindicato Nacional do Ensino Superior (SNESup) (2018).

Academic staff in all sectors are appointed through public competitions and, as a general rule, full-time staff should receive unlimited contracts once they have successfully completed standard probationary periods. In practice, alongside permanent teaching staff and researchers (*docentes* or *investigadores de carreira*), academic staff can also be hired

at any of the three core academic grades on fixed term contracts, usually on a part-time basis. These staff members are referred to as 'specially contracted' or 'invited' staff (*docentes convidados).*[14] If, in exceptional cases, 'invited' staff members are appointed on a full-time basis, the maximum duration of their contract is limited to four years.

In addition to the core academic grades, a large number of individuals are employed across all sectors on a fixed-term, part-time basis as junior lecturers (*assistentes*). Often, *assistentes* are doctoral candidates, who supplement their income through teaching. Other staff categories include bachelor or master's students employed as part-time teaching assistants (*monitores*).

A final distinction is made between academic staff who work exclusively for their institution – a status called 'exclusive dedication' – and those who also take on other work alongside their academic position (such as private consulting or work in a second institution), even when this is nominally a 'full-time' position. Exclusive dedication is considered the default status for academic staff in the relevant legislation. Staff working under the rules of exclusive dedication receive the highest salaries in their respective grades. Those working full-time, but without the commitment to exclusive dedication (simply '*tempo integral'* – full time) receive two-thirds of this salary and those working part-time receive a salary calculated pro-rata on the basis of the *tempo integral* salary. As shown in Table 7.2, gross monthly salaries for academic staff in the public sector with 'exclusive dedication' are consistent across sectors and range from around EUR 2 300 for the lowest paid *assistentes* to EUR 5 400 for the highest paid full professors.

Table 7.2. Salaries for academic staff in the public sector in Portugal

Basic gross monthly salaries in euros (2018)

Academic grade	Step 1	Step 2	Step 3	Step 4
Full professor (Professor catedrático) *Principal co-ordinating professor (Professor coordenador principal)* *Co-ordinating researcher (Investigador-coordenador)*	4664.97	4910.49	5074.17	5401.54
Associate professor (Professor associado)* *Co-ordinating professor (Professor coordenador*)* *Principal researcher (Investigador principal*)*	3601.03	3764.71	4092.08	4255.76
Assistant professor (Professor auxiliar)* *Assistant researcher (Investigador auxiliar*)*	3191.82	3437.34	3764.71	4010.23
Adjunct professor (Professor adjunto) (Polytechnics)*	3028.14	3191.82	3437.34	3682.87
*Research Assistant (Assistente**)*	2291.56	2373.40	2537.09	

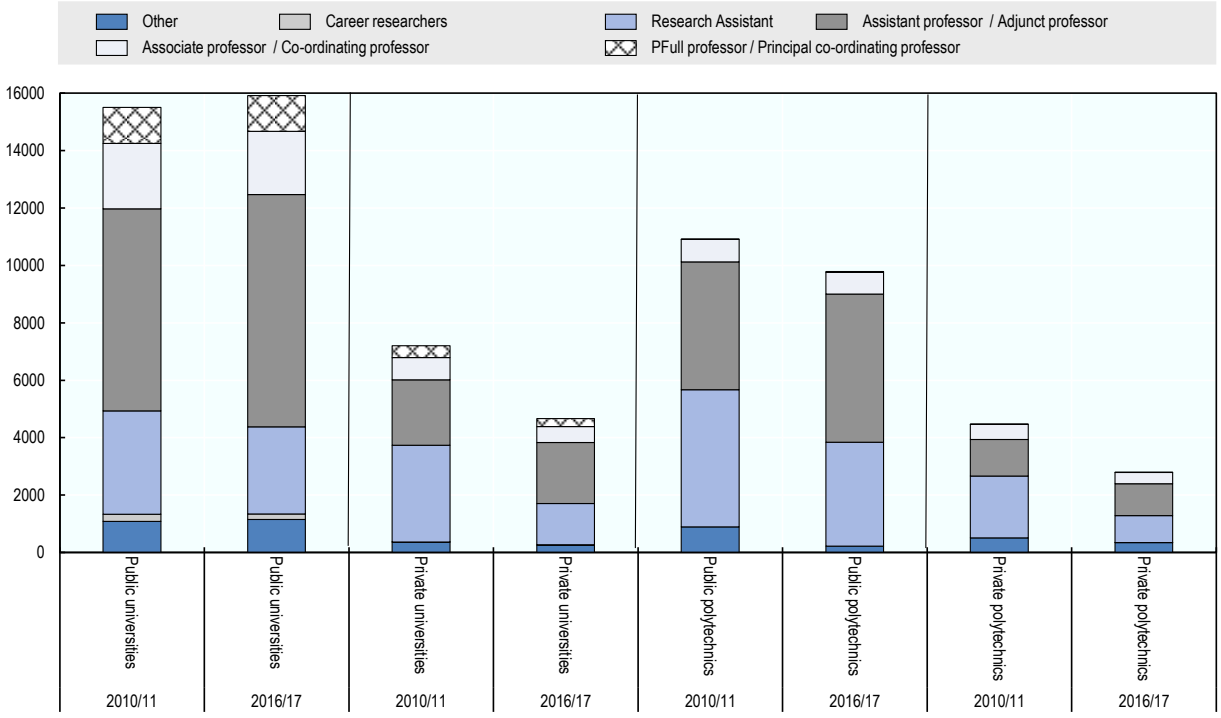
Note: * without *Agregação*; ** with Master's or Doctorate; All salaries are for staff with the status of 'Exclusive dedication'.
Source: Sindicato Nacional do Ensino Superior (SNESup) (2018).

As a result of the fiscal consolidation implemented in the wake of the sovereign debt crisis, the Portuguese government implemented generalised salary cuts in the public sector, which also affected staff in public universities and polytechnics. In 2011, basic salaries for all teaching staff were cut by 10% and holiday pay reduced. Salaries were then frozen at the lower level for the subsequent years. Further cuts were proposed in 2014, but not implemented. It was only over the course of 2016 that staff salaries were progressively raised again to pre-crisis (2010) levels, where they remain at the start of 2018.

In 2016-2017, a total of 33 160 academic staff were employed in higher education institutions (head count). By far the largest number of teaching faculty is in public universities, followed by public polytechnics. The smallest number of teachers is in private

polytechnics. The total headcount in 2016-17 represents a 13% fall in employment from a peak of over 38 000 reached in 2010-11 (DGEEC, 2017b).

Figure 7.2. Evolution of staff numbers (head count) by staff category and sector



Source: Direção-Geral de Estatísticas da Educação e Ciência, DGEEC, 2017b (Table 5).

As shown in Figure 7.2, in public universities, staff numbers and the distribution of posts between staff categories have increased slightly over the last five years, although the increase in absolute numbers masks a small decline in full-time equivalent (FTE) posts. In the same period, total staff numbers fell by over 10% in the public polytechnic sector, by 35% in private universities and by 37% in private polytechnics. Across the sectors that experienced a decline, the greatest numbers of posts have been lost at the *assistente* level. There were lower rates of decline or even modest increases in the top three academic staff categories in the public and private polytechnic sectors, characterised by higher numbers of permanent staff and greater job security. In the private university sector, however, the number of full professors fell from 406 in 2010-11 to 278 in 2016-17. Moreover, since the 2009 reforms, when the post was created, only 44 people have been appointed to the highest rank of 'principal co-ordinating professor' in the public and private polytechnic sectors.

In the public university sector, 29% of assistant professors; 14% of associate professors and 13% of full professors are employed as 'invited' staff, meaning they work part time or full time on a fixed-term contract of at most four years' duration. In the public polytechnic sector, 44% of adjunct professors and 5.5% of co-ordinating professors have 'invited' status (DGEEC, 2016a and 2016b). In the public university sector in 2015-16, only 23% of full professors and a third of associate professors were women. In the same academic year, in the public polytechnic sector, the gender ratio was generally more balanced (48% of the 781 co-ordinating professors – the second most senior rank in polytechnics – were women, for example). Of the 21 principal co-ordinating professorships created in public

polytechnics up to 2016, 15 were held by men. This pattern of gender balance in the public sector was mirrored almost exactly in the private university and polytechnic sectors.

Between 2010-11 and 2016-17, the proportion of teaching staff (all categories) with a PhD increased in the public university sector from 68 to 74%, in private universities from 42 to 61%; in public polytechnics from 21 to 44%; and in private polytechnics from 21 to 35% (DGEEC, 2017b: Table 7). This shift reflects the requirement, created in 2009, that an applicant have a PhD to enter a teaching career in a polytechnic. The same rules guarantee a position in a teaching career to all current polytechnic teachers who finish their doctorate in a specific time. Some of this increase also likely reflects the decline in positions in recent years at private institutions where a PhD is less common.

7.3. Assessment

Policy issue 7.1. Career planning and entry: queuing and inbreeding

Limited employment opportunities, precarious contracts and unrealistic expectations

Access to academic careers in Portugal has become increasingly difficult in recent years as a result of increasing supply of potentially qualified candidates for academic positions and falling demand for new academic staff from the higher education and public research sector. As discussed in Chapter 6, on the supply side, the number of individuals graduating with a PhD in Portugal each year has increased significantly, from around 1 000 in 2005 to almost 2 350 in 2016. Over the same timeframe, total enrolment in higher education in Portugal[15] fell by over 6% (from around 380 000 in 2004-05 to 356 000 in 2015-16) and the total number of teachers and researchers in higher education institutions – with all teaching and career researcher categories combined – declined by around 10% between 2004-05 and 2016-17 (DGEEC, 2017b).

Since a peak in the total number of posts in 2010-11, almost 5 000 posts have been lost in Portuguese universities and polytechnics. Three-quarters of these have been in the private sector and 90% at junior lecturer (*assistente*) level – a staff category that does not require a PhD and is, by definition, employed on fixed-term contracts. However, there has also been a decline in the number of staff employed in core academic grades in universities and polytechnics. As shown in Table 7.3, staff numbers in these core grades in the private sector declined by over 16% between 2010-11 and 2016-17. The decline in the number of posts, seen across all core staff categories in private institutions, resulted from contracts for 'invited' teachers not being renewed, non-replacement of staff who retired and, in some cases, permanent staff being made redundant. In the public sector, the picture has been more mixed. Here, there was an increase in the total number of posts in core academic grades, with a 14% increase in the number of posts (almost 1 600 additional posts) at the entry-level positions levels of *professor auxiliar* (in universities) and *professor adjunto* (in polytechnics).

Table 7.3. Evolution in staff numbers by core academic grade

		2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Change in number (2011/12-2016/17)	% change (2011/12-2016/17)
Public Sector	Full professor	1 201	1 222	1 209	1 198	1 224	1 241	40	3.33%
	Associate professor	2 228	2 231	2 174	2 164	2 184	2 203	- 25	-1.12%
	Assistant professor	7 244	7 357	7 404	7 525	7 803	8 101	857	11.83%
	Tenured researchers	283	361	226	226	238	190	- 93	-32.86%
	Principal co-ord. professor	11	18	21	22	21	27	16	145.45%
	Co-ordinating professor	760	765	769	772	781	763	3	0.39%
	Adjunct professor	4 434	4 416	4 466	4 557	4 901	5 159	725	16.35%
	TOTAL Public Sector	**16 161**	**16 370**	**16 269**	**16 464**	**17 152**	**17 684**	**1 523**	**9.42%**
Private Sector	Full professor	385	371	332	304	289	278	- 107	-27.79%
	Associate professor	731	683	640	611	600	554	- 177	-24.21%
	Assistant professor	2 379	2 301	2 190	2 069	2 098	2 134	- 245	-10.30%
	Principal co-ord. professor	5	7	12	12	11	17	12	240.00%
	Co-ordinating professor	557	504	460	387	409	388	- 169	-30.34%
	Adjunct professor	1 292	1 183	1 157	1 056	1 002	1 114	- 178	-13.78%
	TOTAL Private sector	***5 349***	***5 049***	***4 791***	***4 439***	***4 409***	***4 485***	***- 864***	***-16.15%***
	TOTAL	**21 510**	**21 419**	**21 060**	**20 903**	**21 561**	**22 169**	**659**	**3.06%**

Note: Figures in headcount. Research career (*Carreira de investigação*) not included for private universities or private or public polytechnics due to very small numbers of staff involved.
Source: DGEEC (2017a) Inquérito aos Doutorados (CDH – Careers of Doctorate Holders) – Sumários Estatísticos http://www.dgeec.mec.pt/np4/208/.

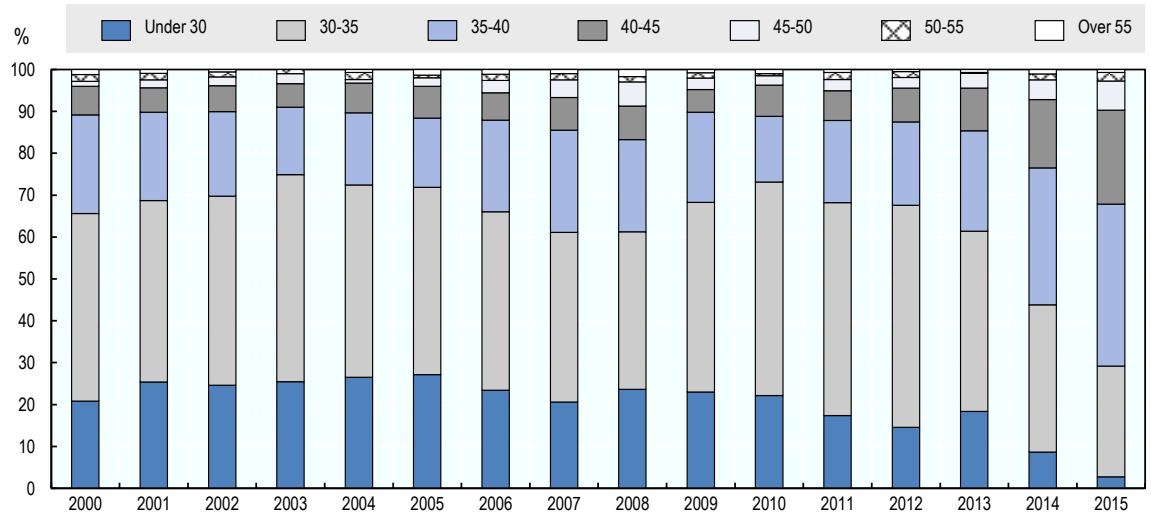
As discussed in Chapter 6, a potentially desirable consequence of the increased flow of new doctorate holders and falling demand in the academic sector has been an increasing tendency for doctoral graduates to seek and find work in other sectors of the economy. A more problematic consequence has been the increase – illustrated in Figure 7.1 – in the number of doctoral graduates in precarious post-doctoral positions, without formal employment contracts and with limited perspectives of obtaining a permanent academic post in the longer term.

In recent years, the population of post-doctoral researchers in Portugal has not only grown, but grown increasingly older. As shown in Figure 7.3, while in 2001 around 70% of beneficiaries of FCT post-doctoral fellowships were under 35 and only around 10% were over 40, by 2015, fewer than 30% of beneficiaries were under 35 and over 30% were over 40. In parallel, the number of applicants rose from 413 in 2001 to 1 935 in 2015. With 324 fellowships awarded in 2001 and 585 in 2015, this represents a fall in the success rate from 87 to 30% (FCT, 2017a, 2017b, 2017c).

It is not possible to determine what proportion of doctoral graduates in Portugal would ideally like to pursue a career in academia. Neither are there accurate data on the proportion of new PhD graduates who obtain a post-doctoral position and the proportion of post-docs who ultimately transition to an academic post. However, the scale of the challenges facing new doctoral graduates and post-docs in Portugal is illustrated in Table 7.4 First, while almost 15 000 new doctoral graduates 'came onto the market' in Portugal between 2011 and 2016,[16] in the same time period, only just over 3 000 post-doctoral positions were funded directly by the FCT: a ratio of 1:5, even before competition for post-doc positions from older and international PhD graduates is taken into account. Second, in the same

timeframe, the number of academic employment opportunities for those completing periods as post-docs – entry level positions as part-time teachers (*assistentes*) and on the lowest core academic grade – fell. Even allowing for promotion and retirement (see below) creating 'replacement positions', realistic opportunities for post-docs and other PhD holders to transition to core academic posts have been (and remain) few and far between.

Figure 7.3. Age profile of beneficiaries of FCT post-doctoral fellowships



Source: Fundação para a Ciência e a Tecnologia, 2017b.

Table 7.4. Academic careers: trends in supply and demand

	From 2011 to 2016
New PhD graduates and new PhDs recognised in Portugal	+14 942
New post-doc fellowships awarded by the FCT	+3 066
Change in total number of *assistente* positions (private and public sector)	-4 948
Change in total number of *professor auxiliar* and *professor adjunto* positions (private and public sector)	+755

Source: DGEEC, 2016c, FCT, 2017a, DGEEC 2017b.

The trends described above are by no means unique to Portugal. In the United States and other OECD countries, for example, there is an ongoing discussion about how to respond generally to the increased number of PhD graduates (see Chapter 5.) and, specifically, to the 'post-doc pile-up' created by expanded use of post-doctoral positions (see Nature, 2015). Across countries, academic research departments, particularly in the natural sciences and engineering, have increasingly come to rely on post-docs as a source of highly qualified, but cheap, labour to staff laboratories and conduct the day-to-day business of research. Although, under the right circumstances, individuals can gain valuable research experience and develop other skills relevant to their future careers, spending prolonged periods as a post-doc has clear disadvantages. Alongside the stress and uncertainty created by short-term contracts (or grants as in Portugal), post-doc positions may lead individuals to specialise too narrowly and leave little time for them to prepare adequately for subsequent transition to a job outside the academic sector – even though this is statistically the most probable outcome for most.

A new initiative to create academic employment opportunities that carries risks

The new initiative to promote scientific employment launched by the government in 2016 (Box 7.1) has the stated aim of creating more and more stable research posts in the academic sector and, in so doing, helping to address the precarious situation of post-doctoral fellows in Portugal. The package of measures involves replacing stipends with employment contracts for new post-docs and obliging higher education institutions to open a contractual position when they have an existing post-doc that has been in receipt of a fellowship for three years or more. The FCT will cover the cost of the newly created contractual position for a period of up to six years, after which time institutions are obliged to open a permanent position. At each step – the initial creation of a contractual position and the subsequent opening of a permanent position – there will be a competitive selection process, open to all qualified candidates.

Key objectives of the new initiative are laudable. First, the move away from stipends to formal employment contracts means new post-docs will benefit from greater stability and better conditions, most notably in relation to accumulation of pension rights. The shift also brings Portugal into line with standard practice in many other advanced research systems. Second, the aim of creating new permanent research positions at different levels (from junior researcher to co-ordinating researcher), rather than temporary post-doc positions, is broadly consistent with recommendations made elsewhere in the world to tackle the 'post-doc pile-up' and enhance the productivity of the research system. A 2014 report of the United States National Academies of Sciences, Engineering and Medicine, for example, recommends shifting the composition of research units in the United States towards a model based on a higher ratio of permanent 'staff scientists' to post-doctoral 'trainees' (National Academies, 2014).

However, the new initiative – and particularly the transitional procedures planned to support existing post-docs – also carries risks. First, for individual PhD graduates and existing post-docs, the new system risks perpetuating unrealistic expectations about the chances of obtaining a permanent academic post and diverting individuals from exploring job options and opportunities in other sectors. Permanent positions in the academic sector will not be opened in the short-term (the system initially creates another set of temporary contracts) and, provided competitions in institutions are implemented – as they should be – in a fair and transparent way, incumbent post-docs are by no means guaranteed to obtain the contractual post that their current fellowship gives rise to.

Second, for the institutions, the transitional regime proposed risks tying (future) resources to existing areas of post-doctoral research activity and restricting opportunities to refocus activities in line with renewed institutional profiles and institutional and national development strategies. In simple terms, institutions may ultimately be forced to create permanent positions in fields where they do not need permanent researchers, thus diverting resources for priority areas. At the same time, the proposed system could compound Portugal's already serious problem of inbreeding, whereby permanent academic staff are trained and pursue a career exclusively in one institution, rather than gaining experience in multiple locations.

Inbreeding already creates its own challenges

Entry to academic and research careers in Portugal is already marked by a high degree endogamy or inbreeding. Institutions have a strong tendency to recruit their own doctoral graduates and staff may go on to pursue their entire career within the same institution. Evidence from Portugal shows that "inbred" scholars produce less research and research of

lower quality than those who have been trained outside the institution in which they make their career (Tavares et al. 2017). Moreover, inbreeding is widely thought to encourage traditionalism, and to endanger excellence and innovation (Altbach et al., 2015). Viewed in comparison to decades past, "recruitment processes in Portuguese academia have been opening up and decisions to hire candidates are increasingly based on merit." However, in spite of the extensive legal reforms adopted in 2009 (Tavares et al., 2017), "formal and informal barriers to open and meritocratic hiring still endure" (Horta, 2013).

Doctoral and postdoctoral students with whom the Review Team met frequently expressed their aspiration to make a career in the institution in which they had been trained. Recent analyses by DGEEC (2017b) shows that 70% of public university faculty received their PhD at the institution in which they hold their appointment, 19% took their PhD abroad and another 10% hold a PhD from a different Portuguese university.

The level of inbreeding varies between and within public higher education institutions. In some organic units more than 95% of those holding career appointments have received their doctorate at the institution, while in others – exceptionally – fewer than 5% have done so. Additionally, there is significant variation in inbreeding by faculty rank. Variation in inbreeding arises from many factors, including exclusiveness (or, near-exclusiveness) of supply, the physical isolation of higher education institutions, the age and reputation of the institution, and norms and practices that favour local candidates.

Policy issue 7.2 The structure of careers: weak differentiation and performance-based rewards

Centralised regulation of staff workloads restricts flexibility and limits specialisation

Careers in public higher education institutions are structured to a large extent by national legal and regulatory frameworks. As well as defining staff categories and selection requirements, the specific legislation dealing with careers for university and polytechnic teaching staff also specifies maximum and minimum ratios for particular grades and staff categories, imposes minimum and maximum teaching hours and contains general guidelines relating to staff evaluation, promotion and pay. Portugal also has the specificity of having a distinct legal basis to regulate research careers, even though university – and increasingly polytechnic – teachers (*docentes*) are expected to conduct research as well as teach. The comparatively detailed regulation of academic careers in law in Portugal creates rigidities in the system, in particular in relation to the way staff use their time and profile themselves.

The legal basis for university careers[17] (Article 71) specifies that university teachers must teach between six and nine hours each week, while the equivalent legislation for polytechnic careers[18] (Article 34) specifies between six and 12 hours teaching per week. Interviewees in many of the institutions visited during the Review visits told the Review team that this centralised regulation of workload created a significant obstacle to staff organising their time and developing their careers effectively. In particular, the uniform weekly teaching requirements mean it is difficult – in the strict sense of the law, at least – for teaching staff to vary their teaching workload over the course of a year or a number of years. This can make it harder to dedicate specific periods to research or for some staff members to profile themselves to a greater extent in research or teaching. Academic staff interviewed during the OECD Review visits expressed frustration that exceptional

contributions to research and external collaboration with firms were not recognised through a re-balancing of responsibilities among faculty missions.

Although the concerns of staff about the inflexibility of the legal provisions are legitimate, the principle that academic staff should both teach and conduct research is both fundamental to the European university tradition and crucial to ensuring high quality research-based instruction in universities and polytechnics. The most appropriate solution would appear to be to introduce more flexibility into the law to allow staff to develop more differentiated profiles, while maintaining the link between teaching and research.

Evaluation, pay-setting and promotion procedures do little to reward good performance

Facilitating the allocation of time to different tasks and objectives is one issue. Ensuring staff are supported and incentivised to perform their tasks well and achieve their objectives is another. According to the legislation governing teaching and research careers, academic staff in Portugal should be subject to a system of continuous performance evaluation.[19] The specific procedures are to be agreed in each higher education institution, after consultation with trade unions. The legislation also specifies that the results of staff evaluations are to be used to inform decisions about contract renewal, conversion to indefinite contracts and individual pay increases (*alteração do posicionamento remuneratório*). No further details about the design of evaluation processes or the link between performance and rewards are provided at national level, other than the legislative stipulation that individuals who are classified in the top performance category for six consecutive years must be granted an individual pay rise.

Few public higher education institutions have provided opportunities for academic staff to collaborate in the design of performance evaluation systems that are well-understood and well-regarded, and that permit faculty members to choose evaluation profiles that align to their preferred career profiles. Those higher education institutions that have chosen to adopt foundation status have the possibility to establish positions under private rather than public law, providing them with an opportunity to establish their own policies with respect to compensation and teaching responsibilities. However, only six institutions have adopted foundation status, and few of those have established alternative career policies for academics holding private law appointments.

Several factors have hindered the widespread implementation of effective performance evaluation and reward systems in Portuguese higher education institutions. As in other countries, the principle of academic autonomy and the absence of any tradition of performance evaluation for staff in higher education have made progress in this area slow. In addition, the rigid national pay scale applied in public institutions, with relatively few pay steps in each grade and comparatively small pay differences between steps (Table 7.2), and the absence of public money to fund individual pay rises in recent years have made it difficult to develop systems of performance evaluation which link performance with financial rewards.

Policy issue 7.3. Career mobility and retirement: low mobility and late retirement

Limited incentives for mobility between institutions in Portugal

Those who hold career appointments in academia in Portugal tend not to move between institutions in the country. The data showing the proportions of academic staff in public universities that gained a PhD in the institution where they currently work (DGEEC, 2017b) points to very low rates of inter-institutional mobility throughout individuals' careers. The combination of a national salary scale and low differentiation in career profiles across institutions reduces the incentives for academics to move institutions to obtain a role that better fits their desired profile or in order to gain a pay rise. The numerous available opportunities to conduct research outside one's host institution through affiliation with an associated laboratory or R&D centre further reduce the incentives to move. As noted in the earlier discussion on inbreeding, limited mobility reduces the range of experience gained by individuals and the innovation and development benefits for institutions of bringing in 'new blood' (Altbach et al., 2015).

The Portuguese higher education system fails to attract many international staff

Inbreeding and the comparatively static nature of academic careers in Portugal are also contributing factors in explaining the comparatively low level of internationalisation among academic staff in the country. The proportion of international staff in higher education institutions has remained stable at a comparatively low level over the last decade. In the academic year 2016-17, of the 33 160 academic staff (all categories) in public and private higher education in Portugal, 1 126 (or 3.4%) were of non-Portuguese nationality. The proportion of non-Portuguese academic staff varies between 4.6% in public universities, 3.3% in the private university sector and less than 2% in public and private polytechnics. Twenty-five percent of non-Portuguese staff held Spanish nationality and roughly 10% each Italian, United Kingdom and German nationality (DGEEC, 2016a).

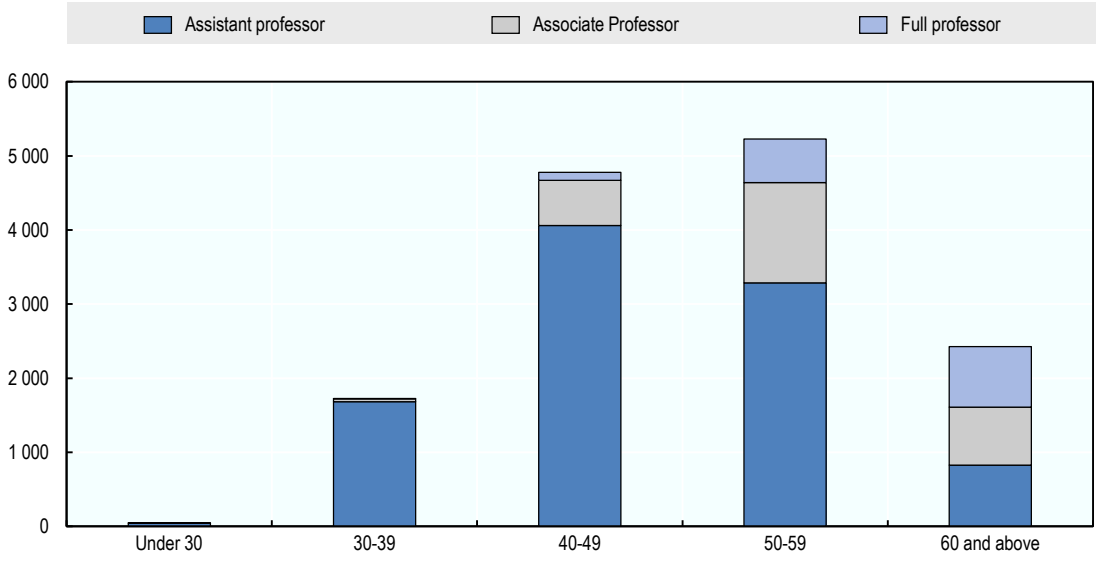
Many of the factors that make Portugal an attractive destination for international students (notably in the EU-sponsored Erasmus+ programme), such as culture, climate, cost-of-living and the reputation of Portuguese higher education in certain specific disciplines, hold equally for international staff. As more programmes have been created that are taught partially or entirely in English, language has become less of a barrier for academics from abroad than it once was. The level of salaries in relation to the cost of living makes them comparatively competitive. However, alongside the tendency for inbreeding, limited job opportunities in recent years, pay cuts and freezes and the wider structural problems affecting the organisation and performance of the system that are discussed in this report, have all combined to reduce the more general attractiveness of Portuguese higher education for international academics.

A tendency for older staff to remain in post

Another aspect of the static nature of staffing in Portuguese higher education reported to the Review team during interviews is that older staff often remain in post beyond pensionable retirement age, limiting opportunities for younger staff members to advance into more senior posts. Interviewees argued that this problem is particularly pronounced in the public and private university sectors.

Data on the number of staff remaining in post beyond pensionable age is not available. Available data does, however, highlight the relatively high age of the teaching staff in Portuguese universities. In public universities, 50% of full professors and 28% of associated professors were over 60 in 2015-16. The equivalent figures for the smaller private university sector were 71 and 29%. As illustrated in Figure 7.4, across the public and private university sectors, 17% of staff in the core academic grades are over 60 and very few staff are appointed to the level of full professor before the age of 50.

Figure 7.4. Age profile of core academic staff in public and private universities, 2016



Source: Direção-Geral de Estatísticas da Educação e Ciência DGEEC, 2017a.

Given the limited opportunities to tailor activities to current strengths, those who may be beyond the peak of their research productivity have few opportunities to reallocate their responsibilities to areas in which advanced seniority might improve performance, such as institutional administration and community engagement. Research (such as Stephan and Levin, 1992) has shown that the age of academic staff matters: those trained in the 1980s and 1990s, not to mention the 1970s, are less likely to be at the forefront in adopting and implementing new technologies and methods. The relationship between age and productivity is stronger in the physical and earth sciences than in the life sciences. Older scientists may also stifle the creativity and productivity of the relatively fewer younger scientists who are working in Portugal today. Such a view is consistent with Max Planck's belief that "a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it" (Stephan and Levin, 1992).

Based on available data of the age profile of university teaching staff, if the same number of posts is maintained in the university system and staff are encouraged to leave by at least the age of 70, some 2 400 posts in the university sector will open up through retirement in the next decade. This should create opportunities for younger staff to secure more senior academic posts.

7.4. Recommendations

Recommendations on strengthening career planning and entry

7. 1. Improve information and guidance to prospective academic staff

Portugal needs to ensure talented people are able to make the best use of their knowledge and skills for the good of the country. Ensuring the brightest and best are attracted to careers in academia and public research is an important part of this. However, in the current system in Portugal – as in other OECD countries – too many young (and less young) doctoral graduates seek to embark on an academic career with unrealistic expectations about the probability of ultimately securing an academic post. This can lead to a sub-optimal use of talent, as individuals devote time and energy to pursuing unrealistic goals, when they could be otherwise engaged in rewarding jobs with stronger long-term career prospects. The higher education sector as a whole has a responsibility to be more transparent about the likely flow of job opportunities and the purpose of post-doctoral positions.

Appropriate public authorities, including the FCT, along with higher education institutions, should develop guidance and information campaigns to ensure those considering an academic career are well informed, including:

- Making clear that post-doctoral positions are only appropriate for those seeking to pursue an advanced research career, and should not be viewed as the default step for those completing doctoral training.
- Publishing transparent information about likely recruitment of staff into entry-level academic positions (professor auxiliar, professor adjunto, investigador auxiliar) by providing project recruitment plans for the next five years, which are updated annually.

7.2. Ensure that post-doctoral positions (*Investigador júnior*) allow post-docs to gain skills and experience that can be exploited outside academia

Recognising that entry to permanent academic posts will – and must – remain highly competitive, those who do embark on a period as a post-doc under the new system of post-doctoral support in Portugal must be supported to develop experience and skills which they can also use to obtain and thrive in work outside the academic sector in Portugal. As a condition for receiving direct or indirect funding from the state (primarily directed through the FCT), post-docs and their host institutions should be required to jointly produce a career and skills development plan setting out specific measures the post-doc will take to develop their wider skills sets and how the institution will support the post-doc in skills development and career planning. All post-docs should have access to a mentor, who is different from their direct supervisor, who can support them in career planning.

7.3 Adapt FCT funding rules to counter inbreeding

In order to promote greater mobility of students and junior researchers between Portugal's higher education institutions and research centres, the FCT should make mobility a condition of the award of a majority of its funding for doctoral training and junior researcher (post-doc) positions. To receive FCT funding doctoral candidates should be required to train in a different institution to the one where they completed their previous education. Junior researchers should be required to work in institutions other than the one that awarded their PhD. Exceptions to this general rule may be permitted where research topics are so specific that relevant training or junior research opportunities are available in only a single institution in Portugal. However, care must be taken to limit such exceptions and maintain the general principle that trainee researchers and junior researchers should move institution.

7.4. Ensure fixed-term and permanent employment positions created through the new initiative for scientific employment support institutional profiling and development strategies.

The new system to support scientific employment must be used to support the development of institutional profiles as recommended above. The best available candidates need to be employed in research and teaching activities that help the institution develop its areas of strength and build its profile. The objective of creating more permanent research posts is commendable and consistent with recommendations made in other research systems. However, it is imperative that the new system does not lead to poor quality candidates being employed on permanent contracts in fields which contribute little to institutional development and the needs of Portuguese society more generally. To avoid this, the Portuguese authorities should:

- Ensure that alignment with institutional profiling and national development goals is a criterion in the selection of new post-docs and other research posts created through the initiative on scientific employment.
- Encourage applications to posts from individuals based or educated in institutions other than the host institution for the post.
- Allow institutions the maximum degree of flexibility in creating permanent academic posts after the subsidised fixed-term contract periods have expired, notably through avoiding a narrow definition of the scientific area in which the new post should be created.

Recommendations on ensuring greater differentiation in the career structure

7.5. Ensure institutions and academic staff have flexibility to allocate staff time efficiently and to follow different career profiles

The legal framework for academic careers should be modified, as necessary, to allow higher education institutions to set their own policies on the allocation of time among teaching, research and outreach obligations in response to short-term changes in opportunities and responsibilities. Further, HEI should create opportunities for staff to choose among differentiated career profiles for those who wish to adopt long-term changes to the balance of responsibilities they perform. Policymakers should use the new role of A3ES as an evaluator of higher education institutions as part of this process. Institutional review by A3ES should permit higher education institutions to demonstrate their fitness and capacity to take responsibility for workload and career profiles, and permit institutions to become self-regulating with respect to workload and career profile policies rather than subject to national regulation.

7.6. Encourage institutions to implement transparent and merit-based procedures for staff performance review that are aligned to institutional mission, and support differentiation in pay and rewards.

After transparent systems of performance review aligned to institutional mission are established, they should be used to support differentiation in compensation and other rewards. In the near term, these agreed evaluation systems should initially be used to support the allocation of benefits permissible under current law, such as performance bonuses, and temporary revisions to teaching obligations (within the national framework). In the longer run, performance evaluation plans should be used to support decisions about within-rank increases in compensation; limited adjustments to base compensation that may become available within a modified legislative framework; and to guide decisions for those who hold appointments under private law in foundation universities.

Recommendation for ensuring greater career mobility

7.7. Promote near-term measures to increase inter-institutional mobility and timely retirement, while, in the long-term, adopting reforms that increase domestic and international mobility.

In the near term, promote inter-institutional mobility through short-term faculty exchange programmes and expanded opportunities for visiting appointments through funds allocated by FCT, and awarded by higher education institutions. Additionally, ensure that research staff retires at a fully pensionable age, in line with national legislation, to ensure senior positions are freed up. The reforms described above – with wider institutional responsibility to set workload, career profile, and compensation policies that are aligned to differentiated institutional profiles – will significantly increase domestic mobility by creating incentives for mobility that are presently absent. These reforms, in combination with the further development of private law employment in foundation universities, will make Portugal a significantly more attractive destination for researchers than it is at present.

Notes

1. The dispersion of post-docs across different types of institution and a lack of systematic data collections makes it impossible to verify the figures from the CDH with any certainty.

2. https://www.fct.pt/apoios/contratacaodoutorados/edital2008.phtml.pt.

3. https://www.fct.pt/apoios/contratacaodoutorados/investigador-fct/index.phtml.pt.

4. https://www.fct.pt/apoios/contratacaodoutorados/investigador-fct/estatisticas.phtml.pt.

5. Decree-law 57/2016 (*29* August 2016), amended by Parliament through Law 57/2017 (19 July 2017) Diário da República n.º 138/2017, Série I de 2017-07-19.

6. Notably *unemployment insurance* and pension contributions.

7. Law 35/*2014 Lei Geral do Trabalho em Funções Públicas.*

8. *Código do Trabalho*, last *revised* in 2009 through Law 7/2009.

9. Estatuto da Carreira *Docente* Universitária, Decree-Law 448/1979, amended by Decree-Law 205/2009 and Law 8/2010.

10. Estatuto da Carreira do Pessoal Docente do Ensino Superior Politécnico, Decree-Law 185/1981, amended by Decree-Law 207/2009 and Law 7/2010. In addition, Decree-law 45/2016 extends the transition period during which teaching staff in Polytechnics are required to obtain a PhD or the status of 'Specialist'.

11. Estatuto da Carreira de Investigação Científica, Decree-Law 124/1999, Diário da República n.º 92/1999, Série I-A de 1999-04-20.

12. Law 62/2007: RJIES – Regime Jurídico das Instituições de Ensino Superior.

13. Decree-Law 206/2009.

14. Temporary or part-time staff from foreign institutions are referred to as *docentes visitants.*

15. Excluding vocationally oriented *Cursos de Especialização Tecnológica* (CET), some of which were provided in higher education institutions.

[16]. Some of whom were teaching staff in polytechnics who 'upgraded' their qualification level in an existing post.

[17]. Estatuto da Carreira Docente Universitária, Decree-Law 448/1979, amended by Decree-Law 205/2009 and Law 8/2010.

[18]. Estatuto da Carreira do Pessoal Docente do Ensino Superior Politécnico, Decree-Law 185/1981, amended by Decree-Law 207/2009 and Law 7/2010. In addition, Decree-law 45/2016 extends the transition period during which teaching staff in Polytechnics are required to obtain a PhD or the status of "Specialist".

[19]. Article 74-A of Decree-Law 205/2009 on university careers, for example.

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Chapter 8. High-skilled employment, co-operation with HEIs and innovation in the business sector

Although Portugal has significantly increased its innovation capacity since it joined the European Union, the innovation output of Portuguese businesses have remained at a low level in international comparison, partly due to the dominance of SMEs and the weight of traditional sectors in the economy. Strong efforts have been dedicated to the support of research-based innovation and the upgrading of low-tech small and medium enterprises (SMEs). The government has progressively created a diversified system of intermediary organisations to support SMEs upgrade their innovation capacity and collaborate with academia. They fulfil a wide range of business knowledge transfer and service needs, but most of these organisations have, until recently, operated with fragile business models without systematic public support, which has hindered their ability to fulfil their mission.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

8.1. Introduction

Portugal has significantly increased its innovation capacity since it joined the European Union, but major barriers to economic innovation remain. This calls for co-ordinated efforts in research, innovation and higher education policy to increase the knowledge intensity of the private sector, which consistently supports both the supply and demand for knowledge in a consistent manner. This includes fostering the employment of highly skilled people in the private sector, enhancing collaborative R&D between businesses and HEIs and research units, supporting the creation of new firms, strengthening knowledge-intensive clusters and intermediary organisations that support them, and embedding Portuguese businesses and research units more firmly in international knowledge and value chains. Alongside support for research-based innovation, the upgrading of low-tech small and medium enterprises (SMEs) and the strengthening of managerial skills are crucial mechanisms for increasing the level of business innovation in Portugal.

Five factors are important in supporting the upgrading and diversification of the Portuguese economy towards more knowledge-intensive sectors (Table 8.1):

- Opportunities and incentives are in place for co-operation and exchanges between 'academic' institutions and staff and individuals and organisations in the private economy and public services.
- Strategy and dedicated funding instruments to support high-skill employment and innovation in the private economy and public services are clear, with changes organised to ensure transparency and predictability.
- Strategy and policy and funding instruments to support innovation support the goals of international openness and attractiveness, including through attracting Foreign Direct Investment (FDI) and international staff.
- Public and private resources allocated to innovation-related activities and support institutions are adequate to needs. Public funding mechanisms for innovation are designed to incentivise effective private investment in research and innovation activities and provide sufficient accountability for use of public funds.
- Public policy and funding instruments to promote innovation are designed to accommodate the needs of different types of businesses/organisations/institutions and respond quickly and effectively to changing circumstances.

Against this backdrop, the Review considers two key questions in this section:

1. How can Portugal revitalise its industries, support the emergence of new sectors and strengthen firms' competitiveness through innovation?
2. How can Portugal ensure that public research and the transfer of knowledge infrastructure both help support a virtuous circle of research and innovation?

8.2. Context

8.2.1. Business R&D and innovation investment

The Portuguese business sector has significantly enhanced its innovation capacity over the last two decades, in particular during the period preceding the 2008 crisis. It experienced the largest increase in business R&D investment (BERD) of all OECD countries, with BERD increasing from 0.11% of GDP in 1995 to 0.75% in 2009, then declining to 0.58%

of GDP in 2015 and 0.62% in 2016 in the wake of the crisis. During the period of pre-crisis growth, the concentration of R&D activities in a small number of large enterprises decreased, and the 'innovation base' broadened. The number of researchers working in business enterprises reached its maximum in 2011, with 12 198 researchers [Full-time equivalent (FTE)] and has since stagnated, with small increases in 2016 (13 426) (DGEEC, 2017).

Innovation activities remain limited in Portugal, with low knowledge intensity and proximity to the market. About 2 500 Portuguese firms appear to perform research, and about 1 000 benefit from indirect or direct public innovation support schemes (Box 8.1). Portuguese firms principally conduct experimental development and applied research, and venture to a lesser extent into more upstream research, whether internally or through contracts with PRIs.

In small countries, innovation performance and participation in international markets are often closely correlated and reinforce each other. Most domestic firms in Portugal are small and do not participate in international markets. The virtuous circle between innovation and internationalisation has been initiated only in a few sectors of the Portuguese economy, such as shoes, textile, moulding; and in some dynamic start-ups.

Foreign direct investment (FDI) has grown, but remains limited. Multinationals that locate activities in Portugal are typically concentrated in service industries with modest knowledge intensity, such as accounting and human resource management, capitalising on access to good skills at low labour costs. In countries that are well-integrated in global value chains, foreign firms, in particular large multinationals, play a significant role in research and development (R&D) investment and provide a source of learning for domestic firms. Portugal has a few major industrial R&D investments from multinationals, such as Bosch in Braga and Volkswagen Autoeuropa in Palmela. These play an important role at the regional level, co-operating with clusters of local academic and business organisations. However, multinational firms are not sufficiently numerous in Portugal to be significant drivers of economic development at the national level.

The overall industrial structure remains dominated by small and medium enterprises (SMEs) and low- to medium-tech industries and services with low knowledge intensity, which invest less in R&D,[1] Research activities in some formerly strong sectors have declined. Telecommunications represented the majority of business R&D investment prior to the crisis, but following privatisation no longer does. The decline in telecommunications investment has not been offset by other sectors, such as information and communication technologies (ICT) and telecommunications, in which the level of investment has remained stable. Promising new sectors, such as space and ocean-related activities, have not altered aggregate patterns of business R&D.

Micro and sectoral dynamics result in a business innovation landscape in Portugal marked by strong regional imbalances. Knowledge-intensive activities are concentrated principally in the Lisbon and Porto areas, and in the North and Centre regions. As in other OECD countries, remote and interior regions of Portugal face challenges of demographic decline and out-migration. Upgrading the knowledge intensity of these regions has been hampered by the low attractiveness of higher education institutions to students and staff from other regions, both as a result of their perceived remoteness and a lack of clear specialisation in areas of excellence.

Box 8.1. The main features of business research and innovation activities in Portugal

How much do Portuguese companies spend on R&D or innovation?

- Portuguese firms expenditures on R&D amounted to EUR 1 156 million in 2016, representing 48% of BERD (up from 46% in 2015). R&D personnel was the largest source of R&D expenditures in the private sector (53%), followed by current expenses (31%) and equipment (16%).
- Innovation expenditures include a broader range of activities than R&D, such as marketing and organisational innovations, and were estimated at EUR 3 billion in 2016, an increase of 37% compared to 2014.

How do Portuguese companies finance their R&D and innovation activities?

- Private R&D in Portugal is overwhelmingly financed by firms themselves: 87% of private sector R&D was self-financed in 2016.
- The government financed 4% of private R&D in 2016. Funds from abroad represented 7% of R&D funding to the private sector. The Framework Programmes and Horizon 2020 play an important role as international funders of private R&D.

How many enterprises engage in innovation in Portugal?

One can only estimate the number of innovative companies by crossing various sources of information, each of them using a different definition (R&D, innovation, etc.) or 'marker' (e.g., applications to innovation policy instruments).

- One indicator of innovation is the number of enterprises active in the innovation-intensive sector, which are more likely to be engaged in technology development. There were 468 enterprises active in high-tech manufacturing sectors and 14 726 in high-tech knowledge intensive services in Portugal in 2014 (respectively 2 668 and 50 116 in Spain). These sectors are not very developed: high-tech and medium-high-tech sectors represented 4% of value-added in 2014, with medium-high tech representing the bulk of this figure.
- A second measure of interest is the number of enterprises applying to direct and indirect innovation incentives: about 1 100 firms benefited from the System of Fiscal Incentive for Business R&I (Sistema de Incentivos Fiscais à I&D Empresarial) (SIFIDE) tax credit scheme in 2015 (upward trend since 2011). The same number of companies applied to the National Innovation Agency's (Agência Nacional de Inovação) (ANI) collaborative schemes between 2015 and 2017.

R&D and innovation surveys can be used to estimate the number of research-active and/or innovative companies:

- 2 835 companies declared they carried out some R&D activities in 2015 in the R&D Survey.
- About 4 094 companies declared at least one product or process innovation in 2015-16 according to the Innovation Survey 2016 (up from 3 395 companies in 2013-14).

Sources: MCTES (2017), *Science, technology and tertiary education in Portugal – Perspectives for 2030*, Background report to the OECD joint-review of Science, Technology and Tertiary Education in Portugal, draft document, Ministry of Science, Technology and Higher Education.; Eurostat (2018) Science and technology database (last accessed on 27 April 2018) http://ec.europa.eu/eurostat/statistics-explained/index.php/Science_and_technology.; OECD (2017d), Main Science and Technology Indicators, Volume 2017 Issue 1, OECD Publishing, Paris. http://dx.doi.org/10.1787/msti-v2017-1-en; OECD (2017c), *Review of national R&D tax incentives and estimates of R&D tax subsidy rates – 2016*, Version 12 September 2017, Report for the H2020 project 'TAX4INNO', OECD. www.oecd.org/sti/RDTaxIncentives-DesignSubsidyRates.pdf ; DGEEC (2016), *Principais resultados do CIS 2014 – Inquérito Comunitário à Inovação*, September 2016, Direção-Geral de Estatísticas da Educação e Ciência www.dgeec.mec.pt/np4/207/%7B$clientServletPath%7D/?newsId=113&fileName=Principais_Resultados_CIS2014_29092016.pdf.

8.2.2. Business innovation performance

Business innovation performance in Portugal is limited, principally due to an industrial structure in which SMEs concentrated in low technology sectors play a predominant role in the economy. Despite rising investment in R&D prior to the 2008 crisis, innovation output indicators are lower than for other European countries. Patenting grew rapidly in the decades preceding the crisis, but it is still low by international standards, and most patents originate from public research rather than from the business sector.

Innovation surveys also reveal a post-2008 decline in the proportion of companies that report the introduction of innovation. Among surveyed firms in Portugal, 14.5% report having introduced an innovation into their market, a smaller proportion than in countries such as Greece, Italy, or Turkey – though ahead of Spain and Poland[2] (OECD, 2017a). Moreover, Portuguese firms report that the type of innovation in which they engage is, on average, lower in knowledge-intensity (DGEEC, 2016). Business demand for new knowledge that is channelled through collaborative research and employment of high-skilled new recruits (including PhDs) is also low.

Innovation performance is unevenly spread between Portuguese regions. In Portugal as in all EU countries with regions that perform significantly below the European average, the Community Cohesion Policy is an essential source of funds to reduce the territorial economic and social disparities. Structural Funds have notably supported the formation of competitiveness and technology poles and clusters, which have been positively evaluated. However, the project-based nature of Structural Fund investments and their emphasis on research excellence limit their capacity to build sustainable and regionally relevant innovation ecosystems aligned to longer-term specialisation priorities. Stakeholders with whom the Review Team met suggested that national funds are used to compensate regions that are excluded from receiving money from European Structural Funds, which offset, in part, the intended effect of European Structural Funds to close the development gap.

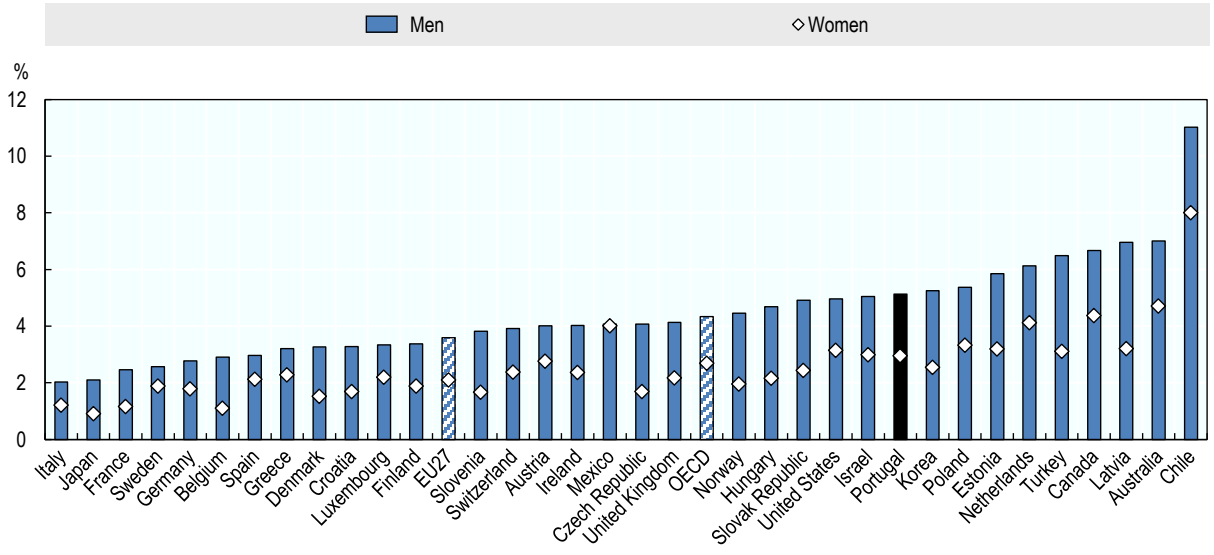
8.2.3. Entrepreneurship

Entrepreneurship activities are well developed in Portugal. The proportion of men and women involved in setting up businesses in Portugal is slightly above the EU average (Figure 8.1), and these Portuguese men and women own young businesses (between 3 months and 3.5 years old) at a rate significantly higher than EU and OECD averages. Overall, the share of the adult population (18-64 years old) involved in total early stage entrepreneurial activities[3] was 8% in Portugal in 2016, more than twice the 2010 share. Youth entrepreneurship is also well-developed: the rate of those 18-30 years old involved in entrepreneurial activities in Portugal (8.2%) is slightly above the European average (7.7%).

Portugal also has a well-developed entrepreneurial culture: entrepreneurship is perceived as a desirable career choice by 69% of the adult population, above the EU average of 56% (EC, 2017). However, entrepreneurial activity and interest in business creation remains, in part, driven by a lack of satisfactory options in the labour market: over 20% of Total Early-stage Entrepreneurial Activity (TEA) was motivated by necessity over 2010-2014, slightly under the EU25 average for the period (OECD/EU, 2017).

Figure 8.1. Early entrepreneurship activities, men and women, 2012-16

Percentage of population (18-64 year olds)



Notes:
1. All European Union Member States participated in the GEM survey at least once during the 2012-16 period
2. All OECD countries participated in the GEM survey at least once during this period except for Iceland and New Zealand.
3. Data presented in this figure were pooled over the 2012-16 period. A number of countries did not participate in the GEM surveys in every year but were included in the figure: Australia (participated in 2014, 2015, 2016); Austria (2012, 2014, 2016); Belgium (2012, 2013, 2014, 2015); Czech Republic (2013); Denmark (2012, 2014); France (2012, 2013, 2014, 2016); Israel (2012, 2013, 2015, 2016); Japan (2012, 2013, 2014); Latvia (2012, 2013, 2014); Luxembourg (2013, 2014, 2015, 2016); Norway (2012, 2013, 2014, 2015, 2017); South Korea (2012, 2013, 2015, 2016); and Turkey (2012, 2013, 2016).
4. The new business ownership rate measures the proportion of the population (18-64 years old) that is currently an owner-manager of a new business that has paid salaries, wages or any other payments to the owners for more than three months, but not more than 42 months.
Source: OECD/EU (2017) based on Global Entrepreneurship Monitor (2017), Special tabulations of the 2012-16 adult population surveys from Global Entrepreneurship Monitor.

Portugal has demonstrated a strong commitment to supporting entrepreneurship, having introduced a number of measures since 2008 to promote business creation across the country, including programmes targeting specific groups such as the youth or the unemployed. In particular, a national strategy for entrepreneurship, "Start-up Portugal" was introduced in 2016. The strategy outlines measures to boost economic performance and job creation in young firms. Portugal has several voucher schemes in place (an incubation voucher, the "start-up voucher" aimed at supporting business creation by the youth). Capacity-building initiatives are also well-developed and include training, coaching and mentoring (OECD/EU, 2017). The "National Incubator Network" (*Rede Nacional de Incubadoras*) was also created to co-ordinate best practices across the country. Youth entrepreneurship is a core focus of the national strategy and several dedicated programmes provide funding and entrepreneurship training to young entrepreneurs such as the Youth Guarantee Implementation Plan and the Youth Investment Programme (EC, 2017).

Young firms account for much of the new job creation in Portugal, but older firms are relatively small, pointing to a lack of growth after firm entry. Recent government initiatives

have aimed to open up additional channels of finance for companies to stimulate growth. These include the new *Capitalizar* programme, among with other instruments (OECD, 2017c). Strengthening business innovation is a major challenge for Portugal. Public support for business R&D and innovation is mostly indirectly provided through tax credits, although debt financing, e.g. through loans and guarantees of business R&D investments has become more common in recent years. In particular, the recent Start-Up Portugal programme aiming at broadening developing market-based finance for SMEs could help alleviate the credit constraints of SMEs (OECD, 2015a, b).

8.2.4. Advanced skills for innovation and upgrading

Portugal has significantly improved the educational attainment of its population. It now offers a fairly highly-qualified human resource base of graduates and PhDs at comparatively low labour costs. The share of STEM graduates and PhDs is also slightly above the European average. This has been recognised by some international firms, which have established engineering activities in Portugal, for instance in ICT, biotechnology and the automotive industry.

Despite progress in raising the educational attainment of younger age cohorts, the entire adult Portuguese population has a low level of educational attainment when compared internationally. This weakness has compounded since the financial crisis and the subsequent economic recession by the outward flow of skilled adults leaving the country to find professional positions abroad.

Employers in Portuguese firms that require highly trained workers, especially graduates in engineering, report that firm growth may be hampered by skill shortages. Periodic employer surveys indicate that one in four companies with more than 10 employees considers access to the right technical skills a high or very high obstacle to their business activities, second to difficulties in laying off staff. The impact of skilled staff shortages on the capacity of firms to innovate is not well documented. Non-innovative firms do not consider the lack of qualified staff to be the primary reason for their decision not to innovate (Eurostat, 2018),[4] however, econometric analyses indicate that this factor does play a role in firms' propensity to engage in product and process innovation in Portugal (Madeira et al., 2017). In meetings with the Review Team, senior managers from firms reported that some sectors face problems in finding appropriately skilled staff for their needs, especially engineers. Large firms such as Bosch have implemented targeted training programmes to ensure that they can obtain employees with appropriate skills, and these are sometimes in co-operation with higher education institutions.

Continuing training for adults remains limited and mainly benefits workers with the highest level of educational attainment. In 2016, 9.6% of Portuguese adults reported having participated in some adult learning in the past four weeks (Sofia Pacheco *et al.*, 2017). This was slightly less than the EU28 average (10.8% of adults), but far above the level reached in 2007 (4.4% of adults, for an EU average of 9.2%), due to significant government efforts during the period 2005-2010. Since 2011, the participation of adults in training has decreased, in large part due to the fall in participation in learning opportunities targeting the low-skilled (OECD, 2018).

Demand for PhD graduates in manufacturing and services sectors is growing but remains limited. ANI implemented a dedicated scheme between 1997 and 2007, resulting in 296 PhDs and Masters hired in 177 companies. A similar programme will be resumed in the context of the programme Interface in the near future. Similar incentives, for instance

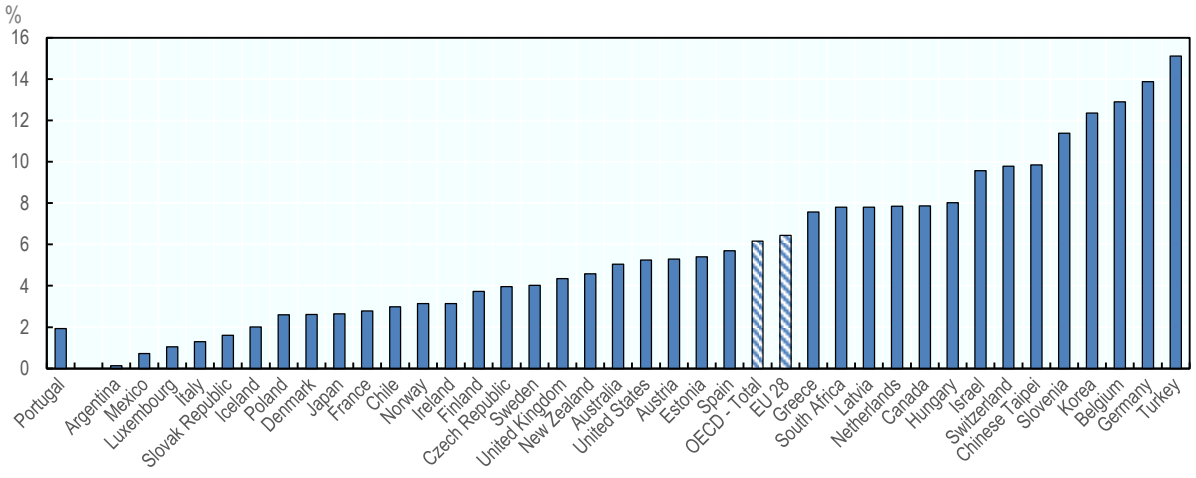
implemented in some regions in the framework of their respective Operational Programme, have experienced a shortage of applications.

8.2.5. Research-industry knowledge exchange

In the decade prior to the financial crisis, industry and academic R&D capacity grew, and partnerships between them strengthened (Heitor and Horta, 2012). However, many sectors of the Portuguese economy, including large firms, carry out their business activities with little or no regard for domestic public research and higher education institutions. This separation between the scientific and private sector communities is reflected, for instance, in the low number of public-private co-publications per million population (30% of the EU average), in the share of patents co-filed between higher education institutions and firms, in the number of citations made in patents, and in the very limited share of higher education expenditures financed by business firms (Figure 8.2). Science-industry collaborations may be difficult to observe and quantify from research inputs or outputs because they often rely on informal channels.

Figure 8.2. Percentage of HERD financed by the business sector

2015 or latest available

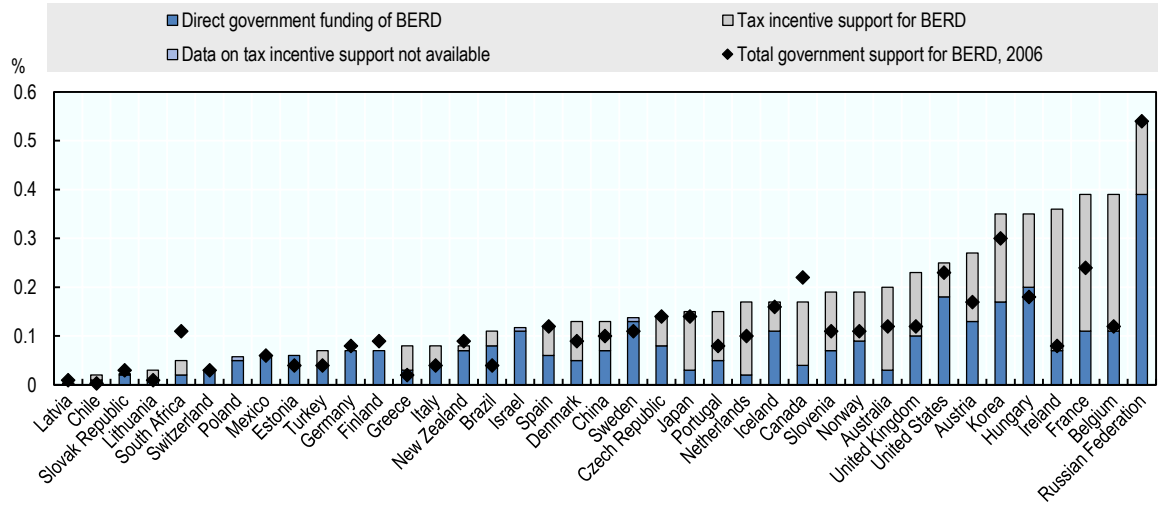


Source: OECD, Main Science and Technology Indicators Database, www.oecd.org/sti/msti.htm, 17 July 2018.

Information provided by innovative firms themselves through innovation surveys confirm their limited co-operation with higher education institutions, in absolute terms and in international comparison (Figure 8.3). Small firms, although they have less co-operative relationships with HEIs than large firms in all countries, fare particularly badly in that regard in Portugal, while large firms are above the average of surveyed countries. The results of the latest Innovation survey, conducted in 2016, confirm these results.

Figure 8.3. Large and small firms co-operating on innovation activities with higher education or government institutions

Percentage of product and/or process innovative firms, 2012-14.



Source: Direção-Geral de Estatísticas da Educação e Ciência DGEEC (2017), *Inquérito ao potencial científico e tecnológico nacional – IPCTN16*, Provisional R&D data, document dated August 2017, Direção-Geral de Estatísticas da Educação e Ciência, http://www.dgeec.mec.pt/np4/206/%7B$clientServletPath%7D/?newsId=11&fileName=2016_RDSurvey_ProvisionalData.pdf.

Science-industry partnerships are not only limited in number and scope, they are also in most cases not embedded in formal contractual frameworks. Some noteworthy examples do exist, such as the pharmaceutical firm Hovione, which sponsors a lab for analytical chemistry in collaboration with several polytechnics. Besides the research benefits, this long-term partnership also ensures that graduates from these polytechnics can be trained in precisely those skills that Hovione would expect from its future employees. Moreover, polytechnics can offer short courses using the new equipment, which they otherwise could not afford.

The government recently launched the Collaborative Laboratories (CoLABs) as a new type of legal entity to host long-term, market-oriented, science-industry partnerships. Like the Institut Carnot in France, these entities combine at least one company and one research unit, which together are its shareholders. The partner company must commit its own resources in this joint undertaking, while the FCT is responsible for supporting the R&D unit. The official purpose of these consortia is to create "*skilled jobs and economic and social value, by promoting employment through the development of knowledge-based activities, based on the implementation of medium-term research and innovation*" (Encarnação, 2017). The "CoLAb Label" is assigned by FCT upon evaluation and is meant to be reviewed every five years.

This new scheme is still at a very early stage, with six proposals gaining approval as CoLABs by January 2018 in areas of national strategic interests (ocean economy, digital transformation, agriculture, and environment). EUR 19 million of FCT funding is earmarked for this scheme for the period 2017-2020, which might translate into a government support of around EUR 1 million annually per entity (or less if new CoLABs are labelled in coming years), to which matching funds from the non-academic partners

must be added. Although the needs will differ according to the different underlying projects, this amount represents significant average funding which should allow ambitious research and innovation agendas to "co-develop".

8.2.6. Knowledge transfer infrastructure

Intermediary organisations – such as technology transfer offices and S&T parks – can help overcome the lack of absorptive capacity among traditional SMEs and bridge the gap between firms and academic institutions. This has been demonstrated by international experience, and by Portuguese success stories in the textile, shoe and molding industries.

The Portuguese knowledge transfer infrastructure has experienced gradual expansion and diversification in the past two decades (FCT, 2013; MCTES, 2017), and currently includes the following actors:

- Technology centres that collaborate largely with low and medium-tech SMEs located in the North and Centre region, some of which are research-oriented.
- R&D centres with in-house R&D. These represent a set of very diverse entities, more evenly distributed across regions and mostly collaborating with high tech SMEs and large companies of low-medium technological intensity.
- Science and technology parks, which provide infrastructure to technology-based firms mainly in the North and Centre region.
- Technology Transfer Offices (TTOs) and incubators/accelerators.

Technology and R&D centres generated income from national net sales and services during the period 2013-2015 of EUR 14 million and EUR 60 million, respectively. However, they operate with a fragile business model in which systematic public support is absent.

TTO activities focus on venture creation rather than patenting and licensing. TTOs have increased invention disclosures (2013-2015), but these have been concentrated in a few higher education institutions. TTO success stories include, for instance, the Instituto Pedro Nunes (IPN) in the University of Coimbra, a private-public incubator and accelerator under private management. It has been engaged in a technology transfer initiative to promote knowledge diffusion from large European agencies, such as The European Organization for Nuclear Research (CERN), European Southern Observatory (ESO), and the European Space Agency (ESA) to Portuguese firms, with a focus on the space industry. The University Technology Enterprise Network (UTEN), which has its origin in the international partnership signed by the government of Portugal with the University of Texas/Austin brings together the most internationally oriented technology transfer offices to strengthen their commercialisation of domestic research activities via joint activities and exchange of good practices (including through training of Portuguese technology transfer officers by American specialists).

8.2.7. Government direct and indirect support to business innovation

Business firms largely rely on their own resources to finance their innovation activities. Apart from the R&D tax credit, about 4% of business R&D expenditures have been financed through government funds in 2016.

Among firms reporting a product or process innovation during the previous three years, about one-quarter of firms, and one-half of large firms, reported benefiting from public support to innovation, near the OECD average.

Direct innovation financial incentives provided to business firms are financed through Structural Funds, particularly in the three "convergence" regions of North, Centre and Alentejo, and are managed by one of the three principal agencies active in the area of business support: ANI, IAPMEI and IACEP (Table 8.1).

The portfolio of innovation policy instruments used by the government in Portugal appears comprehensive and addresses all stages of the innovation cycle, from upstream research in collaboration with academic institutions to the support for international marketing of new innovations.

FCT is the main funding agency for basic and applied research. Few of its competitively allocated funds – about 1% – go to firms. Private firms may obtain FCT grants only in collaboration with HEIs, which occurs infrequently. Most FCT grants obtained by firms have been allocated to companies active in IT and computing-related areas (FCT, 2013).

The R&D tax incentive scheme SIFIDE (System of Fiscal Incentive for Business R&I) (*Sistema de Incentivos Fiscais à I&D Empresarial*) (EUR 194 million in 2015) is the main instrument used by government to support business R&D. In 2015 its share of GDP was twice that of direct funding instruments (Figure 8.4).

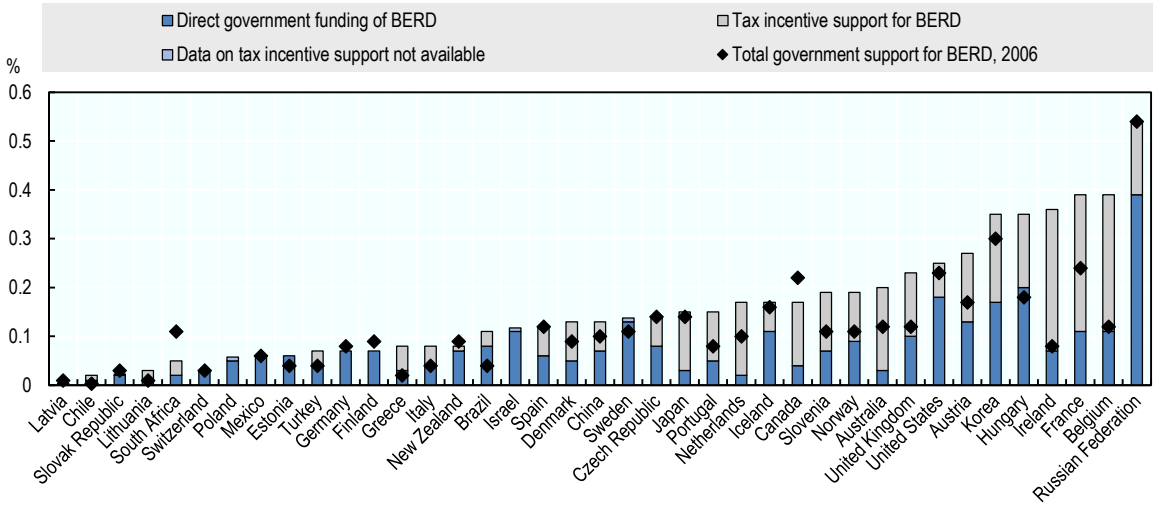
Table 8.1. Main policy instruments to support business innovation

	FCT	ANI	IAPMEI	AICEP
Business innovation and upgrading		R&D tax credit (SIFIDE)	Individual innovation grants for SMEs	Individual innovation grants
Collaborative research	Basic and applied research collaborative grants	Collective innovation grants (co-promotion projects)		Collective innovation grants (RCI R&D projects)
	Collaborative laboratories (CoLABs)			
Knowledge transfer and entrepreneurship	Support to knowledge transfer via the Technology Office	Support to network of intermediary organisations (Interfaces) Support to knowledge transfer in companies (inc. IP) Support to technological entrepreneurship	Support to knowledge transfer in SMEs Support to technological entrepreneurship (*StartUP* Voucher and Visa)	
Advanced skills for research and innovation	PhD and post doc grants Support to employment of PhD holders in business firms			
Internationalisation of domestic research and innovation	Support to participation in the research and innovation international networks Support to international research programmes	Support to participation in the research and innovation international networks Support to SMEs' internationalisation	Support to participation of SMEs in the research and innovation international networks	Wide range of instruments to support the internationalisation of companies
Demonstration and testing of innovation	Demonstration of advanced technologies and pilot lines	Demonstration of advanced technologies		
Networks of innovative companies		Support to network of innovative companies (Mobilising projects)	Support to poles and clusters	

Note: This table does not cover academic research support schemes, mainly provided by FCT (see chapters 2 and 3).
Sources: MCTES (2017), *Science, technology and tertiary education in Portugal – Perspectives for 2030*, Background report to the OECD joint-review of Science, Technology and Tertiary Education in Portugal, draft document, Ministry of Science, Technology and Higher Education.
JRC (2016), *RIO Country report 2015 : Portugal*, Joint Research Committee, European Commission, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101210/pt_cr2015.pdf.; Caldeira, J. (2017), *Knowledge & Collaborative Innovation – The Role of the National Innovation Agency*, Presentation at the OECD Workshop, Lisbon, 25 May, ANI.

Figure 8.4. Direct government funding and tax support for business R&D, 2006 and 2015

As a percentage of GDP



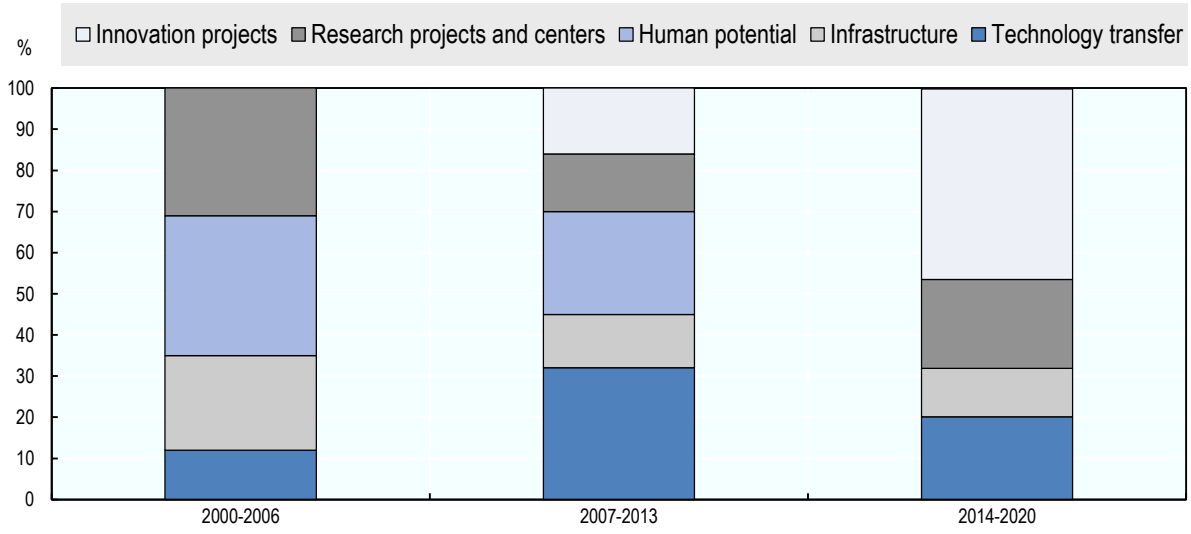
Notes: For more information on R&D tax incentives, see http://oe.cd/rdtax, and for general notes and country-specific notes for this R&D tax incentive indicator, see http://oe.cd/sb2017_notes_rdtax.
Source: OECD (2017), OECD Science, Technology and Industry Scoreboard 2017: The digital transformation, OECD Publishing, Paris, https://doi.org/10.1787/9789264268821-en.

The Portuguese tax credit, like that of Korea and Spain, aims to reward firms for maintaining and increasing their level of R&D investment by combining volume and incremental credits. Portugal has reformed the SIFIDE scheme in order to improve its attractiveness and effectiveness, and its tax incentives are currently among the most generous among all OECD countries. This generosity applies to both SMEs and large firms, and to both loss-making and profitable firms (OECD, 2017c).

The portfolio of policy instruments supporting business R&D has evolved across three cycles of Structural Funds, with increasing focus on spurring knowledge-based economic development. Analysis of the period 2000-2020 shows that:

- Structural Funds initially focused on advanced training of human resources, research infrastructures and equipment.
- There has been a marked increase in the support to business innovation and reduction in support to research activities. Research is now most often supported as part of collaborative research projects, or through national funds.

Figure 8.5. Share of Structural Funds allocated to research and innovation activities by type 2000-20



Source: JRC (2016), *RIO Country report 2015 : Portugal*, Joint Research Committee, European Commission, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101210/pt_cr2015.pdf.; European Commission (2014), *Summary of the Partnership Agreement for Portugal*, 2014-2020, 30 June, Brussels, https://rio.jrc.ec.europa.eu/en/file/7469/download?token=0ciuEZAt.; European Union (2007), *National Strategic Reference Framework 2007-2013 – Portugal,* CSF III Observatory, http://www.qren.pt/np4/file/1354/2_NSRF_National_Strategic_Reference_Fram.pdf.,; FCT (2013), *An analysis of the Portuguese research and innovation system – challenges, strengths and weaknesses towards 2030*, FCT, https://www.fct.pt/esp_inteligente/docs/SWOT_FCT_2013_En.pdf

8.3. Assessment

Policy issue 8.1. The Portuguese innovation policy mix needs a careful balance between the support to high- and low-tech business firms

The economic success of many Portuguese firms has been achieved by incremental innovation and learning by doing rather than by science-based innovation.

As in many OECD countries, the support to science-industry collaborations and science-based start-ups ranks high in the research and innovation policy agenda. More should be done, including at the level of HEIs to provide the right set at incentives for greater engagement with industry at institutional and individual levels (see section 0). However, these initiatives, although essential, concern only a limited number of companies with the sufficient 'absorption capacity' to collaborate with academic institutions. The new CoLAB scheme for example is an important new development that could alleviate the problem of the lack of institutionalisation and long-term commitment of partners. It is however in practice limited to industrial partners that can afford multi-year financial commitments and have already built relationships with the academic institutions. Structured research-industry collaboration between industrial partners with little prior research and innovation experience and polytechnics, for example, might usefully complement the programme.

Current government policies in support of science-industry relationships and high-growth start-ups are not sufficient. Further support for low-technology firms is essential for further business innovation, and intermediary organisations will be key to this support. Tapping

into the potential of firms that do not yet significantly innovate and serve mainly regional markets is a major opportunity that has not been fully addressed. The economic success of many Portuguese firms has been achieved by incremental innovation and learning by doing rather than by science-based innovation. It is therefore essential that public support covers a wide range of types of innovation, from the knowledge-intensive projects based on internal R&D and collaboration with academic research to rather informal and incremental innovation activities.

A key factor of success will therefore be the ability of Portuguese authorities, in close interaction with the research and innovation communities, to set up a co-ordinated, two-fold approach which supports business innovation from both sides of the supply and demand of knowledge:

- An intensive margin approach aims to deepen the knowledge-intensity of medium-high and high-tech industries and services.
- An extensive margin approach aims to support the upgrade of the innovation capacity of each sector, including lower-tech ones. Key to this process is the provision of systematic, hands-on and stable support to business innovation. Tapping into the potential of firms that do not yet significantly innovate and serve mainly regional markets is a major opportunity that is only imperfectly addressed.

Policy issue 8.2. There are emerging opportunities to support business innovation that merit well-designed policies

Although Portuguese business innovation capacity is limited, past accomplishments and positive trends exist, and merit well-designed policy support. For example:

- Company R&D investment resumed growth in 2016. Provisional data show that the BERD increased from 0.58 to 0.62% of the GDP, representing an increase of EUR 120 million).
- Some traditional industries have developed quite successfully by raising the added value of their activities, partly based on the use of new technology and targeting of higher end markets. After a significant downsizing in the shoe industry between 1994 and 2009, Portugal became the 11th largest shoe export country in the world, with the second highest average price per pair of shoes, just behind Italy, with a workforce of 35 000 people (Marques and Guedes, 2015). Other labour-intensive sectors such as textiles and clothing have also shown productivity gains in recent years.
- The technological balance of payments has been steadily increasing since the late 1990s and is positive again since 2012, after a significant decline due to the financial crisis (OECD, 2017d). This is an indication that Portugal has developed more endogenous technology.
- Business take-up of government innovation support has increased, as is demonstrated, for example, by the first calls for collaborative research organized by ANI (Caldeira, 2017).[5] Furthermore, financial incentives attract each year a significant proportion of companies that had not applied to these instruments in the past, which tend to show that a certain industrial renewal or upgrading is underway. However, although above 50% during the period 2014-16, the rate of newcomers has been decreasing steadily since the period of rapid expansion that preceded the crisis (MCTES, 2017). Recent positive trends can also be observed in the

participation of companies in EU programmes, either H2020 or SME-specific instruments.

Portugal has implemented a comprehensive portfolio of policies offering direct support for business innovation, largely co-financed by the Community Cohesion Policy. However, the project-based nature of Structural Fund investments and their emphasis on research excellence limit their capacity to build sustainable and regionally relevant innovation ecosystems aligned to longer-term specialisation priorities. Although hard to assert with certainty since only very few of these schemes have been assessed (beside some evaluations conducted at overall programme level in the framework of Structural Funds), the fact that the innovation support is often spread thin among a variety of business firms and intermediary organisations also probably limits their effectiveness. We estimate that, on average, EUR 490 000 was allocated by ANI to collaborative projects in 2015, equal to EUR 65 000 for each participating entity, half of which were business firms. Individual R&D projects managed by IAPMEI were substantially larger, at EUR 750 000 per project and EUR 255 000 per participant (calculation based on MCTES, 2017). Only very few of these schemes have been assessed, beside some evaluations conducted at overall programme level in the framework of Structural Funds.

Policy issue 8.3. Cluster-based approaches are instrumental to support innovation, including in less developed regions

Several examples in Portugal and elsewhere point to the importance of regional networks to support the innovation upgrading of firms in low-tech industry and service sectors, even in remote areas.

The added value of some innovation support schemes lies in the technical services they provide or in networking effects, rather or in addition to direct financial support. This is the case of ANI's mobilising projects (*Programas Mobilizadores*). Business leaders having benefitted from this scheme suggested to the review team that the primary benefit of these broad projects was the stimulus they provide to the development of networks within a sector, linking one part of the "value chain" to another, rather than the limited funds received by each participant. Also, as shown by one rare example of specific scheme evaluation, Structural Funds have positively supported the formation of competitiveness and technology poles and clusters.

These initiatives can also have a positive effect to alleviate regional imbalance in innovation, a major concern for Portuguese authorities. However, there are important limitations to what research and innovation policies can achieve to counter the strong territorial concentration dynamics. The attractiveness for knowledge-intensive firms and highly qualified individuals of the peripheral regions depends on a wide range of economic and socio-cultural factors. These factors are slow to change and range far beyond the research and innovation policy fields, such as the population decline in the interior of the country, which will increase in the future. Stronger and wider co-ordination between policy fields will be needed to address these issues and ensure that research and innovation policies contribute to alleviate economic and social development imbalances.

Policy issue 8.4. Further support for intermediary organisations in low tech industry and service sectors is needed

Cluster-based initiatives often develop around intermediary organisations, such as technology centres, or higher education institutions, particularly polytechnics and regionally profiled universities. The government has progressively created a diversified system of intermediary organisations (transfer offices, technology centres, S&T parks, incubators, poles and clusters) to fulfil a wide range of business knowledge transfer and service needs, from science-based to very incremental and problem-solving innovations. It has been documented that some of these intermediary organisations, in particular Technology Centres, have been in several cases very instrumental in this upgrading process. They not only gradually provided the necessary technologies and skills, but also promoted and supported collective actions among these – sometimes competing – firms. This upgrading process came, however, at the price of significant job losses in these sectors, as exemplified, for instance, by the shoe industry.

Some intermediary organisations received Structural Funds when launched, but have since received no basic funding. This has resulted in more consulting engineering and other commercial activities, and less "upstream" applied research and innovation-collaborative activities. The 2017 Interface Programme assists some intermediary organisations in rebalancing their activities between risky collaborative applied research and innovation activities and commercial activities. The programme provides multi-annual basic funding, measures to support the hiring of PhDs by these organisations in collaborations with industry, and financial support for the acquisition of new equipment. This institutional funding, if limited to the funding of public service missions and linked to regular evaluations, could have a significant effect on upgrading the domestic firms' innovation capacity.

In some countries, including the United States, the United Kingdom and several Latin American countries, specific institutions have been set up to provide various 'innovation support services' to SMEs, most often in a regional context.[6] These services include technology transfer and diffusion services (support in the form of advice and counselling for technology transfer and uptake by SMEs) as well as innovation management and non-technological innovation services (innovation management advice, audits to identify needs, innovation coaching, design and support for marketing innovative products, etc.) (OECD, 2011).

Policy issue 8.5. Mismatches between the supply and demand of qualified personnel may be hampering innovation

Portugal has improved the level of qualification of its population over the past decades. It now offers a fairly-qualified human resource base of graduates and PhD holders and low labour costs than other economies in Western Europe. However, there are some mismatches in graduate qualifications and industry needs. About 25% of young workers in Portugal were considered overeducated for their current positions in 2012; this is the highest rate of OECD countries for which data was available (ILO, 2014).[7] Specifically, there appears to be an overemphasis on academically-oriented PhDs relative to engineers or more professionally-oriented PhDs.

This originates, in part, in secondary education, where more practice-oriented curricula are not held in as high esteem as theoretically-focused curricula (chapter 5). As consequence,

practice-oriented higher education, e.g. at polytechnics, tends to be perceived as less attractive than academic education at universities.

Higher education and PhD training even in engineering disciplines do not consistently develop close links with industrial practice. Academic requirements seem to be difficult to reconcile with the need to prepare graduates for later employment outside of the public research system, and incentives for academics to intensify their collaborations are limited.

Policy issue 8.6. The knowledge exchange infrastructure should be strengthened to improve connections between tertiary education institutions (TEIs) and industry

Portuguese industry, public research and higher education institutions are not consistently connected to one another in a close and beneficial way. Data and the interviews performed in the course of this Review point to these factors:

- The nation's industrial structure is composed of SMEs in low to mid-tech activities for which the 'knowledge gap' between research carried out in academic institutions and firms is too wide to allow fruitful interactions, or even simply to identify the needs for such interactions.
- Public research is strongly oriented towards scientific criteria, and tends to be weakly oriented to the needs of the private sector. There are weak incentives for commercial collaboration on the side of higher education and research institutions at the institutional and individual researcher level. Despite progress in recent years, academic institutions and researchers still benefit more, in terms of funding or career advancement, from publications and citations than from research that is coupled to innovation. Moreover, Portuguese funding agencies have a tradition of 'neutral' research policy, i.e. without formal strategic orientations of the calls for proposal for instance. Applied research financed under Portugal2020, hence subject to the Smart Specialisation Strategy, has alleviated this problem only to a certain extent since the excellence-based section criteria remain prevalent here as well.
- Structured and institutionalised partnerships between HEIs and industry are infrequent, as demonstrated by the very limited share of higher education expenditures financed by business firms, although there are some notable examples. The new CoLAB scheme is an important new development that could alleviate this problem of the lack of institutionalisation and long-term commitment of partners, and be a channel to orient research towards economically and socially relevant objectives. Initiatives from Bosch and Hovione could also serve as role models for other companies or wider schemes. However, they also demonstrate that their main research partnerships are international rather than domestic, and that building such domestic partnerships requires years of private investment and public support.
- Practice-oriented research, undertaken in particular in polytechnics, is not recognised at the same level as academic research, either by the majority of students and researchers or by public authorities. Recent initiatives such as the Programme for the Modernisation and Promotion of Polytechnics attempt to change this mind-set.

Technology transfer offices and science and technology parks can help bridge the gap between firms and academic institutions. This has been demonstrated by international experience, and by several Portuguese 'start up' success stories. However, TTOs have often

limited budgetary and human resource. Studies have shown that the performance of knowledge transfer organisations and services is positively linked to the size of the higher education institutions to which they are connected. The University Technology Enterprise Network (UTEN) is an interesting initiative in that regard as it brings together the most internationally oriented technology transfer offices to strengthen their commercialisation of domestic research activities via joint activities and exchange of good practices (including through training of Portuguese technology transfer officers by American specialists).

Some countries have gone further and experimented with new approaches to strengthen knowledge transfer institutions and reach critical mass and high quality of services, for instance via the creation of new models such as technology transfer alliances (TTAs) which bundle the resources and standardise the practices of some TTOs.

8.4. Recommendations

Recommendation on providing resources to upgrade innovation capabilities

8.1. Establish regional innovation platforms to provide domestic SMEs easy access to critical resources – such as information, expertise, and equipment – for upgrading their innovation capabilities.

Efforts should be devoted to enhance the density of relationships in regions between domestic firms, higher education institutions (particularly polytechnics and regionally oriented universities), and the various intermediaries. This will require local and regional networks with a clearly acknowledged node offering a broad range of innovation services adapted to local needs.

The core of these networks could take the form of a permanent (rather than project-based) local platforms, i.e. 'light' co-ordination structures that gather on one site the competencies and offer of services of multiple partners (HEIs, Technology centres and various other intermediary organisations, consulting and engineering companies, individual experts, local administrations, etc.). Although not very formal (with a status of not-for-profit association for instance), it is essential that these platforms be resourced with some dedicated experienced staff and equipment (e.g. for metrology and testing) with the capacity to support the innovation activities of local companies. Different models exist, from the various types of regional innovation agencies (OECD, 2011) to technology-focused extension service organisations.

Emulating the best international practices, their activities should include not only specific hands-on support activities to individual (or groups of) SMEs (technical assistance and consulting, interface between experts, from academia and industry) but also public mission services (provision of information, awareness-raising, promotion of innovation, general capability building, etc.).

The public mission services provided by the platforms should be financed by the government on both the supply and demand sides:

- on the supply side, the platform needs permanent funding to set, operate and maintain the needed skills and equipment
- on the demand side, incentivise companies to use these services, for instance using ANI's current R&TD Vouchers.

The twofold mission of regional innovation platforms

Public mission background work	Specific support to SMEs or groups of SMEs/joint projects
– Provision of information on opportunities for improvement in existing technologies, best practices, international trends, relevant regulations, business networks, opportunities to become government suppliers and other support to contractual arrangements – Awareness raising – General capability building – Stimulation and/or running of networks and clusters – Node for local/regional partnership – Promotion of internationalisation, promotion of foreign investors – Facilitator for sharing scientific and technical equipment – Maintenance of database of experts	– Benchmarking of companies in the industry at the national and international levels to gauge performance level – Technical assistance and consulting in the context of innovation/improvement projects designed individually for interested companies (including identification of needs) – Training of plant and administrative staff for the effective use of technologies more advanced than those previously used by the company – Provision of services to a group or network of companies with common needs and challenges that are not directly related to competition among them – Joint projects of companies and public and academic laboratories for solving specific problems associated with the companies' products or processes – Advice on developing new strategies for the company and assistance in diagnosing and managing impending changes during implementation

Sources: Adapted from OECD (2011), "Maximising the impact of regional innovation agencies, http://dx.doi.org/10.1787/9789264097803-9-en; Rogers (2013), "Technology extension services".

Their beneficiary targets should include SMEs with limited in-house innovation capabilities that rarely co-operate with academia, do not hire highly skilled staff and seldom use shared equipment. These companies generally do not innovate due to a lack of entrepreneurial culture, skills, and incentives, or their inability to identify innovation opportunities.

Several organisations deliver some of these activities, including polytechnics, technology centres (and other intermediary organisations), Clusters and Poles, and networks financed by ANI's Mobilizing Projects. Building on the experience and resources of these organisations, the added value of the regional innovation platforms lies in their systematic approach and the wide range of services they would provide.

The precise composition and status of these platforms is beyond the scope of this Review. It should result from negotiations between national and regional authorities and the existing providers of some of these services.

Different options exist, including creating platforms within or in close connection with polytechnics, which could be the backbone of these platforms in each of their respective speciality. Several of the polytechnics the Review team visited have already engaged in significant collaborations with regional industries and services but these remain often on a limited scale. These institutions should be provided sufficient support and incentives to become acknowledged as key providers of research and innovation services in companies.

Recommendation on supporting efforts to strengthen local development

8.2. Continue upgrading polytechnics and regionally-profiled universities, supporting their capacity to further develop as 'practice-based knowledge-intensive institutions' dedicated to local development

Following a thorough review of their capabilities concerning linkages with industry partners, the most dynamic polytechnics and regionally profiled universities should be supported and incentivised to strengthen their profile in enhanced professional education. This profile would include short courses on emerging technologies, digitalisation, innovation management or other matters of primary relevance to industry, collaborative research and, more generally, the types of innovation support services needed in the regional innovation platforms. This would allow them to play a more extensive role in the provision of professional skills to support the upgrading of industry and services than they currently do.

The broadening of their range of missions and corresponding activities should be encouraged according to local needs, e.g. special forms of staff training geared towards the needs of clusters (on innovation, intellectual property (IP) management, digital transformation, internationalisation, etc.) and other support services to local companies. The type of public support they receive, currently focused on innovation projects in a rather narrow sense in the framework of the Structural Funds, should be adapted to this broadened portfolio of activities.

These HEIs could be incentivised to provide enhanced professional education through for instance institutional evaluation and performance contracts, in close connection with their research activities. Regarding Polytechnics specifically, the on-going specific FCT support to their research activities in collaboration with industry should be continued.

Recommendations on intermediary organisations to provide knowledge exchange and innovation services

8.3. Ensure that intermediary organisations have a sufficient level of guaranteed multi-annual funding to maintain and expand their networks, infrastructures and support services

Intermediary organisations (clusters, technology centres, applied research centres, etc.) fulfil various tasks to support innovation in firms and public organisations. Some of these tasks have the nature of public mission and should therefore be funded via stable state or EU funding (at a level of 20 to 30% of their turnover, as most of their counterparts with which they increasingly compete in Europe) in order to avoid significant drift toward more lucrative commercial activities (engineering consulting, etc.).

The government has recently announced the launch of the Interface Programme, which includes several support schemes (including a share of basic funding) for selected 'labelled' intermediary organisations. This programme should be implemented and maintained on a continuous basis for intermediary organisations that have successfully fulfilled the objectives announced in their development plans.

8.4. Support the sharing and pooling of resources among knowledge transfer organisations

The sharing and pooling ('mutualisation') of knowledge transfer services of different institutions should be promoted in order to encourage critical mass of project deal flows and strengthen the specialised expertise of internal staff of these organisations.

Various models of such groupings and partnerships –for instance the Technology Transfer Alliances – exist and could serve as examples [e.g. Innovation Transfer Network (ITN) in the United States, and *Sociétés d'Accélération du Transfert de Technologies* (SATT) in France. These initiatives differ according to the methods to mutualise knowledge transfer services, from the creation of networks and consortiums where some resources and shared and exchanges encouraged, to the merger of TTOs. The models also vary according to the logic of mutualisation, regional (one TTO to serve all universities and research institutions in a given region) or thematic (specialised 'hubs' of TTOs in specialised thematic areas).

Notes

1. In 2015, low- to medium-tech industries and low knowledge intensity services accounted for respectively 30% and 8% of the BERD.

2. Portugal fares better in international comparison when considering only firms active in services.

3. Creating and managing businesses under 42 months old.

4. Only about 3% of non-innovative firms consider the lack of qualified staff as a very important barrier to innovation, a proportion that is lower than the EU average. http://ec.europa.eu/eurostat/web/science-technology-innovation/data/database.

5. The number of companies included in the proposals to the first call was multiplied by respectively 3 and 2.5, representing 270 and 608 companies willing to participate in collaborative research.

6. The long standing and positively evaluated Manufacturing Extension Partnerships in the United States (Robey J. et al., 2018) and the former Manufacturing Advisory Services in the United Kingdom. Some of the Catapult Centres in the United Kingdom now provide such 'extension' services.

7. This indicator of over qualification, here defined as the percentage of workers having more years of education than the job requires, is based on the 2012 European Social Survey.

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Annex A. Assessment framework

The table below summarises how the characteristics of successful systems relate to the six aspects of the system.

Table A.1. Characteristics of effective tertiary education, research and innovation systems

	Does the system offer sufficient opportunities and incentives for engagement and co-operation?	Are there clear objectives and stable and predictable rules and policy frameworks at relevant levels of the system?	Is the system internationally open and attractive?	Is there a sufficient and predictable flow of resources and appropriate incentives for good performance and accountability?	Does the system allow enough differentiation, adaptiveness and flexibility?
1. Strategy, structures and funding at the level of the 'system'	Strategy and allocation of strategic resources at national level take into account the views and input of – and are broadly accepted by – a full range of relevant actors in the HERI system. There is adequate horizontal and vertical co-ordination between different policy-making, regulatory and funding bodies.	A strategy is established to guide the direction and objectives of the different actors in the HERI system, with a medium to long-term time horizon. The strategy identifies clear priorities and indicative allocation of resources to achieve objectives, permitting individuals and institutions to act with confidence and efficiency in planning their own activities (including hiring staff etc.).	Strategy and strategic allocation of resources take full account of the global context and opportunities for international co-operation. Promoting international openness and attractiveness is as a core priority.	Adequate financial resources are made available for strategic investment to support achievement of overall goals and priorities in system-level strategy. Analytical and support resources are in place to develop accurate and effective strategy and targeting of resources.	Strategy and resource allocation arrangements are neither over-prescriptive, nor set in stone. Actors at different levels of the system (funding agencies, HEIs) have flexibility and autonomy to take risks, be creative and adapt their activities to their specific needs and evolving circumstances, while keeping in line with the broad national strategic orientations; strategy and resource allocation are periodically reviewed to ensure continued relevance
2. Missions, profiles and use of resources in tertiary education and research institutions	A full range of relevant actors are involved in developing and agreeing missions, profiles and prioritisation of resource use for tertiary education and research institutions. In setting profiles, institutional leadership takes into	Higher education and research institutions have clear and missions and profiles that guide their activities and are tailored to the needs of the specific populations and regions they work in and serve. Relevant legislative, regulatory and funding instruments at system level	Institutional profiles and internal allocation and use of resources support international openness and attractiveness (e.g. attracting international staff and students).	Institutions of different types receive adequate resources to allow them to fulfil their missions, are rewarded for good performance in a transparent way and are held accountable for their use of public resources. Institutions have adequate management capacity	Strategies and funding arrangements at institutional level leave staff adequate autonomy and flexibility to pursue activities in creative and innovative ways. Institutional profiles are periodically reviewed to ensure continued relevance.

	Does the system offer sufficient opportunities and incentives for engagement and co-operation?	Are there clear objectives and stable and predictable rules and policy frameworks at relevant levels of the system?	Is the system internationally open and attractive?	Is there a sufficient and predictable flow of resources and appropriate incentives for good performance and accountability?	Does the system allow enough differentiation, adaptiveness and flexibility?
	account views of policy-makers, funders, staff, students and partners in the wider economy.	support clarity of missions and effective development and achievement of strategies		and professional staff to achieve goals.	
3. Undergraduate and Master's level education	Businesses and public services collaborate with HEIs in the design and delivery of programmes. Programmes are focused on student learning outcomes and involve adequate student-teacher interaction.	The course offering and the qualifications they deliver are transparent and easily understood by students and employers.	HEIs have international faculty, international co-operation and exchange in teaching (including credit mobility for students) and international students (in-coming degree mobile).	Adequate funding is provided for teaching activities; adequate training and incentives for good teaching are in place. There are adequate incentives and resources for student support (pastoral and financial)	An adequate range of course types and flexible modes of delivery are in place to serve students from different background and population groups. The course offering is regularly reviewed to ensure it remains relevant to student learning needs
4. Doctoral training	Businesses and public services collaborate with HEIs and funding bodies in delivering and funding PhD training and in determining priorities for PhD funding.	There are clear priorities against which PhD funding is allocated and the mechanisms for allocation of funding are clear and predictable for candidates, institutions and employers.	There are a significant numbers of international doctoral candidates in the system, alongside international faculty (supervisors) and co-operation agreements.	The level funding awards and support for doctoral programmes is adequate, the overall volume of funding is predictable and meets national needs and adequate incentive are in place to ensure relevance and good performance.	Funding mechanisms and doctoral training approaches reflect the need for a full range of PhD types, including practice-based research. The funding system and doctoral training provision are able to adapt to changing and specific skills needs.
5. Academic careers	Academic staff are closely involved in the development and achievement of the objectives of their institutions and research centres. They are encouraged and supported to develop innovative work that contributes to institutional and system-level objectives.	Regulations (national and institutional) and planning governing staffing are clear, relevant to the needs of the system and predictable for hiring managers, staff and potential recruits. Career structures, promotion rules and recruitment policies create clear pathways for career progression.	Significant numbers of international academic staff work in the national system, alongside nationals with international experience. International exchanges (e.g. sabbaticals) are promoted and commonplace.	Remuneration levels are adequate to ensure academic careers are attractive for talented individuals, including from abroad and the overall level of funding ensures adequate staffing levels. Remuneration and promotion is based on performance, ensuring staff are both incentivised and accountable for good performance.	Institutions and research centres are able to manage their human resources policy in a differentiated and flexible way, to respond to specific needs and changing circumstances.
6. High-skilled employment, co-operation with higher education	Opportunities and incentives are in place for co-operation and	Strategy and dedicated funding instruments to support high-skill	Strategy and policy and funding instruments to support innovation	Public and private resources allocated to innovation-related activities and support	Public policy and funding instruments to promote innovation are designed to accommodate the

	Does the system offer sufficient opportunities and incentives for engagement and co-operation?	Are there clear objectives and stable and predictable rules and policy frameworks at relevant levels of the system?	Is the system internationally open and attractive?	Is there a sufficient and predictable flow of resources and appropriate incentives for good performance and accountability?	Does the system allow enough differentiation, adaptiveness and flexibility?
institutions and innovation in the business sector	exchanges between 'academic' institutions and staff and individuals and organisations in the private economy and public services.	employment and innovation in the private economy and public services are clear, with changes organised to ensure transparency and predictability.	support the goals of international openness and attractiveness, including through attracting Foreign Direct Investment (FDI) and international staff.	institutions are adequate to needs. Public funding mechanisms for innovation are designed to incentivise effective private investment in research and innovation activities and provide sufficient accountability for use of public funds.	needs of different types of business / organisation / institution and respond quickly and effectively to changing circumstances.

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OECD Review of Higher Education, Research and Innovation: Portugal

Portugal aims to develop a more innovative, inclusive and productive economy, and to ensure that the ensuing benefits are widely distributed, regionally and socially. This report assesses the extent to which Portugal's higher education, research and innovation system is well configured to help Portugal achieve its vision of inclusive innovation, and identify which policy options might help it achieve its goals.

The assessment and the related recommendations focus on: 1) governance, strategy and funding in higher education, research and innovation; 2) the missions, profiles and use of resources of higher education institutions; 3) undergraduate and master's level education activities; 4) doctoral training activities; 5) academic careers; 6) high-skill employment and business innovation.

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