

This publication is a Science for Policy Report by the Joint Research Centre, the European Commission's in-house science service. It aims to provide evidence-based scientific support to the European policy-making process. This publication, or any statements expressed therein, do not imply nor prejudge policy positions of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

Contact information

Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)

E-mail: jrc-ipts-secretariat@ec.europa.eu

Tel.: +34 954488318

Fax: +34 954488300

JRC Science Hub

<https://ec.europa.eu/jrc>

JRC101210

EUR 27873 EN

PDF ISBN 978-92-79-57808-3 ISSN 1831-9424 doi:10.2791/493673 LF-NA-27873-EN-N

© European Union, 2016

Reproduction is authorised provided the source is acknowledged.

How to cite: Manuel Mira Godinho, Vítor Corado Simões, Jana Zifciakova; RIO Country Report 2015: Portugal; EUR 27873 EN; doi:10.2791/493673

All images © European Union 2016 except for the ERA Dashboard image on the first page by Niels Meyer licensed under CC BY 2.0

Abstract

The 2015 series of RIO Country Reports analyse and assess the policy and the national research and innovation system developments in relation to national policy priorities and the EU policy agenda with special focus on ERA and Innovation Union. The executive summaries of these reports put forward the main challenges of the research and innovation systems.

Table of Contents

Foreword	4
Acknowledgments	5
Executive summary	6
1. Overview of the R&I system	14
1.1 Introduction	14
1.2 Structure of the national research and innovation system and its governance	15
1.2.1 Main features of the R&I system.....	15
1.2.2 Governance.....	17
1.2.3 Research performers	19
2. Recent Developments in Research and Innovation Policy and systems	20
2.1 National R&I strategy	20
2.2 R&I policy initiatives	21
2.3 European Semester 2014 and 2015	24
2.4 National and Regional R&I Strategies on Smart Specialisation.....	26
2.5 Main policy changes in the last five years	29
3. Public and private funding of R&I and expenditure	30
3.1 Introduction	30
3.2 Smart fiscal consolidation.....	31
3.2.1 Economic growth, fiscal context and public R&D	31
3.2.2 Direct funding of R&D activities	32
3.2.3 Indirect funding – tax incentives and foregone tax revenues	35
3.2.4 Fiscal consolidation and R&D.....	36
3.3 Funding flows	37
3.3.1 Research funders	37
3.3.2 Funding sources and funding flows	37
3.4 Public funding for public R&I	39
3.4.1 Project vs. institutional allocation of public funding	39
3.4.2 Institutional funding	40
3.4.3 Project funding	41
3.4.4 Other allocation mechanisms	42
3.5 Public funding for private R&I	42
3.5.1 Direct funding for private R&I	42
3.5.2 Public Procurement of Innovative solutions	44
3.5.3 Indirect financial support for private R&I	44
3.6 Business R&D	45
3.6.1 The development in business R&D intensity	45
3.6.2 The development in business R&D intensity by sector.....	46
3.6.3 The development in business R&D intensity and value added.....	47
3.7 Assessment.....	49
4. Quality of science base and priorities of the European Research Area	51

4.1	Quality of the science base	51
4.2	Optimal transnational co-operation and competition	52
4.2.1	Joint programming, research agendas and calls	52
4.2.2	RI roadmaps and ESFRI	53
4.3	International cooperation with third countries.....	54
4.4	An open labour market for researchers.....	54
4.4.1	Introduction	54
4.4.2	Open, transparent and merit-based recruitment of researchers.....	55
4.4.3	Access to and portability of grants	57
4.4.4	Doctoral training	57
4.4.5	Gender equality and gender mainstreaming in research	58
4.5	Optimal circulation and Open Access to scientific knowledge.....	58
4.5.1	e-Infrastructures and researchers electronic identity	58
4.5.2	Open Access to publications and data.....	59
5.	Framework conditions for R&I and Science-Business cooperation	61
5.1	General policy environment for business.....	61
5.2	Young innovative companies and start-ups	62
5.3	Entrepreneurship skills and STEM policy	63
5.4	Access to finance	65
5.5	R&D related FDI.....	66
5.6	Knowledge markets	67
5.7	Public-private cooperation and knowledge transfer.....	68
5.7.1	Indicators	68
5.7.2	Policy measures	74
5.8	Regulation and innovation	76
5.9	Assessment of the framework conditions for business R&I.....	76
6.	Conclusions.....	77
	References	80
	Abbreviations	83
	List of Figures.....	85
	List of Tables	86
	Annex 1 – List of the main research performers	87
	Annex 2 – List of the main funding programmes	88
	Annex 3 – Evaluations, consultations, foresight exercises	89

Foreword

The report offers an analysis of the R&I system in Portugal for 2015, including relevant policies and funding, with particular focus on topics critical for EU policies. The report identifies the main challenges of the Slovak research and innovation system and assesses the policy response. It was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The quantitative data is, whenever possible, comparable across all EU Member State reports. Unless specifically referenced all data used in this report are based on Eurostat statistics available in February 2016. The report contents are partly based on the RIO country report, 2014 (Mira Godinho, Corado Simões, 2015a).

Acknowledgments

The report draft has benefited from the comments and suggestions of Madalena Antunes Pereira from the Ministry of Science, Technology and Higher Education of Portugal and John Edwards from JRC IPTS.

Comments from DG RTD are also gratefully acknowledged. Peter Fako, Lorenzo Isella and Athina Karvounaraki produced the statistics and the analytical assessments for sections 3.2 and 3.6 of the report.

We would like to thank Sophie Bodart for her assistance in preparing this report for publication.

Authors' affiliation:

Manuel Mira Godinho, University of Lisbon (Lisbon, Portugal)

Vitor Corado Simões, Technical University of Lisbon (Lisbon, Portugal)

Jana Zifciakova, European Commission, Directorate-General Joint Research Centre, Directorate J - Institute for Prospective Technological Studies, Innovation Systems Analysis unit (Brussels, Belgium)

Executive summary

Context

The Portuguese economic and political context has been characterised by austerity and slow growth. Even if the Economic Adjustment Programme negotiated with the EC, ECB and IMF ended in May 2014, the economic adjustment is still being pursued. This economic climate has had an impact on the R&D expenditure. The trend in terms of R&D investment was positive until the beginning of the recession, with the GERD/GDP ratio peaking at 1.58% in 2009, for a Gross Expenditure in Research and Development (GERD) of €2,772m. However, after 2009 R&D followed the overall macroeconomic trend. The latest data show that the GERD/GDP ratio has declined between 2009 and 2014 from 1.58% to 1.29% and the BERD/GDP ratio has dropped from 0.75% to 0.59%.

There has been a decline in the manufacturing sectors. In 2013, the services sector accounted for 76.2% of the total production, manufacturing and extracting industries for 13.3% and agriculture for only 2.4%, with the remaining being accounted for the utilities and construction sectors. Employment in high- and medium-high-technology manufacturing sectors as a share of total employment in Portugal is at about half of the EU average, at 2.9% versus 5.6% in 2013. The situation is relatively better in what concerns employment in knowledge-intensive service sectors as a share of total employment, with 33.2% in Portugal versus 39.2% in the EU.

The national R&D intensity target for 2020 is set to 2.7%-3.3%, with the business sector expected to contribute to 1.7%-2.1% and the public sector to 1.0%-1.2%. These targets were defined in the National Reform Programme 2011 and were kept for several years, although they were quite unrealistic. The goal for R&D expenditures as a share of GDP in 2020 was revised to 2.7% in 2014 and confirmed in the National Reform Program 2015. The likelihood of such target being met is not high because instead of rising, the R&D intensity has been falling over the past few years. Since the outset of the crisis, conditions related to the activity of the R&I system have deteriorated, increasing the potential for an irreversible loss of critical mass, due to a dynamic emigration of highly-skilled researchers (Sistema de Segurança Interna, 2013). This was recognised by the 2015 NRP, which underlines the need to the promotion of high-skilled jobs to keep talents in Portugal. This is an important change in political stance, which had previously downgraded the significance and the risks of the emigration of masters and doctors.

The country-specific recommendations issued by the Council of the EU in 2014 highlight the need to enhance cooperation between public research institutions and businesses and foster knowledge transfer.

Key recent developments include:

- The Agência Nacional de Inovação was created, replacing the former Agência de Inovação.
- The Operational Programmes under the Portugal 2020 Partnership Agreement started to be implemented and several measures have reached cruise speed.
- The 2013 evaluation of the research units carried out by FCT was finished in May 2015.
- The October 2015 election led to the establishment of a new government in December, with changes expected in relation to research policy; a new FCT President was already nominated.

Despite some important advancements, the Portuguese R&I system still faces very significant challenges. Some of these come from deep, historical structural weaknesses that require sustained and significant policy efforts to tackle them. Others stem from the 2011-2015 austerity policy, which has raised new challenges not just for companies but also for research organisations.

The identified challenges for the Portuguese R&I system are:

1. Strengthening in-house R&D, as well as technological, organisational, marketing and managerial capabilities in business firms;
2. Stimulating structural change, by fostering the emergence of new companies, both domestic and foreign-owned, particularly in knowledge-intensive activities;
3. Improving cluster policies and developing systemic approaches to strengthening synergies between science and industry; and
4. Improving the R&I governance, building trust and ensuring the sustainability of the research system.

R&I Challenges

Challenge 1: Strengthening in-house R&D, as well as technological, organisational, marketing and managerial capabilities in business firms

Description

Faced with the financial constraints, companies have followed a two-pronged attitude. One has been an increased focus on international markets to escape from domestic market decline. The other has been a more cautious financial stance, saving money to compensate for difficulties in access to credit. The first had mixed implications for investment in research and innovation. While the moves towards developed and Asian markets required an increase in the commitment to innovation, those addressed to Portuguese-speaking markets, did not rely so much on innovation. In this case, the rationale has been very much the replication of approaches already followed in the domestic market, while with some adaptations. The second attitude, while making firms more aware of the opportunities for process innovation, had a negative effect on business firms' propensity to carry out R&D expenditures.

Strengthening the support for developing technological, organisational, marketing and managerial capabilities in business firms to increase firms technology and knowledge intensity and foster the emergence of new companies (both domestic and foreign-owned) in knowledge intensive sectors is therefore a key challenge for the Portuguese R&I system.

Policy Response

The government established, in 2007, in the context of the COMPETE 2007-2013 programme, under the 2007-2013 National Strategic Reference Framework, three key initiatives to stimulate business R&D and support business innovation. SI I&DT aims at intensifying BERD, increasing competitiveness and fostering cooperation. SI Inovação targets the development of new goods, services and processes in export-oriented firms in strategic sectors. SI Qualificação PME aims at increasing SMEs competitiveness through financing to enhance their productivity, flexibility and responsiveness to the global market. In 2013 the first two initiatives supported 847 projects with a budget of EUR 755 million.

Tax incentives are an important instrument for promoting business R&D activities. In Portugal they include the system of Tax Incentives for Research and Development (SIFIDE II) and the regime of scientific patronage. SIFIDE II provides generous incentives for companies and its application has been revised and extended in 2014 with the Tax Investment Code (Decree-Law 162/2014) until 2020. SIFIDE II comprises two types of incentives for companies performing R&D: a basic tax incentive, corresponding to 32.5% of eligible R&D expenditure undertaken in the relevant fiscal year, and an incremental incentive, corresponding to 50% of the increase in R&D expenditure compared to an average of the two previous years. The amount of tax credits approved under SIFIDE has been close to 100 MEUR/year.

In the new framework provided by the Portugal 2020 framework, the 'Operational Programme for Competitiveness and Innovation', whose short name is COMPETE 2020, comprises 6 axis, with its axis 1 dedicated to the strengthening of research, technological development and innovation. Axis 1 includes a variety of policy tools to support R&I by business firms.

Measures aimed at promoting knowledge sharing and the development of SMEs capabilities are taken at the national and especially regional levels, including in Regional OPs. These include the SMEs' Capabilities and Internationalisation Incentive System and the SMEs Productive Innovation scheme, which aims at encouraging investment projects carried out by SMEs with the purpose of launching new goods and services as well as of adopting new manufacturing, logistics, and distribution processes and new organization methods.

Policy assessment

The country has not been so far capable to overcome its focus on activities of lower knowledge intensity and to build innovation-friendly framework conditions for business investment in R&I. Though still limited, the number of firms conducting R&D activities on a permanent basis has been steadily increasing, collaborative R&D projects became a common feature in several economic sectors and some of the innovation output indicators show signs of an improved, although still modest, R&I performance. There is potential for gains from economies of scale and knowledge spillovers, enhanced by the concentration of clusters in the regions Norte and Centro and the national scientific specialisation.

The analysis of tax credits granted over the period 1999-2008 revealed they were ineffective as they concentrated on a limited number of industries. The majority of them were directed to manufacturing and more than half to three industries (pulp and paper, chemical and pharmaceutical and electronic products). Although low and medium-low tech industries predominated, the weight of high and medium-high tech industries in the tax credits are particularly striking when compared with the relative importance of this type of activities in the Portuguese economy. The asymmetric distribution of public funds across industries was even clearer in the case of tax incentives for R&D. Close to half of the tax incentives for R&D granted between 2006 and 2008 were focused on six industries (IT services, pharmaceuticals, automotive industry, telecommunications, and electronic products). (Godinho, Mamede & Simoes, 2013).

The evaluations of the measures included in the former COMPETE 2007-2013 programme were positive. Among the main findings of the evaluation exercise focussed on innovation and internationalisation (IESE/Quatenaire Portugal, 2013), it was pointed out that the incentive system had reached a high level of maturity, drawing upon a systemic concept of competitiveness, and had been focussed on promoting companies' capabilities, as well as on collective initiatives; and that there had been a co-evolution of companies' capabilities in innovation and internationalisation.

Challenge 2: Stimulating structural change, by fostering the emergence of new companies, both domestic and foreign-owned, particularly in knowledge-intensive activities

Description

As outlined above, the relative weight of the manufacturing sectors has been declining in favour of the services sector. However, much of the new activities that have been set up meanwhile operate in non-tradable product areas.

The evolution of the country's international specialisation has not been favourable. While the share of the exports of the medium-low tech sectors was 13.7% in 2001, it reached 26.5% in 2014. In contrast, in the same period the high-tech exports declined from 11.4% to 6.9%, with medium high-tech exports staying relatively unchanged.

The situation is intensified by the fact that the size distribution of firms is marked by a significant absence of large internationally-oriented companies in medium-high and high-tech sectors. These are usually companies which carry out the majority of business R&D expenditure, and this situation hinders the possibility of Portugal to move up in the business R&D rankings.

Policy Response

A new financing line for Business Angels was open in 2014 to promote entrepreneurship and stimulate the creation of new companies and the launch of innovative projects by providing seed and early stages capital. The line is addressed to companies majority-owned and managed by at least three Business Angels, whose investment policy is focussed on seed capital and early stages with at least five years. The overall amount assigned to this financing line is €10 million. The programme +Inovação +Indústria launched in 2012 by Portugal Ventures, the public venture capital organisation, in line with the reindustrialisation initiative, is set to invest in the creation of new companies in traditional industries.

Portugal defined a RIS3 as a result of a process launched by IAPMEI and FCT, with a significant involvement from stakeholders. The process started with a SWOT exercise to identify the main strengths and weaknesses of Portugal's R&I system as well as to devise the main opportunities and threats faced (FCT, 2013 and 2014). The RIS3, approved in December, 2014, defines a set of thematic R&I priorities, combining both the national and regional levels.¹ Those priorities cover a wide range of sectors, focusing on improving some traditional areas while investing in the development of new emerging activities.

Policy assessment

The design of the RIS3, led by IAPMEI and FCT, provides a good example of participatory involvement from different stakeholders, as well as of collaboration between national and regional bodies. The ex-ante evaluations of COMPETE 2020 were on these issues also positive.

The policies aimed at attracting foreign direct investment were based mainly on financial and tax incentives. The commitment to attract R&D-intensive investments, which are rather driven by the quality of the workforce, the country's research system as well as local suppliers, has not been strong enough.

Despite the evaluation of the measures included in the former COMPETE 2007-2013 programme being positive, as outlined above, that evaluation highlighted some areas for improvement, namely: the financing of start-ups; public policy intermediation through the involvement of industry associations; the dissemination of results throughout the economic fabric, and clustering initiatives.

There has been, however, a contradiction between these policies and the overall aim of reducing labour costs which has characterised the economic policy followed by the XIX Constitutional Government. This has discouraged change while fuelling a return to cost-based strategies instead of innovation and differentiation ones (Mamede, Godinho & Simões, 2014; Mamede, 2015).

¹ Regional strategies are anchored on the "thematic axes", but they express them in different ways and with different focus areas. For instance, the Norte region takes on-board all the fields considered at national level and assigns them different priorities, putting the focus on: ICTs; Manufacturing Technologies & Product Industries; Automotive, Aeronautics & Space Industries; Health, and; Cultural and Creative Industries. In contrast, the strategy for the Algarve does not include all the axes defined at the national level, focusing instead on the Maritime Economy and Tourism.

Challenge 3: Improving cluster policies and developing systemic approaches to strengthening synergies between science and industry

Description

There is a widespread agreement that the strengthening of the interactions between science and industry is mandatory. However, the dominant policy perspective to respond to the problem, expressed on both Portugal 2020 and the successive NRPs, is based on a 'technology transfer' view, which suffers from a linear, supply-side, bias, assuming that knowledge goes from science to industry only.

The academia-industry cooperation as measured by the indicator Public-private co-publications per million of population in Portugal, (in spite of a 7.4% increase in performance in 2015) is still very low, at the 30% of EU average (IUS, 2015).

Portugal lags behind the EU average as to the involvement of businesses in science and innovation. It has stepped up investment in R&I over the past years with an annual real growth rate of 7% between 2000 and 2007, yet its performance is still below the EU average. Portugal's overall R&D intensity fell from 1.58% in 2009 to 1.33% in 2013. Public R&D intensity diminished by an average annual growth of 0.4% from 2008 to 2013, reaching 0.68% in 2013. Business R&D intensity has also fallen since 2009 and by 2013 it was only about half of the EU average. In 2012 public expenditure on R&D financed by business enterprises was very low (0.007% of GDP), pointing to a very low level of cooperation between business and science, with Portugal among the bottom five EU countries.

The low share of privately funded R&D activities performed by the public sector has its roots in the structural composition of the Portuguese economy with economic activities of low or medium-low technological intensity. Portugal has more than 80% of doctoral affectations in higher education institutions and is the EU country with the lowest rate of PhD holders employed in the business sector: 2.6% only (FCT 2013, SWOT analysis of Portugal's research and innovation system).

Policy response

Following the launching of the cluster initiative in 2009 and its evaluation in 2013, the government revised the cluster policy and, in March 2015, published a regulation on the recognition of Competitiveness Clusters, making a distinction between consolidated and emergent clusters. The recognition of a cluster entails the establishment of a contract with IAPMEI regarding the definition of duties, objectives and goal for the cluster. In the frame of Compete 2020, clustering initiatives are provided financial support under the Collective actions support system.

In 2012, the University Technology Enterprise Network (UTEN) supported the commercialisation of public research with a budget of EUR 1.6 million. The Fundação para a Ciência e a Tecnologia (FCT), through the Portuguese Technology Transfer Initiative of 2012 promotes knowledge diffusion from large European agencies (e.g. CERN, ESO, ESA) to Portuguese firms, with a focus on space industry.

The newly established Agência Nacional de Inovação (ANI), which supports cooperation projects between research and industry, has been given a stronger role and its governance streamlined, which is expected to improve productivity and competitiveness. A new scheme for industry PhD studentships has been established by the FCT to increase productivity and competitiveness.

Portugal has a well-established practice in providing public support to science and technology parks and to technology-based and innovation-based incubators. There is an overabundance of business incubators facilities, yet many of them are too small or lack the know-how to provide relevant services for start-ups. There are, however, a few examples of very successful incubation facilities, comprising the Coimbra-based Instituto Pedro Nunes, which has won several international awards.

The design of the Compete programme enabled to solve the latent conflict and overlap between the Ministries in charge of economic and scientific affairs. This positive development was strengthened with COMPETE 2020 and the establishment of more appropriate governance approaches. Both the Research and technological development and the Scientific and technological research incentive systems support cooperative projects, namely in fields consistent with RIS3. COMPETE 2020 will also support Science-based entrepreneurship.

Policy Assessment

An increase in the number of collaborations between companies, universities and research institutes and an intensification of knowledge flows at national and international level, has been registered over the past years. Evaluations of the 2007-2013 Compete programme and the 2007-2013 National Strategic Framework indicate that the results have been overall positive, with evidence of an increased level of cooperation between research organisations and business firms (IESE/Quatenaire Portugal, 2013; Mamede, 2012). With regards to clusters, the evaluation findings are mixed with results short of expectations (SPI&Inno TSD, 2013). The evaluation suggests a thorough revision of existing clusters through a procedure of re-evaluation of clusters' capabilities and performance; this has been taken into account in the above mentioned revision of cluster policy. The establishment of appropriate links between clustering, R&I and territorial policies in connection with Smart Specialisation strategies was also highlighted.

There are still several challenging issues, which need to be addressed, both on demand and supply side. On the demand side, the manufacturing sector is characterised by medium-low and low tech companies with a lower propensity for R&D activities (challenges 1 and 2) and, on the supply side, budgetary constraints may limit the flows of knowledge from academia. The problem is amplified by the linear approach pervading many of the policies focused on the promotion of cooperation between science and industry, namely the initiative 'Programme of Knowledge and Technology Transfer towards Companies' mentioned in Portugal's NRP. This reinforces the one way knowledge transfer process (Godinho & Simões, 2015), and undermines the possibilities to develop a clear view about the systemic nature of the innovation process, including its non-technological dimensions.

Challenge 4: Improving the R&I governance, increasing stakeholders' role in shaping the R&I policy and ensuring the sustainability of the research system

Description

Portugal's research system has experienced a significant development, following Portugal's entry into the European Economic Community in 1986, supported by the allocation of Structural Funds. This trend was strengthened since mid-1990s, through a substantial effort to finance research activities in all scientific fields. This enabled Portugal to create a very active and growing research community.

However, in recent years the funding of research has been restricted to the austerity policies as reflected by the negative evolution of the GBAORD. The recessive environment led to an important emigration flow as well as to increased financial difficulties on the side of the research units. With such a background, an increased awareness emerged about the need to rationalise the research system, namely through mergers between research units and other measures.

The international evaluation of research units started by FCT in 2013 was carried out with the aim to reinforce the role of research units but also to enhance the financial sustainability of the research system. This evaluation was concluded in 2015 and generated a multi-tiered system of research units. Some elements of the process stirred controversy (FCT, 2015). This was followed by changes in the FCT management and a panel evaluation of the process.

There is a need to improve policy governance and consistency. The government's techno-structure integrated the R&D and innovation issues only to a limited extent. The process of establishing the R&I strategy through Smart Specialisation recognised also the existence of the traditional divide between research and innovation as a major hindrance to the quality and consistency of the Portuguese R&I system (Caraça, 1999, Godinho & Simões 2005). Portugal has a structured consultation system with several bodies. However, the consultation process is not done systematically and relies on the ministerial commitment. The involvement of stakeholders in the process of designing R&I policies, especially on the entrepreneurial side, is still limited.

Policy response

In the recent past, several initiatives were implemented to bridge the research and innovation policies divide, involving a new approach to inter-ministerial collaboration, namely between the ministries for Education and Science and for the Economy, and the model of governance of Portugal 2020. The main policy responses followed two main axes (governance and inter-ministerial cooperation, and the design of Smart Specialisation Strategy (RIS3)), besides the cluster approach (Challenge 3). The first included two aspects: a new approach to inter-ministerial relationships, namely between the Ministries for Education and Science and for Economy, promoting cooperation and adjustment instead of confrontation (Cooke & Simões, 2013) and the model of governance of Portugal 2020, which goes further than the 2007-2013 National Strategic Reference Framework. Important developments were the creation of the Development and Cohesion Agency, the setting up of the Inter-ministerial Commission for Coordination of the Partnership Agreement (CIC), and the formal establishment of several functional cooperation networks, including regional dynamics, incentive systems, and support to R&D&I and smart specialisation. The development of the RIS3 sets up a good example of participatory involvement of stakeholders and an effective collaboration between national and regional bodies.

Faced with budgetary constraints which have curtailed the financial envelope available to support research, the government made an effort to diversify the sources of financing, namely through the encouragement of an increased recourse to EU programmes, namely in the context of the R&TD programmes (FP7 and Horizon 2020). This was envisaged as essential element for the sustainability of larger research organisations. Several initiatives were taken on this regard, following the creation of the office for promoting S&T cooperation. This drive emerges also in COMPETE 2020. In fact, both the Research and technological development and the Scientific and technological research incentive systems provide for R&D internationalisation projects.

With regard to promoting scientific employment, a few measures were taken in recent past. These include the FCT-Investigator, the Doctoral programmes in Companies and SIFIDE II. The revision of SIFIDE II has provided improved conditions for the recruitment of high-skilled labour by firms, since expenditures with the wages of PhD holders are considered as 120% of the wages effectively paid.

The process of evaluation of research units launched by FCT in 2013 was also aimed at enhancing the financial sustainability of the research system. There was the idea that increased budgetary constraints demanded the reduction of the number of research units supported and an increased selectivity in assigning funding.

Assessment

The assessment of recent policy developments regarding the governance of the R&I system is mixed. Some may contribute to a new collaborative approach among the different public organisations involved in R&D policy. The CIC is likely to provide a forum to enhance policy coordination and to make implementation more effective. The design of the RIS3, led by IAPMEI and FCT, provides a good example of participatory involvement from different stakeholders, as well as of collaboration between national and regional bodies.

Increasing stakeholders' role in shaping the R&I policy remains an important challenge. Research and innovation activities are collaborative processes which demand appropriate links and collaborative networks among the players. To address this, a new policy approach, based on cooperation, stakeholder participation and open discussion could enable the development of rigorous and reasonable R&I strategies.

1. Overview of the R&I system

1.1 Introduction

With 10.4 million inhabitants in January 2015, Portugal has a 2.0% share of the EU population. In terms of GDP, the share is smaller, standing at 1.24% in 2014. These figures translate into a GDP per capita in purchasing power parity which was equivalent to 60.8% of the EU's 2014 average.

After a period of severe negative growth, which peaked in 2012 (with -4.0%), the trend (though still in the negative field) reversed in 2013 (-1.1%) and moved to positive values in 2014 (0.9%) and in 2015 (1.7% GDP growth as estimated by the [Autumn 2015 European Economic Forecast for Portugal](#)).

Despite the austerity policies that have been carried out, the country still boasts a budget deficit well above the EU average, with a deficit/budget ratio of -4.5% versus -2.9% for the EU overall. Further, despite the annual budget deficit declining in recent years, this has not been enough to change the raising trend of the national public debt, with the government debt rising to 130.2% in 2014, the second highest in the EU.

In correlation with the changing trend of the GDP, unemployment has also declined recently, from 16.4% in 2013, when it peaked, to 14.1% in 2014. However this most recent improvement in unemployment is also associated with a contraction of the number of those who are statistically accounted for as active population.

The economic structure of the country has been changing fast over the most recent decades, namely with a severe decline of the manufacturing sectors. In 2013, and referring to data provided by the national statistics institute (INE), the services sector accounted for 76.2% of the total production, manufacturing and extracting industries for 13.3% and agriculture for only 2.4%, with the remaining to 100% being accounted for the utilities and construction sectors. The equivalent figures for employment in 2013 were respectively 60.0%, 14.0% and 11.3%, thus reflecting quite different labour productivity levels across the main sectors.²

Employment in high- and medium-high-technology manufacturing sectors as a share of total employment in Portugal is at about half of the EU average, at 2.9% versus 5.6% in 2013. The situation is relatively better in what concerns employment in knowledge-intensive service sectors as a share of total employment, with 33.2% in Portugal versus 39.2% in the EU.

Concerning the turnover of innovation as a % of total turnover, Portugal seems to be still in a better position vis-à-vis the EU average, with values of respectively 12.4% and 11.9% in 2012.

Up until the beginning of the recession, the trend in terms of R&D investment was positive, with the GERD/GDP ratio peaking at 1.58% in 2009, for a GERD (Gross Expenditure in Research and Development) of € 2,772m. However, after that year R&D followed intensively the overall macroeconomic trend. By 2013, the Portuguese GERD was € 2,334m, which translated into a GERD/GDP ratio of 1.33%, still down from the previous year by 0.05%.

The national R&D intensity target for 2020 is 2.7%-3.3%, with the business sector expected to contribute 1.7%-2.1% and the public sector 1.0%-1.2% to that value.

The likelihood of such target being met is not high. Instead of rising, the R&D intensity has been falling, at least until the most recent data that has been provided by the statistical authorities. A positive factor is that the operational programmes of the national reference framework Portugal 2020 have been advancing fast, thus delivering a new wave of structural funds into the R&D system. However, the capacity of the

² The INE data for GVA can be seen in this link and for employment in this other link.

business sector to increase its contribution from less than 0.7% to 2% of the GDP over the next 5 years seems highly unlikely. Further to the overall contraction of manufacturing, the specialisation trend has been one of reinforcement of the medium-low tech sectors, instead of the medium-high and high-tech sectors, which are the natural performers of R&D activities. While the % of the exports of the medium-low tech sectors was 13.7% in 2001, it reached 26.5% in 2014. In contrast, in the same period the high-tech exports declined from 11.4% to 6.9%, while the medium high-tech exports kept relatively unchanged.³

Table 1 – Main R&I indicators 2012-2014

Indicator	2012	2013	2014	EU average +
GDP per capita	16 000	16 200 (e)	16 600 (e)	27300
GDP growth rate	-4.0	-1.6 (e)	0.9 (e)	1.3
Budget deficit as % of public budget	-5.6	-4.8	-4.5	-2.9
Government debt as % of GDP	125.8	129.7	130.2	86.8
Unemployment rate as percentage of the labour force	15.8	16.4	14.1	10.2
GERD in €m	2,316	2,334	n.a.	271,220 (Total for EU 28)
GERD as % of the GDP	1.38	1.33	1.29%	2.03
GERD (EUR per capita)	220.1	221.4	n.a.	536
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	2.8	2.9	n.a.	5.6 *
Employment in knowledge-intensive service sectors as share of total employment	32.5	33.2	n.a.	39.2*
Turnover from innovation as % of total turnover	12.4	n.a.	n.a.	11.9**
Value added of manufacturing as share of total value added	24.0	n.a.	n.a.	n.a.
Value added of high tech manufacturing as share of total value added	0.58	0.60	n.a.	n.a.

Notes: e - estimated; n.a. – not available; + all EU values are for 2014, except * (2013) and ** (2012).

1.2 Structure of the national research and innovation system and its governance

1.2.1 Main features of the R&I system

Notwithstanding a rising BERD/GERD share over the 2000s decade, R&D governance is still dominated by the public sector. The research system has been marked by a high degree of centralisation, through fund allocation and political coordination. The regions have had a minor role in the allocation of research funds. This situation has been changing though, as a part of those structural funds dedicated to research have been allocated to the regional operational programmes (OPs). In 2015, 29.9% of the GBAORD allocations were for the 5 continental regional OPs, plus the two Atlantic regional OPs. National R&D budgets are not announced annually ex-ante, together with the preparation of the national government budget, as they are rather presented as an ex-post accounting exercise. At €1,756 m in 2015, the government budget appropriations or outlays for R&D were at almost the same level of 2010, when they peaked at €1,768

³ The source of this information is the Portuguese Ministry for the Economy (follow this [link](#)).

m, though they were significantly higher than in the previous year, when they were €1,626 m

Focusing on actual R&D funding, instead of the budget perspective, in 2013 the government sector contributed to 47% of the executed GERD, while the business sector contributed with a smaller share, at 42%. The remaining to 100% was covered by foreign funding, higher education and the private non-profit sectors with shares of, respectively, 5%, 4% and 2%. Historically the government sector had a much higher contribute, peaking at 70% in 1999, but after that year there was a growth of business funding, which reached its top share at 48% in 2008.

When turning to the expenditure side of GERD, and still referring to 2013 values, the breakdown is significantly different from the one observed for funding, with the government sector accounting for only 7% of the national GERD and the higher education being the great beneficiary, with a share of 45%. Business is an exception to this changing pattern, with BERD accounting for 48% of the national GERD, thus revealing a share close to the 42% the sector contributes to funding. Historically the government sector was the top performer, but is has relatively shrank decade after decade as governments have not invested in the sector, this eventually leading recently to the closure of one of the public labs (IICT, tropical research).

The analysis of micro data referring to the top 100 firms investing in R&D in 2012 reveals that they accounted for about 65% of total BERD, with a high concentration at the top 10, which is responsible for about 35% of the 2012 BERD. This ranking is led by PT, a telecom company, with €144.9m, followed by Bial, SONAE and Nokia Siemens, with respectively €55.7m, €50.9m and €50.8m in 2012. The 100th company in this ranking spent little less that €1.5m in R&D in 2012. Within the top 10 R&D spenders Nokia Siemens is the only multinational firm, and direct funding by foreign firms does not seem to be significant, at only €15.0m in 2012.

1.2.2 Governance

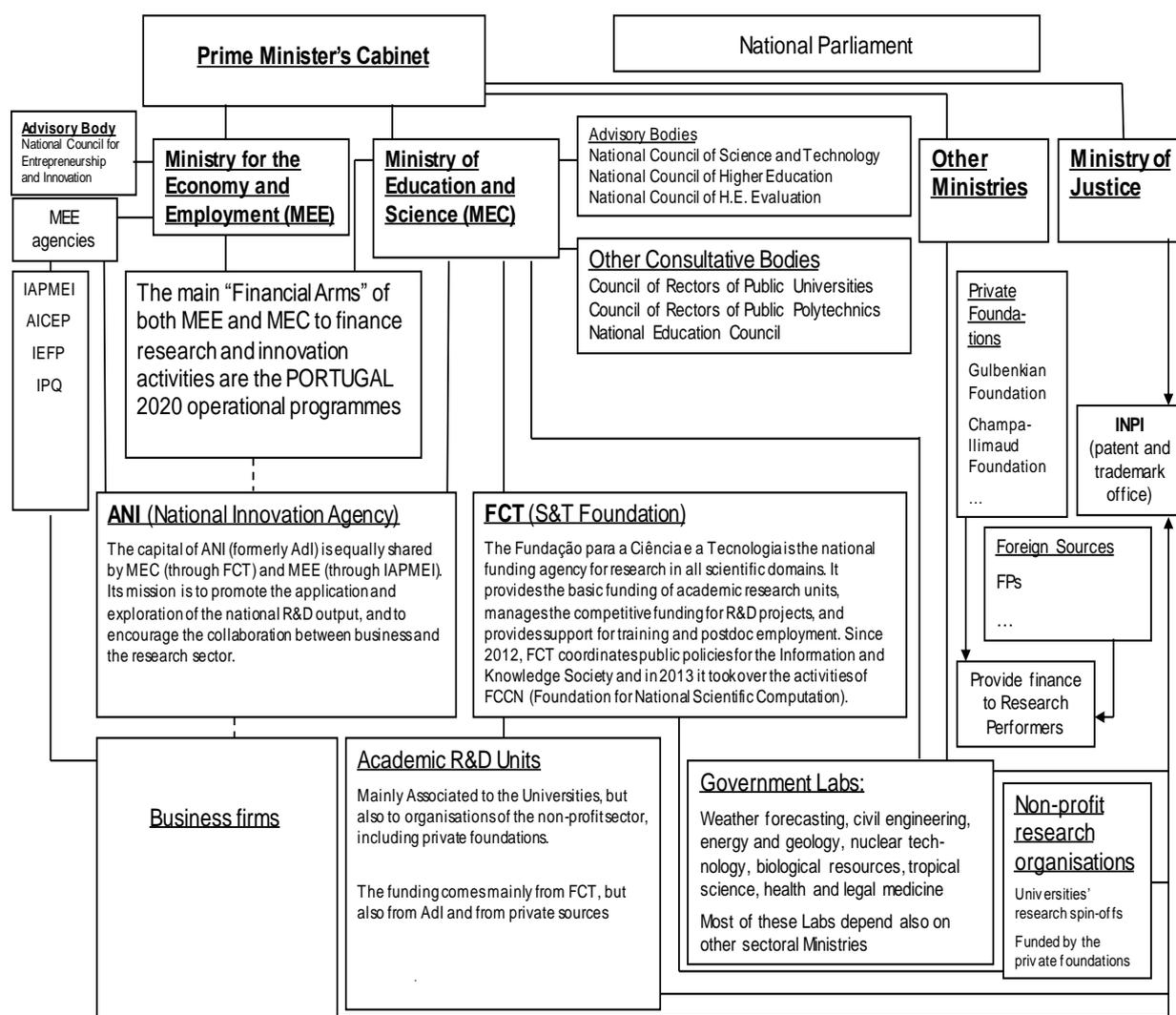


Figure 1 Portugal's RDI governance system

The organisation chart displayed above refers to the ministerial organisation that was in force over most of 2015. The new government that took office on the 26th of November 2015 has brought a ministerial organisation which differs from the one above. The Ministry of Education and Science was divided into two separate ministries, respectively the Ministry for Education and the Ministry for Science, Technology and Higher Education. Simultaneously the former Ministry for the Economy and Employment has been renamed as Ministry for the Economy, with labour issues being transferred to a different ministry.

As seen in the chart, the research system is organised in three levels. The first level (the political level) contains the Prime Minister's Office and the main ministries in charge of supporting R&D: the Ministry for Education and Science and the Ministry for the Economy. Other sectorial ministries, including the Agriculture, Health, Environment, Foreign Affairs and Defence ministries, also allocate funds for R&D, but their importance in R&D funding is not comparable. The second level (the operational level) is comprised of the managing bodies of the main operational programmes that provide funds for research, together with the major executive agencies. Finally, the third level (research performers) displays those entities that actually perform R&D activities, namely academic R&D units and public laboratories. The entities that provide advice to the

Ministry for Education and Science are also displayed. The Parliament is not formally connected in the organisation chart with the remaining sectors, as this political body has had a limited role in discussing and defining policy objectives in the area of S&T.

The governmental structure has integrated the R&D and innovation issues to a limited extent. In recent years the recession and the emergency to tackle the debt have not allowed much space to take on board those issues. Before that, despite these issues ranking high in the policy agenda and public speeches, they were not integrated in the national macroeconomic modelling or were not effectively integrated in scenario planning exercises adopted by governments.

Formally there is a well-structured consultation system with several bodies (see the organisation chart above), though their activity and actual impact have been quite uneven. The National Council of S&T has been active and on a few circumstances has made public its views, reflecting different perspectives existing within the research community. In contrast, the National Council for Entrepreneurship and Innovation, though having within its composition representatives of some of the most dynamic R&D performing firms, seems to be less active in promoting its activities. Beyond these two National Councils, there are no other formal channels to seek advice of professional, regional or scientific associations. Further, the degree of organisation and networking of these types of groups is also limited, which may account for their weak involvement in the policy-making process.

The main funding agency providing support for academic research has been FCT (The Foundation for Science & Technology). FCT has performed a role as research council, providing funding for the academic research units, support for research projects and also for advanced training, mainly at the PhD and postdoc levels. In parallel, the Agência Nacional de Inovação (formerly Agência de Inovação), has also had a role in funding applied research and innovation activities. In contrast to FCT, which is more oriented towards academic research, this entity has managed policy tools directly related with support to innovation-driven research.

Despite no multiannual budgeting being in place, the resources that are allocated through the OPs of the national reference framework Portugal 2020 allow for a certain coordination and predictability of public expenditure on R&D, though several factors have historically interfered with the execution of the OPs.

The Portugal 2020 provides a full evaluation framework for its programmes. Each OP has an 'Evaluation Plan of the Programme' which puts forward the guiding principles and the norms for evaluation through its life cycle. There are mechanisms designed in those Evaluation Plans for incorporating the recommendations of the interim evaluations and monitoring activities, though in many cases the managers of the OPs have perceived the recommendations stemming from the evaluation reports as too much generic or ambitious and thus without possibility of being implemented.

The perception that exists is that the capacity to actually integrate the feedback of the evaluations is limited. However, despite the feedback mechanisms of the evaluations into the programmes and their instruments not having an immediate effect, in the medium and long terms the design of new policies tend to incorporate some of the more pertinent observations and recommendations of the evaluators. This is what happened in the past, when for example the policy tools towards supporting academic and innovation-driven research were integrated in the same Operational Programme of the national strategic reference framework 2006-2013. But besides the evaluation activities that are carried out in relation to the use of structural funds, the evaluation system is generally underdeveloped. There are no systematic activities in terms of using output indicators, international benchmarking, or impact analysis. An integrated monitoring and review system is not in place to provide comparable information about the quality and efficiency of different policy tools.

1.2.3 Research performers

The government R&D sector has been shrinking in relative weight over recent decades and presently (2013) it accounts only for 6% of total GERD. The dominance of public R&D up until the early 1980s was replaced by a rise of the share of the higher education sector, which reached 43% in 1992. However since then, HERD went down to 30% in 2007, when BERD reached a historical maximum of 51%. Meanwhile, in recent years, the higher education sector regained prominence, with HERD accounting for 36% of GERD in 2012 and 45% in 2013. The increase reflected in this last value has to do with a break in the series, as part of the expenditure that had been accounted for under the non-profit sector was transferred to the higher education sector, as most units which were previously accounted for as 'non-profit' actually are in the perimeter of the universities.

Most of the research that is carried out by the HE sector takes place within the universities, as the polytechnic institutes only perform a marginal role on this regard. Most of the R&D performed by the sector takes place in the largest public universities, namely the Universidade de Lisboa, Universidade do Porto, Universidade do Minho, Universidade de Aveiro, Universidade de Coimbra and Universidade Nova de Lisboa. The funds allocated to these six universities accounted for almost 50% of the [government budget for higher education in 2015](#), while the 14 polytechnic institutes accounted for less than 20% of that budget. It must be recalled that 40% of the funds allocated for current expenditures of higher education institutions are accounted for as R&D expenditure. The concentration of R&D funds on the largest universities is even higher, if the funds allocated through FCT for research are accounted for. It is also on the largest universities that most of the 'third mission' activities are concentrated, though some polytechnic institutes with a dynamic engineering stream, as the one in Leiria, also have a role in promoting joint activities with the business sector.

On the business side of R&D activities, it has already been pointed out that there is a significant concentration of the investment on the top performing firms, with the top 10 spenders having a BERD share close to 35% in 2012, which is about the same as all the smaller performers below the 100th business R&D spender. One particular characteristic of the Portuguese BERD performers is the relatively important role played by banking corporations, with at least two of them among the top 10 performers. In contrast, multinational companies do not perform in general a very relevant role in domestic GERD, and the economic situation the country has experienced has not favoured the attraction of foreign capital for performing R&D activities in Portugal recently. One aspect that may account for the business expenditure in R&D has to do with the overall structural change of the economy. Further to the overall contraction of manufacturing, the specialisation trend has been one of reinforcement of the medium-low tech sectors, instead of the medium-high and high-tech sectors, which are the usual performers of R&D activities. While the % of the exports of the medium-low tech sectors was 13.7% in 2001, it reached 26.5% in 2014. In contrast, in the same period the high-tech exports declined from 11.4% to 6.9%, while the medium high-tech exports kept relatively unchanged. This shrinking share of the high tech sectors which typically have a much higher R&D intensity has not been helpful for a raise in the R&D intensity of the country.

2. Recent Developments in Research and Innovation Policy and systems

2.1 National R&I strategy

Since the late 1980s, Portugal's R&I strategies have been to a large extent shaped by the framework provided by the successive Community Support Frameworks. These have been the key element to establish the R&I policy measures toolkit as well as the financial means to implement them. As mentioned in the 2014 RIO Report (Godinho & Simões, 2015), a new Partnership Agreement was established between Portugal and the European Commission to provide the framework for Community funding between 2014 and 2020 (Portugal 2020). This includes four thematic (Competitiveness and Internationalisation; Social Inclusion and Employment; Human Capital; and Resource Efficiency and Sustainability), and seven regional Operational Programmes (OPs). In terms of R&I policy, the most important OP the Competitiveness and Internationalisation OP (CIOP); the Human Capital OP (HCOP) also provides a relevant contribution in the fields of education, training and lifelong learning. The Regional OPs establish policies which are directly addressed to the promotion of research and innovation in the regions concerned by four Operational Programmes.

In the context of the EU-led Smart Specialisation approach, Portugal designed a National R&I Strategy for Smart Specialisation (RIS3). This was promoted by the Institute to Support Small and Medium Sized companies (IAPMEI) and the Science and Technology Foundation (FCT) involved several stakeholders at national and regional levels. The starting point for the definition of the strategy was a SWOT exercise to identify the main strengths, weaknesses, opportunities and threats faced by the Portuguese R&I system (FCT, 2013). The RIS3 is aligned with the Europe 2020 strategy and sectoral and regional strategies.

Portugal's RIS3 was approved in December 2014 by an order of the Ministers for Regional Development, Economy and Education and Science. The strategy has five main goals (Governo de Portugal, 2014a):

- To promote the potential of Portugal's S&T base;
- To foster the cooperation between R&D organisation and companies as well as cluster policy and "knowledge transfer and circulation";
- To focus on trading goods and services, company internationalisation, and market diversification;
- To promote entrepreneurship, encouraging employment creation and the skilling of human resources, and
- To stimulate the transition towards a low carbon economy.

At the national level, five "thematic axes" were identified: (1) Cross-cutting Technologies & Applications: encompassing Energy, ICTs and Materials & Raw-Materials; (2) Manufacturing Industry & Technologies: which includes two main priority themes: Manufacturing Technologies & Product Industries, and Manufacturing Technologies & Process Industries; (3) Mobility, Space & Logistics, with two themes: Automotive, Aeronautics & Space; Transport, Mobility & Logistics; (4) Natural Resources and the Environment, which covers the following priorities: Agribusiness; Forestry; The Maritime Economy; and Water & the Environment; and (5) Health, Well-Being and Territory, encompassing four themes: Health; Tourism; Cultural and Creative Industries; and Habitat.

Regional strategies are anchored on these "thematic axes"; however, they are translated in different ways and with distinct focus areas. The RIS3 headlines are further detailed on section 2.4 below.

The strategy is addressed to both research and innovation. However, as it was mentioned in earlier reports (see for instance Godinho & Simões, 2013), the research side was dominant, especially in the SWOT analysis. This was in part due to the

existence of more information available for research than for innovation but also to the fact that the initiative to develop a national R&I Strategy for Smart Specialisation was undertaken by FCT, which has research council functions.

The RIS3 is aligned with EU orientations on Smart Specialisation. It is based on a process of identifying the key priorities and provides for a multi-level governance process, encompassing national and regional bodies, following the S³ Platform Governance Guide (Reek, 2013). The strategy shaped, to some extent, the design of the policy instruments to manage the application of EU funds for 2014-2020 established as a result of the Portugal 2020 Partnership Agreement between the Portuguese State and the European Commission (Governo de Portugal, 2014b). The idea of exploiting opportunities for joint programming, cross-border co-operation and the leverage effects of EU instruments are present in Portugal's RIS3 as well as in the policy instruments mentioned above. In particular, these underline the need to increase Portugal's participation in EU R&D Programmes, and provide support to R&I organisations to develop applications to such programmes. A particular concern has also been expressed with regard to the support to research infrastructures, in line with the EU policy on this regard.

As mentioned above, the RIS3 has shaped the design of the Operational Programmes included in the Portugal 2020 Partnership Agreement. The alignment with Smart Specialisation priorities is a common thread in Thematic and Regional OPs. In the Competitiveness and Internationalisation OP (CIOP), the compatibility between projects and the RIS3 orientations is a general criterion for project evaluation, under the factor "contribution of the project for the economy". The influence is even more evident in one of the support systems of CIOP (the Scientific and Technological Research Support System [STRSS]), whose general objectives are defined as follows: "To increase scientific and technological production, with internationally recognised quality, in strategic fields aligned with the national R&I strategy for Smart Specialisation (RIS3), to stimulate a knowledge-based economy".

2.2 R&I policy initiatives

As mentioned above, Portugal's R&I policies in the last two and a half decades have been significantly shaped by the successive rounds of Community support funds. Since 2007, with the establishment of QREN, the National Strategic Reference Framework (NSRF) 2007-2013, there has been a significant improvement by integrating research and innovation under the same OP, enabling increased policy coordination. The same happens under the present Portugal 2020 Partnership Agreement. The CIOP includes six main incentive systems: (1) Company innovation and entrepreneurship; (2) Promoting SMEs' capabilities and internationalisation; (3) Research and technological development, addressed to companies; (4) Support to Public Administration modernisation and capability building; (5) Scientific and technological research, addressed to research organisations; and (6) Support to collective actions, including clustering initiatives. Though the incentive systems are managed by different organisations, fact that they are under the same OP, sharing the same orientations, enhances consistency and coherence.

According to the Portugal 2020 Partnership Agreement, Education is addressed by another OP, the Human Capital OP (HCOP). The management of this OP is now chiefly committed to the Ministry for Education. The fact that in the XIX Constitutional Government, education and science were under the same Ministry ensured some policy consistency. However, the separation between the two areas in the present Government (XXI Constitutional Government) is likely to require increased coordination.

Research, innovation and education policy coordination is strengthened by the governance system adopted to manage the Portugal 2020 Partnership Agreement ([Decree-Law 137/2014](#), of 12th September 2014, link accessed on 21 October 2015). This provides for the establishment of a centralised political and technical coordination. The first is assigned to the Inter-ministerial Coordination Commission of the Partnership Agreement (ICC), chaired by the Minister responsible for regional development policy,

and comprising the Ministers in charge of the various areas addressed by the Partnership Agreement. Although it would be preferable to have a coordinating body chaired by the Prime Minister (Godinho & Simões, 2005), the solution adopted is likely to improve effective policy coordination. The main tasks of technical coordination are assigned to the Agency for Development and Cohesion (ADC), a recently created body in charge of the coordination of cohesion funds. Furthermore, the coherence of R&I policy coordination is promoted by the establishment of “functional articulation” networks. These include namely the incentive systems network, coordinated by POCI management, and the “research, development and innovation and smart specialisation strategy support systems network, in the field of science”⁴ and coordinated by the President of the FCT, the Science and technology Foundation.

Investments in research infrastructures are included in the RIS3 as well as in policy implementation. More specifically, such investments are provided under the STRSS. Projects in this field should be consistent with the RIS3 and concern the development of infrastructures included in the national roadmap of strategic interest research infrastructures. Investments supported may be carried out individually or in co-promotion between non company R&I organisations namely Higher Education organisations, Government Laboratories, not-for-profit R&D organisations, and other not-for-profit public or private organisations (including International Laboratories headquartered in Portugal).

In spite of these improvements in policy coordination, public action is not always designed and implemented in a strategic, coherent and integrated framework and tailored to foster innovation and strengthen the knowledge base and fundamental research. This is due to four main reasons. First, even though significant improvements have been observed in the last decade, the systemic density of the R&I system, that is, the width and the depth of the interactions and strategic cooperation among the players in the National R&I System, is still insufficient. Second, while the panoply of instruments addresses most of the key issues of R&I policy, there are still two problems which need to be appropriately addressed: the first is, as pointed out above, the biased ‘transfer of technology’ mind frame, under evaluating the role of the “body of practice” (Pavitt, 1998) which shapes companies’ R&I capabilities; the second concerns the need for increased articulation between education policy and business enterprises’ employment needs and for managerial training, an issue which has been better addressed, at regional level, by the HCOP, but on which further work is needed (Godinho & Simões, 2013;; Mamede, 2015). The third reason is related to two features of recent FCT policy which have been subject to wide criticism from the scientific community: the first is the process of evaluation of R&D organisations, which has hurt the high level of trust between this organisation and the scientific community (Livro negro da Avaliação Científica em Portugal, 2015); the second is the use of applicability as a criterion for selecting basic research projects (Godinho & Simões, 2015). Finally, the fourth reason is related to entrepreneurship policy focus. Recognising the importance of entrepreneurship and the need to stimulate the creation of new knowledge-intensive firms (which is a positive fracture of CIOP), the role of entrepreneurship is not independent from its context; in fact, new firms often need to be leveraged by other firms (both as customers and as partners) to grow internationally and to become relevant in the economic fabric, while some approaches to entrepreneurship policy seem to suggest a conflict between new and established firms (Godinho & Simões, 2015; Simões *et alii*, 2011; see [Notícias ZAP](#), link accessed on 21 October 2015).

Evaluations, consultations, foresight exercises

The main evaluation exercises dealing with R&I policy undertaken between 2013 and 2015 were related to the closing of the 2007-2013 round and the launching of a new round of EU funding in connection with the Portugal 2020 Partnership Agreement.

⁴ Own translation of Art. 61 nº 2 g) of Decree-Law 137/2014.

In connection with the 2007-2013 NSRF, the most relevant evaluations focussed on the Competitiveness Factors Operational Programme- CFOP ('Compete') and on the Strategic Evaluation of the NSRF 2007-2013 in the fields of Innovation and Internationalisation (IESE/Quatenaire Portugal, 2013).

The evaluation of the CFOP/'COMPETE' (Augusto Mateus & Associados/PriceWaterhouseCoopers, 2013) provides interesting conclusions. It was found namely the following COMPETE's performance is assessed as being positive, whilst recognising that the effects have a long maturation time; the firms supported by COMPETE are, in general, better than the benchmark of Portuguese firms, exhibiting motivations and strategies focussed on the key competitive challenges; and supported projects had a very positive impact on firms' performance.

The strategic evaluation of the effects of the 2007-2013 NSRF on innovation and internationalisation is largely convergent with the above conclusions, and broadly confirms the appropriateness of the policy adopted for that purpose (IESE/Quatenaire Portugal, 2013). Innovation and internationalization were found to be closely related, with positive reciprocal interactions. This led to a recommendation that the 2014-2020 CIOP should focus more on incremental improvements to the existing set of instrument, rather than on a 'revolutionary' redesign of innovation policy instruments.

In 2014, there was a round of ex-ante evaluations of the Portugal 2020 as well as of the thematic and regional OPs which are part of it. However, with the exception of the Portugal 2020 Partnership Agreement, the results of such ex-ante evaluations had not been disclosed, except for those concerning the environmental evaluations of the OPs of Competitiveness and Internationalisation, and Resource Sustainability and Efficiency. Another policy area of the 2014-2020 NSRF subject to a specific evaluation concerns the 'Financial Instruments'. However this evaluation had already been launched in 2014, although it has not been completed.

The overall ex-ante evaluation of CIOP was positive and it was found to provide "strong guarantees of effectiveness in terms of expected results and impacts with regard to the alleviation of the chronic weaknesses of the Portuguese productive system" (Iceta, 2013: 40). It is recommended that a broader opportunity for large scale R&D projects should be provided, and the launching of thematic tenders for projects between Portuguese R&D organisations and "knowledge centres referenced worldwide". Another recommendation concerns an increased focus on exploring the opportunities for attracting FDI, in order to increase business R&D and structural change. The relationship between existing Competitiveness and Technology Poles and the thematic areas of Smart Specialisation should also be taken into account in the definition of policy measures.

As a result of the critical opinions expressed by the Higher Council for Science, Technology and innovation about FCT evaluation procedures and the criticisms voiced by the academic and research communities to the process of evaluation of R&D units (Godinho & Simões, 2015), FCT commissioned, in 2015, an international evaluation of the procedures it has followed (FCT, 2015).

The panel considers that rules and procedures followed international established practices and goes along with the decision to outsource the evaluation to the European Science Foundation (ESF). In contrast, it has expressed criticism regarding two aspects. The first concerns the fact that the main document 'Evaluation Guide Additional Information', which played an important role in guiding the evaluation, was just published after the deadline of applications. The second "concerns the conversion of the scientific outcome of the evaluation into funding allocation of the Units" (FCT, 2015: 51).

The panel found that FCT plays a key role in Portugal's R&D systems and that "the reforms put forward under Professor Seabra's leadership were in the right direction" (FCT, 2015: 25). However, the way how these have been put in practice suffered from several problems, namely the following: lack of independence of FCT; budgetary

constraints; weaknesses of FCT Board; strained and inaccessible FCT administrative staff; and insufficient recourse to the advice of FCT's Scientific Councils. The consequence of the above problems has been a situation of "lack of trust" (FCT, 2015: 12) between FCT and Portugal's research community.

To improve FCT's operations and its contribution towards a better performance of Portugal research systems, the Panel presented a set of 23 recommendations clustered under different headings, from the role of FCT in the Portuguese research system to the improvement of FCT operations. Such recommendations include *inter alia* the following: (1) improve FCT's administrative and financial autonomy, and providing it with multi-year budgets; (2) to strengthen the role of FCT Scientific Councils; (3) to improve the stability and predictability of financial instruments; and (4) to improve communication with stakeholders", especially with "the scientific community at all levels" (FCT, 2015: 28) and with the Council of Rectors of Portuguese Universities (CRUP). Related to this, the European Science Foundation Final Report on the evaluation process of the FCT also expresses criticisms about the way how the process was developed and managed. This is clearly expressed in the quotation below extracted from (ESF, 2015):

Although panels felt responsible only for the scientific evaluation of R&D Unit applications they were well aware that its outcomes translated into funding for the units. They expressed their concern to the FCT leadership that rules for funding were difficult to comprehend and lacked clarity. They would have valued more explanations from FCT and a clearer picture of what could be expected in the final results in terms of funding from the agreed grades. Some panel members thought that the methodology/formula used for the final weighting was not sufficiently explained to them, nor were the effects derived from each of the scores clearly explained. Thus, for example, in some cases some minor differences in grade seemingly resulted in very significant differences in the average per capita funding that units were offered. In the end, some units will benefit financially comparatively more than expected by panel members and, conversely, others are going to be impacted comparatively much more than panel members had expected, preventing them from achieving the objectives of their strategic programmes. The situation was intensified in their opinion by the fact that the funding rules for strategic funding were not available before panel grades were finalised, i.e., during the evaluation process.

In December 2015, the new Minister for Science launched a working group of 30 scientists and researchers with the mandate to stimulate a discussion on "the orientations guiding FCT's near future in dialogue with the scientific community" (Publico, December 15, 2015)

The main consultation process regarding R&I policy in Portugal took place in the context of the design of a R&I policy for Smart Specialisation. As explained in detail in our previous report (Godinho & Simões, 2015), this involved the collaboration of several national and regional public organisations, and also interaction with multiple stakeholders including *inter alia* firms, business associations, universities, and R&D centres. Whilst there has been no formal foresight exercise undertaken during the period concerned, it should be recognised that the process of designing the R&I strategy for Smart Specialisation took into consideration the prospects for future scientific and technological developments.

2.3 European Semester 2014 and 2015

The NRP 2014 (Governo de Portugal, 2014c) points out the development of "a smart strategy for a competitive economy", based on investment in Education and R&D&I, considered to be key elements for the enhancement of human capital and, therefore of productivity. The strengthening of R&D&I is highlighted as a central objective. The orientations on R&I policy were in line with the priorities of the 'Europe 2020 Strategy'. The main measures mentioned in the NRP on R&I policy concerned the following: the strategy for research infrastructures; the evaluation and financing of R&D Units (see 2.2.1 above); the revision of SIFIDE II, the the system of Tax Incentives for Research

and Development (which was provided in the so called Tax Investment Code [Decree-Law 162/2014, article s 35 to 42]); the Digital Portugal Agenda; the Programme for knowledge and technology transfer to companies, including seven measures, including the setting up of the National Innovation Agency (ANI); and continuation of the 'FCT Researcher' grant programme.

The headlines of the R&I policy presented in 2014 (and 2013) are taken again in the 2015 NRP (Governo de Portugal, 2014d). This includes, however, some new features, mainly stemming from the Portugal 2020 Partnership Agreement and the RIS3. It is shown that the biggest share of European funds (around €8.6M) was allocated goal of 'strengthening R&D and innovation'. The revision of the R&D goal for 2020 is explicitly acknowledged in the following terms: "with the approval of the Research and innovation Strategy for Smart Specialisation, the goal for R&D expenditures as a share of GDP in 2020 was revised and set up at 2.7%" (Governo de Portugal, 2015d: 68).

R&I policy is approached in section 4.3 (Strengthening the cooperation between public research and the enterprise sector and promoting knowledge transfer) of Goal n^o4, dealing with Education Policies; surprisingly, it is not addressed also under competitiveness issues as it happened, for instance, in the Commission Staff Working document dealing with Portugal's NRP (European Commission, 2015). Two of the policy initiatives on this regard had been already included in the NRP 2014: the restructuring of ANI; the Portugal Digital Agenda. The other two are new. These refer to clustering policy, namely the regulation on Competitiveness Clusters, and to the approval of the National Strategy for Smart Specialisation (more on this in section 2.4 below).

The progress observed with regard to the 2020 Goal on R&D expenditures is addressed in Chapter 4 of the 2015 NRP. Here, the promotion of high-skilled jobs to keep talents in Portugal is mentioned as the main R&I policy challenge. This implicitly amounts to the recognition of one of the main drawbacks of the austerity policies followed and pointed out in previous reports, namely Godinho & Simões (2015). The main policy initiatives pointed out to respond this challenge are the following:

- The support to the recruitment of Master and PhD holders by business firms, namely in the context of the Portugal 2020 Partnership Agreement;
- The continuation of the FCT-Investigator programme, and its opening to business firms;
- The change of SIFIDE II, the R&D tax investment system, with a view to provide more favourable conditions for the recruitment of Master and PhD holders by business firms;
- The programme for the commercialisation of public research results, namely the Global Start-up programme, the University technology Enterprise Network (UTEN), the cooperation with Carnegie-Mellon University in the entrepreneurship field, the test-bed and accelerator programmes with the Massachusetts Institute of Technology (MIT), and the development of a knowledge transfer programme with the European Space Agency (ESA).

There is also a reference to the initiatives taken with regard to the European Research Area (ERA). These are developed in the section specifically addressed to priorities of ERA (section 4).

The recommendations disclosed by the Council of the European Union on the 2015 NRP of Portugal do not refer to the R&I policy field (Council of the European Union). The Commission Staff Working document on the Portugal's response to the 2014 Country Specific recommendations (European Commission, 2015) makes an assessment of the progress made. It is pointed out that some progress has been achieved, but there is still a lot to be done. Two main aspects are pointed out. The first concerns the fact that "Portugal still lags behind in terms of public-private cooperation in R&D activities and in the commercialisation of knowledge" (European Commission, 2015: 44-45). The second is related, and has to do with the weak policy incentives towards public research bodies and business enterprises. Among the initiatives to be taken to address the situation, the

document points out the setting up of an investment-friendly environment for business investment in R&I, the establishment of closer links between the higher education and the business sector and the increase of broadband take-up.

An accurate assessment of the responses to these issues demands a wider approach. A large part of the response is outside the reach of strict R&D policy. The concern with promoting technology transfer, namely through the establishment of programmes to encourage the transfer of public research results to companies is a common concern in both the Commission Staff Working document and in Portuguese R&I policy: they are clearly aligned. As it was pointed out in the 2014 report on Portugal (Godinho & Simões, 2015: ii, 9), this focus on technology transfer suffers from a “supply-side bias” as well as from “a science-driven view, which does not correspond with the process as to how knowledge creation takes place in the majority of companies, especially SMEs” (see also Laranja [2012] and Cooke & Simões [2013]). And a large part of the response is outside the reach of R&I policy for two reasons. First, the creation of an investment-friendly environment for business investment in R&I is at odds with the economic policy followed since 2011, largely focussed on the reduction of labour costs and providing few incentives for the integration of young, skilled individuals in the labour market; the above-mentioned concern expressed in the 2015 NRP to promote high-skilled jobs and keep talents in Portugal is an expression of this.

2.4 National and Regional R&I Strategies on Smart Specialisation

As mentioned above as well as in the previous report (Godinho & Simões, 2015), Portugal defined a RIS3 as a result of a process launched by IAPMEI and FCT, with a significant involvement from stakeholders. The process started with a SWOT exercise to identify the main strengths and weaknesses of Portugal’s R&I systems as well as to devise the main opportunities and threats faced (FCT, 2013). The RIS3 was approved in the 14th December, 2014 through a joint decision of the Secretaries of State for Regional Development, for Innovation, Investment and Competitiveness, and for Science. This strategy defines a set of thematic R&I priorities, combining both the national and regional levels, by means of a matrix of the territorial dimensions of thematic priorities (Governo de Portugal, 2014d). This is depicted on Exhibit 1 below.

Thematic Axes	Priority Themes								
		Nacional	Norte	Centro	Lisboa	Alentejo	Algarve	R. A. Madeira	R. A. Açores
I. Cross-cutting technologies and their applications	1. Energy								
	2. Information and Communications								
	3. Materials and Raw-Materials								
II. Industry and Production Technologies	4. Production Technologies and Product Industries								
	5. Production Technologies and Process Industries								
	6. Automobile, Aeronautics and Space								
III. Mobility, Space and Logistics	7. Transport, Mobility and Logistics								
	8. Agro-food								
IV. Natural Resources and Environment	9. Forest								
	10. Sea Economy								
	11. Water and environment								
V. Health, Well Being and Territory	12. Health								
	13. Tourism								
	14. Cultural and Creative Industries								
	15. Habitat								
		more important	4	3	2	1		less important	

Figure 2 Global thematic priorities matrix

At the national level, there are five main “thematic axes”:

1. Cross-cutting Technologies & Applications: encompassing Energy, ICTs and Materials & Raw-Materials;
2. Manufacturing Industry & Technologies which includes two main priority themes: Manufacturing Technologies & Product Industries, and Manufacturing Technologies & Process Industries;
3. Mobility, Space & Logistics, with two themes: Automotive, Aeronautics & Space; Transport, Mobility & Logistics;
4. Natural Resources and the Environment, which covers the following priorities: Agribusiness; Forestry; the Maritime Economy; and Water & the Environment;
5. Health, Well-Being and Territory, encompassing four themes: Health; Tourism; Cultural and Creative Industries, and; Habitat.

Regional strategies are anchored on these “thematic axes”, but they express them in different ways and with different focus areas. For instance, the Norte region, takes on-board all the fields considered at national level and assigns them different priorities, putting the focus on: ICTs; Manufacturing Technologies & Product Industries; Automotive, Aeronautics & Space Industries; Health, and; Cultural and Creative Industries. In contrast, the strategy for the Algarve does not include all the axes defined at the national level, focusing instead on the Maritime Economy and Tourism. The whole set of regional thematic priorities is provided on Exhibit 1.

The RIS3 priorities are considered for project evaluation purposes. In fact, the incentive systems included in Compete 2020 (especially Company innovation and entrepreneurship, Research and technological development (RTD), Scientific and technological research (STR), and Collective actions) established consistency with RIS3 both as a condition for project eligibility and a selection criteria. In practice, there are two approaches: (i) on what concerns projects related to R&TD and STR and any project related to non SME (including Innovation), that consistency is an entry eligibility criteria; and (ii) with regard to the other projects – filled by SME -, RIS3 is used as a selection criteria.

The assessment of consistency with the RIS3 priorities at project level is undertaken by regional authorities (Regional Coordination Commissions). In the context of the Research and Technological Development Incentive System, under Compete 2020, a set of criteria are defined for the assignment of evaluation grades to projects. In early 2016, the priorities for the various regions for Compete 2020 purposes were subject to a slight revision (see Aviso [Notice] 01/SI/2016 on the analysis of project merit). It should be remarked, however, that the revised sets of regional priorities established on that Notice are only slightly different from those defined at the original document on RIS3 strategy, and presented on Figure 2 above.

R&D infrastructures are included in the RIS3. In fact, there has been coordination between the process leading to the RIS3 and the development of Portugal’s research infrastructures roadmap. Both aspects are among the specific objectives assigned to the Science and Technological Development Incentive System (STRIS), which is the main instrument to support research activities which are not carried out by business enterprises. Furthermore, consistence with the national R&I Smart Specialisation Strategy (RIS3) priorities is one of the conditions for the eligibility of projects aimed at the development of research infrastructures falling under the national roadmap of strategic interest research infrastructures. Similar approaches are taken at the regional level.

The document of the RIS3 does not provide a detailed account of the financial commitments required, including those for structural co-funding. This is provided instead in the Portugal 2020 Partnership Agreement, which was agreed with the European Commission, of which the strategy for Smart Specialisation is one of the items covered. In other words, the Partnership Agreement establishes the financial envelope, including European and national funding, that is required to implement the Smart Specialisation

strategy. In the context of the Operational Programmes included in the Partnership Agreement, measures are included which are aimed at stimulating private investments, namely in the fields of R&D and innovation.

A multi-level governance model, combining both the national and regional levels, was defined. This is "based on the cooperation and the sharing [of resources] among the multiple players which take place in the collective and systemic process of carrying out R&D and innovation activities" (Governo de Portugal, 2014d: 167).

The document on the RIS3 sets up a monitoring mechanism (Governo de Portugal, 2014d). A monitoring report aimed at assessing the state of development of the RIS3 will be published on an annual basis. ANI was assigned the responsibility for leading the operational Coordination Council of the implementation of RIS3. Information available does not enable to assess whether the monitoring system will follow the guidelines suggested by Gianelle and Kleibrink (2015).

The first meeting of the Coordination Council was held on March, 19 2015. At this meeting the main functions to be carried out by the Coordination Council were established in more detail. These include namely the following: (1) Coordination and alignment between national and regional smart specialisation strategies; (2) Definition of the evaluation methodology to be applied for projects submitted to the Operational Programmes, and (3) Building up of the RIS3 follow up and assessment system, including the respective indicators. Regarding the RIS3 monitoring process, it was decided to collect enough information on the RIS3 implementation, namely in the context of the OPs, before launching the monitoring activities. More specifically, it was considered appropriate to make the assessment just after the existence of two rounds of applications to the incentive systems. This corresponds to around one year. Therefore, the first annual report on the R&I strategy in the context of RIS3, mentioned in the National Smart Specialisation Strategy (Governo de Portugal, 2014d) is expected to be available later in 2016. This means that the length of experience is still limited, implying it is still too early to assess how RIS3 is influencing innovation policy in Portugal.

2.5 Main policy changes in the last five years

Main Changes in 2011

The 19th constitutional government took oath in June. The former Ministry for S&T and Higher Education was substituted by the Ministry for Education and Science (thus encompassing also primary and secondary education), while the former Ministry for the Economy and Innovation was replaced by the Ministry for the Economy and Employment. The Memorandum of Understanding on Economic and Financial Policies was established between the Portuguese government and the EC, the ECB and IMF.

Main changes in 2012

FCT took over UMIC, the agency in charge of the policies for the information and knowledge society and the digital economy.

+E+I programme (support to innovation and entrepreneurship) was launched.

Main changes in 2013

Launching of the evaluation of the research units by FCT (now expected to finish in the first semester of 2015).

In July the Minister for the Economy, Mr Alvaro Pereira, was replaced by Mr. Antonio P. Lima.

FCT took over FCCN, the entity in charge of the national computing and internet infrastructure

Main Changes in 2014

The former Innovation Agency was re-founded under the name of National Innovation Agency
The Partnership Agreement between Portugal and the EU Commission for the programming period 2014-2020 was presented in July.

The entities selected for the national network of research infrastructures were announced, in connection with ESFRI.

ENEI – Portugal's National R&D Strategy for Smart Specialisation will underpin research policy and funding instruments for 2014-2020 programming period.

Main Changes in 2015

The Operational Programmes under the Portugal 2020 Partnership Agreement started to be implemented and several measures have been advancing fast.

The 2013 evaluation of the research units carried out by FCT was essentially finished by May, but this process has opened a breach in the trust between FCT and the research community

The October election did not deliver an overall majority for any of the main political forces in the country. The right-wing coalition which got around 37% of the votes set out a new government. However, this did not pass in the Parliament and led to the establishment of a new, left-wing coalition government which took office in early December 2015.

3. Public and private funding of R&I and expenditure

3.1 Introduction

Portuguese GERD (Gross Expenditure in Research and Development) was €2,268m in 2013, which was the equivalent to 1.33% of GDP. This represents a decline in relation to 2010, 2011 and 2012, when GERD was respectively €2,758m, €2,566m and €2,469, even though it is still significantly above the years before 2009 (€1,973m in 2007, and €1,201m in 2005, with GERD/GDP ratios of 1.12% and 0.76% respectively).

As the data in the preceding paragraph suggest, the Portuguese R&D situation changed rapidly in the second half of the 2000-2009 decade, with the GERD/GDP ratio peaking at a historic high of 1.58% in 2009.

A co-evolution of private and public funding had contributed to rising R&D expenditure up until 2009, bringing the country closer to the EU's average of 2.0%. Portugal reached a R&D/GDP ratio above 1% for the first time ever in 2007, which increased to 1.58% in 2009. Since then, however, this ratio has been declining, first to 1.53% in 2010, then to 1.46% in 2011, and more recently to 1.38% and 1.33%, respectively in 2012 and 2013.

From 2007 onwards, the business sector became the most important player in the R&D system, with a share of 47% in the national GERD in 2013. In 2001, when R&D expenditure was still at 0.76% of GDP, the private sector's share of R&D funding was 32% (exactly the same it had on the expenditures side), with the public sector still being the main contributor, with a 61% share.

In the most recent years the business sector has kept slightly ahead of government in terms of R&D funding in Portugal, though the relative differences to the corresponding EU averages being quite different. For 2012 the business funded R&D over GDP ratio was 0.63% in Portugal and 1.1% in the EU, while the government funded R&D over GDP ratio was 0.59% in Portugal and 0.66% in the EU overall.

In relation to GBAORD, the figures announced for 2015 reveal an 8% rise in relation to the previous year, from €1,626 in 2014 to €1,757 in 2015. This however happens in the sequence of a significant decline in the years before, namely between 2010 and 2012 when GBAORD fell by 12%. This decline was associated with the austerity policies the country had to adopt to bring about the necessary fiscal consolidation. The main reason for that GBAORD contraction was the significant reduction of the salaries of the academic staff in public institutions, both in the higher education and the government labs sectors, which for the top positions went up by more than 20% if one takes in consideration the rise of direct taxes and other contributions. As the GBAORD estimate for those two sectors is mainly based on a proportion of the amount to be paid in salaries, the salaries' reduction that happened accounts for most of the GBAORD contraction over the recession years. Other items under the GBAORD were also affected, but to a minor extent.

Over the period of the 2007-2013 NSRF, the previous reference framework, the Operational Programmes which conveyed the structural funds allocations dedicated €354m yearly to the national R&D budget (GBAORD). This represents 20.5% of the national R&D budget over this period. Over the same 2007-2013 period, and for the sake of comparison, Portuguese teams benefitted from 1.02% of the overall FP7 funding, which means a total of approximately €670m, equivalent to €96m on a yearly basis.

The rise in the GBAORD for 2015, though needs further qualification (see the next point about 'smart fiscal consolidation'), is related to the fact that the allocations from the operational programmes under the Portugal 2020 framework have now reached cruise speed. Despite the framework Portugal 2020 formally covering the period 2014-2020, the partnership agreement between the EU and Portugal only was formally initiated on the 30th of July 2014. This meant that the bulk of the OPs' measures only got their

regulations ready late in 2014 and early 2015, thus only allowing for reimbursements from 2015 on.

In 2015, 29.9% of the GBAORD allocations were for the 5 continental regional OPs, plus the two Atlantic regional OPs.

Table 2 – Basic indicators for R&D investments

Indicator	2011	2012	2013	2014	2015*	EU average (2013)
GERD (as % of GDP)	1.46	1.38	1.33	1.29		2.012
GERD (Euro per capita)	242.7	220.1	221.4	n.a.		536
GBAORD (€m)	1753.66	1555.36	1579.00	1626.03	1756.59	92094,20 (Total for EU28)
R&D funded by BES (% of GDP)	0.65	0.63	n.a.	n.a.		1.1 **
R&D funded by PNP (% of GDP)	0.03	0.03	n.a.	n.a.		0.03 **
R&D funded by GOV (% of GDP)	0.61	0.59	n.a.	n.a.		0.66 **
R&D funded from abroad (% of GDP)	0.09	0.07	n.a.	n.a.		0.19 **
R&D performed by HEIs (% of GERD)	36	36	45*	n.a.		23
R&D performed by government sector (% of GERD)	7	5	6	n.a.		12
R&D performed by business sector (% of GERD)	47	50	47	n.a.		64

Notes: *Break in the series; ** 2012.

Source: Eurostat

3.2 Smart fiscal consolidation

3.2.1 Economic growth, fiscal context⁵ and public R&D

After a prolonged recession, the Portuguese economy started to pick up in late 2013 to reach a 0.9% real GDP growth in 2014. This was driven by accelerating private consumption and investment. The gradual recovery has continued in 2015: 1.5% growth, according to Eurostat estimations. Economic expansion is expected to pursue: forecasts indicate growth rates of 1.6% for 2016 and 1.8% for 2017, mainly as a result of improving external demand.

According to Figure 3, Portugal ran large budget deficits during the pre-crisis period. After 2010 a gradual fiscal consolidation process started, with mixed results translated into still high and fluctuating deficits (7.2% in 2014). Due to the improved macroeconomic outlook, improving tax collection and lowering expenditures on unemployment the deficit is estimated to decrease to 4.2% in 2015. Based on the (critical view on) balance improving measures of the country's Draft Budgetary Plan submitted on the 22nd January 2016 the Commission forecast 3.4% of headline deficit for

⁵ Sources: DG ECFIN, National Reform Program 2015, RIO

2016 and 3.5% for 2017. During the crisis the country rapidly mounted up a large amount of public debt from its 2008 level of 70% of GDP to around 130% of GDP by 2015. This is forecasted to decrease to 127.2% by the end of 2017 as a result of continued economic recovery and primary budget surpluses.

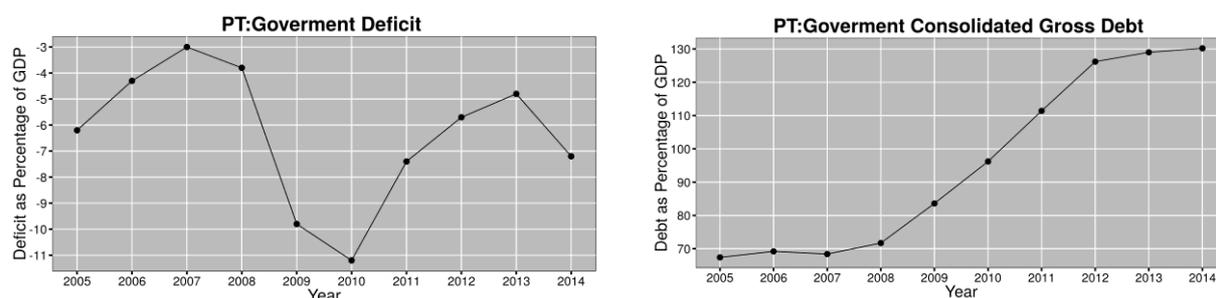


Figure 3 Government deficit and public debt

Data source: Eurostat

Total GERD in Portugal was 2,259MEUR in 2013. There are three main sources of R&D funding: the business sector (955MEUR), the government (1,048MEUR), and foreign funding (138 MEUR⁶). Direct funding from the government goes to business enterprises (98MEUR), the government (123MEUR) and the higher education sector (814MEUR).

Table 3 – Key Portuguese Public R&D Indicators

	2007	2009	2013
GBAORD, % of gov. exp.	1.64	2.01	1.91
GERD, % of GDP	1.12	1.58	1.33
out of which GERD to public, % of GDP	0.44	0.70	0.69
Funding from GOV to, % of GDP			
Business	0.02	0.04	0.06
Public (GOV+HES)	0.41	0.60	0.55
Total	0.50	0.72	0.62
EU funding, % of GDP **	0.02	0.04	0.05

Source: Eurostat

3.2.2 Direct funding of R&D activities⁷

The sources of R&D funding according to the Frascati manual are: Government sector (GOV), Business sector (BES), Higher education sector (HES), Private non-profit sector (PNP) and Abroad (including EC). In this analysis the public sector as source of funds is given by the GOV part of the total intramural R&D expenditure (GERD), whereas the public sector as a sector of performance is the aggregation of GOV and HES. Figure 4 below shows the evolution of GERD financing in current prices in Portugal.

⁶ EU funding in 2013 was 91MEUR.

⁷ The sources of R&D funding according to the Frascati manual are: Government sector (GOV), Higher education sector (HES), Private non-profit sector (PNP) and Abroad (including EC). In this analysis the public sector as source of funds is given by the GOV part of the total intramural R&D expenditure (GERD), whereas the public sector as a sector of performance is the aggregation of GOV and HES.

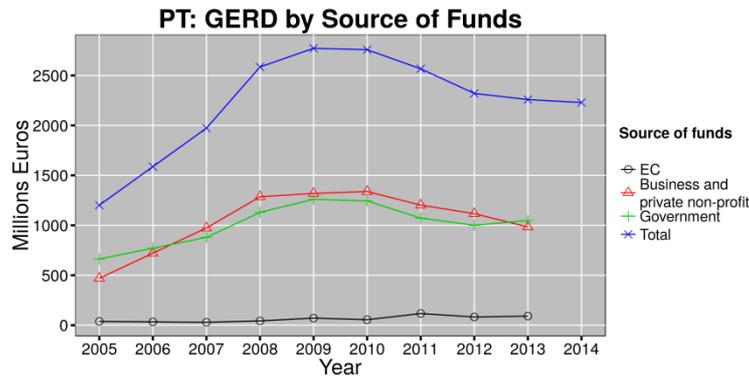


Figure 4 Funding of the total GERD

Data source: Eurostat

Figure 4 shows that the Portuguese expenditures on R&D (GERD) in nominal terms were increasing until 2009. Between 2010 and 2012 R&D expenditures dropped, slowly at the beginning and faster later. The R&D expenditures have been seriously affected by the austerity in the post crisis period and the GERD has decreased to 2,259 MEUR.

The private and the public sector contribute almost equally to the funding of the R&D investments in Portugal. Both private and public R&D investments decreased in the period 2010 to 2012, with the latter being the most affected. On the other hand, EC contributions show an upward trend during the crisis and the post-crisis period with one exception in 2010 (see also section 2.2).

3.2.2.1 Direct public funding from the government

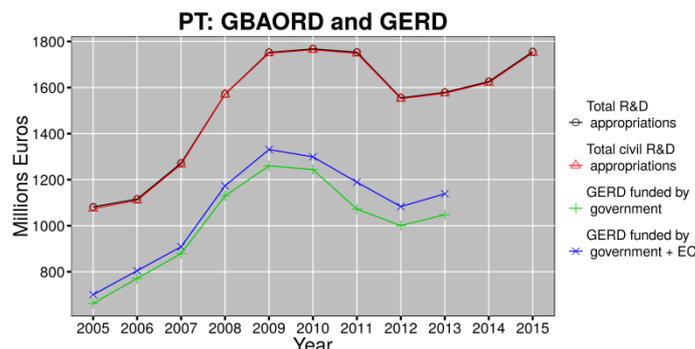


Figure 5 R&D appropriations and government funded GERD in millions of national currency

Data source: Eurostat

Figure 5 shows that the total R&D appropriations (GBAORD) are much higher than the actual public R&D expenditure, expressed as GERD funded by the government. The difference remains big, even when we add the EC contribution to the direct public support.

The Portuguese GBAORD increased in nominal terms until 2009. From 2009 to 2011 there was a stagnation in the R&D appropriations which sharply declined in 2012, most likely due to the austerity measures that imposed significant cuts in the public expenditure. In 2013 GBAORD started going up again and by 2015 it has reached its 2011 level, however, in relative terms, the increase is moderate.

It is interesting to note that in 2011 R&D budget had a very small loss whereas the total governmental expenditure that year dropped dramatically (see Annex 3). This was not the case in 2012 where further decrease in the total expenditure led to cuts in the R&D budget as Figure 5 shows. In other words, the Portuguese government tried to safeguard R&D investments at least at the beginning of the post-crisis period and despite the austerity measures it undertook, it managed to re-establish the levels of R&D budget by 2015.

The GERD funded by the government follows a similar pattern. The difference is that the decline started already in 2010 and continued until 2012 which is the last year for which data is available. Due to this lack of recent data it is not possible to compare the evolution of the public R&D expenditure with that of the R&D appropriations beyond 2012. The EC contribution has increasing during this period but it was not sufficient to cover the losses.

3.2.2.2 Direct public funding from abroad

Table 4 – Public Funding from Abroad to Portuguese R&D (in millions of national currency)

Source from abroad	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total	56.45	81.83	107.22	77.14	113.43	87.97	154.83	120.04	138.23
BES	11.43	38.65	65.86	25.67	33.77	12.31	15.52	14.95	25.42
EC	37.84	33.71	29.58	43.24	70.90	55.08	116.92	82.41	90.79
GOV				2.17		9.02	4.07	8.56	4.96
HES				3.96		7.47	10.35	8.46	11.05
International Organizations	2.40	2.04	1.68	1.66	3.40	2.67	6.10	3.98	3.69
Total as % GERD	4.7	5.16	5.44	2.98	4.09	3.19	6.03	5.17	6.12
EC as % GOVERD	5.71	4.37	3.36	3.83	5.63	4.43	10.91	8.23	8.67

Data source: Eurostat

R&D funding from abroad as % of total R&D investments varies from year to year. The European Commission through Structural Funds and Framework Programmes is the major contributor, from 2008 onwards whereas in 2006 and 2007 the main source was the business sector. Fluctuations over the years may reflect to some extent the life cycle of the allocation and implementation of the Structural Funds.

Although EU support increased during the post crisis period (from 5.6% of the GERD funded by the government in 2009 to 8.2% in 2012), it was not sufficient to reverse the drop in the public GERD, as shown in the previous section (see Figure 5).

Based on data from DG REGIO, the total Structural Funds for the period 2007-2013 for Portugal amounted to EUR 21.4 billion of which EUR 2.1 billion were assigned to 'Core' R&D activities⁸. Compared to this amount, funding stemming from the Portuguese participation in FP projects is much less significant. The financial support for projects under the FP6 and FP7 amounted all together to EUR 792 million, which is slightly more than one-third of the support for projects under Structural Funding for the period 2007-2013 only.

⁸ The definition of 'Core' R&D activities, is provided in the study "Cohesion policy and regional research and innovation potential", http://ec.europa.eu/invest-in-research/pdf/download_en/rkf5th_brochure.pdf

Distribution of public funding

Figure 6, below shows how the distribution of public funding to sectors of performance evolved over time:

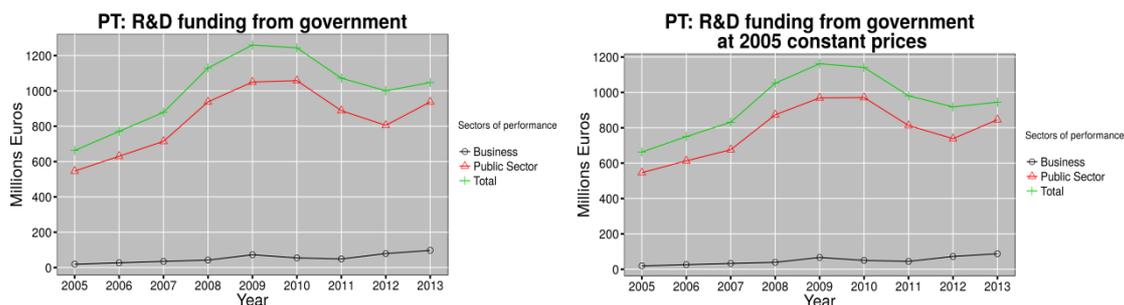


Figure 6 Government intramural expenditure by sectors of performance
Data source: Eurostat

The government invests primarily in R&D performed in the public sector. As a result it was the public R&D that has been mostly affected by the cuts due to austerity measures. In fact, government funding to the public sector peaked in 2009 but declined since then and the levels of 2012 were still below those of 2008.

Direct support to the business sector is significantly lower and it was already reduced in 2010 whereas support to the public sector that year remained stable. However, from 2011 onwards the trend reversed and direct support to business increased whereas support to the public R&D continued going down.

As it will be explained in section 3, the available data on indirect funding does not allow us to draw conclusions on its impact along the years.

3.2.3 Indirect funding – tax incentives and foregone tax revenues

We can distinguish two types of instruments as indirect support to business R&D through fiscal measures: the SIFIDE II and the Patent Box.⁹

SIFIDE II¹⁰ (the second programme launched in 2011) is a tax credit system aiming at stimulating R&D in business companies, which allows for a deduction on the business revenue tax. The incentive entails a credit against the corporate tax liability for the expenditures based on R&D activities, and this does not include cash grants made by the Portuguese Government to the R&D projects.

There was an evaluation of the SIFIDE I programme in 2005/2006 carried out by a commission nominated by the Minister for Science, Technology and Higher Education. The evaluation concluded that SIFIDE had positive impact in inducing business firms to carry out R&D activities. However, national experts point out to the fact that there are serious doubts whether this evaluation commission was fully independent.

The Portuguese patent box which is effective since the 1st January 2014 is part of a comprehensive reform of Portugal's Corporate Income Tax (CIT) system and is effective for intellectual property rights and intangible assets.

Based on OECD data, R&D tax incentives in Portugal represented 0.09% of GDP in 2012. Compared to 2006 we observe an increase in the indirect support to R&D (see Figure 7). Assuming that tax incentives target the business sector, it may be argued that in 2012 indirect support exceeded the direct public support to business, i.e. 0.09% GDP vs 0.05% GDP. We can then conclude that compared to 2006, in 2012, the Portuguese

⁹ A Study on R&D Tax Incentives. Annex: Country fiches, DG TAGUD, August 2014, p.85.

¹⁰ SIFIDE I (the first programme launched in 1997) consisted of a tax credit granted for companies which perform or contract R&D activities.

government managed to increase both direct and indirect support to business R&D but the lack of more recent data does not allow us to assess whether this effort has continued after that year.

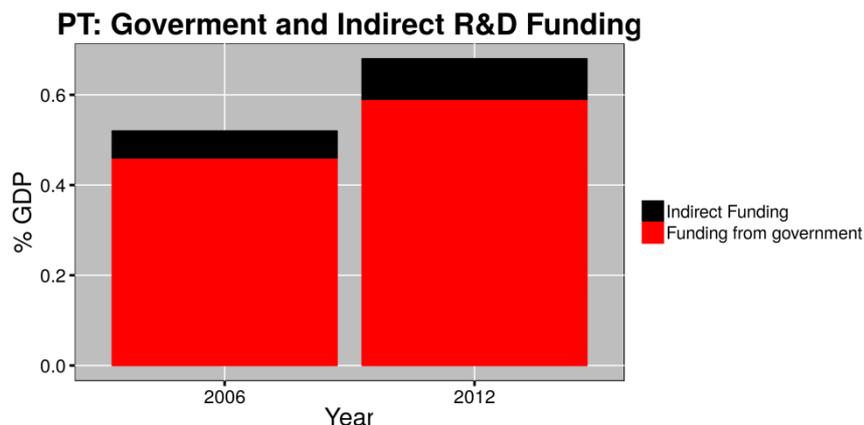


Figure 7 Direct and Indirect support to R&D
Data source: OECD

3.2.4 Fiscal consolidation and R&D

The above analysis provided evidence that the Portuguese fiscal consolidation process has come at the expense of public R&D expenditures. Figure 8 below shows the scatterplot of the structural balance and a relevant measure of the R&D (GBAORD as % GDP, first panel and GERD as % GDP, second panel)¹¹:

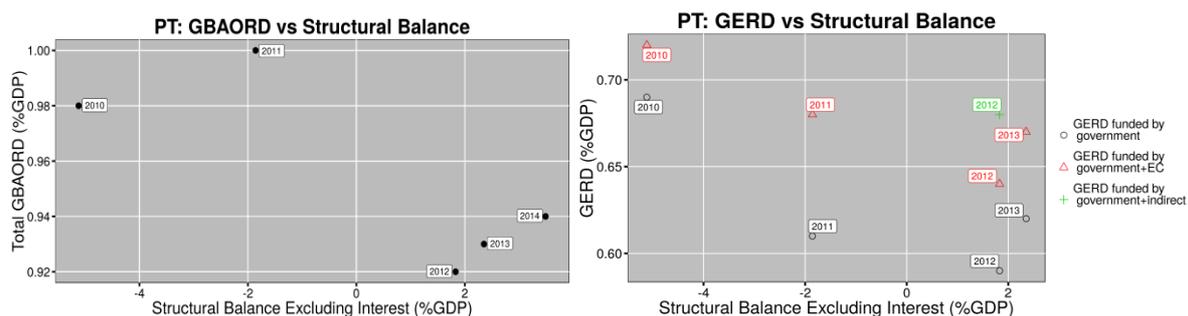


Figure 8 Fiscal consolidation and R&D
Data source: AMECO, Eurostat

According to Figure 8, the fiscal consolidation process started in 2010 had a negative overall impact on GBAORD from 2012 and government GERD already from 2011.¹² Due to the systematic large difference between the budgeted public support to R&D (GBAORD) and the real expenditure (government funded GERD) we consider that GBAORD figures have limited value for our purposes. According to Figure 8 (right plot), government funded GERD has declined during the post-crisis fiscal consolidation period by an amount corresponding to ca. 0.1% of the GDP.

¹¹ Structural balance data comes from the AMECO database the other indicators were taken from Eurostat. The 2013 value of GBAORD (solely) may not be fully comparable with the rest of the series due to the previously mentioned data issues.

¹² Although the 2011 data point appears to be an improvement, this is merely due to a larger fall in the GDP than in the GBAORD. GBAORD in million euros fell slightly in 2011 rather than increased.

Funding from the European Commission through structural funds and framework programmes play a significant role in the overall direct public support to R&D but it has not been sufficient to compensate for the losses in the government GERD. One observes that indirect funding through tax incentives provided to R&D is rather important in Portugal (Figure 8, right panel). However, one single data point is not enough for drawing conclusions.

Taking into account indirect financing through tax incentives (section 3) we can argue that direct public funding has decreased during the fiscal consolidation period, although indirect funding may have played an important role. According to the right panel of Figure 8, EU funding plays some role in the overall public financing, but not a decisive one.

3.3 Funding flows

3.3.1 Research funders

When describing the organisation chart that presents the main actors of the Portuguese R&I system, in section 1.2.2 above, the two major funding agencies (FCT and ANI) have already been mentioned. The scope of their activities is detailed below, while also mentioning other research funders.

The main funding agency is FCT (The Foundation for Science & Technology). Within the portfolio of its activities, FCT provides funding for: further education and training (PhD and post-doc grants) and research career development (contracts), R&D projects, R&D Institutions (R&D Units), international cooperation (bilateral cooperation, membership of international organisations and international partnerships), and other academic research-related activities.

The Agência Nacional de Inovação (ANI) has also a role in funding applied research and innovation oriented-activities. It is managed together by the two ministries portrayed in the organisation chart. Its main purpose is to stimulate R&D and technology absorption by business firms, together with establishing university-industry consortia. The main source of the funds it manages is from the Operational Programmes (OPs).

In parallel with ANI, IAPMEI (the Institute for Competitiveness and Innovation) is a financial arm of the Ministry for the Economy in charge of managing several policy initiatives aiming at stimulating and supporting pre-commercial research and business innovation.

On the private non-profit side there are two private foundations that play a role in what concerns research funding in Portugal. The first of them is the Gulbenkian Foundation, which was established in 1956, and which has scientific research as one of its main areas of activity. In addition to providing grants to support research activities and universities' chairs, the Gulbenkian has also its own Instituto Gulbenkian de Ciência, an institution that hosts several biomedical research groups and a PhD programme. The second of them is the Champalimaud Foundation. It started more recently, in 2005, and established the Champalimaud Centre for the Unknown in 2010, which promotes biomedical research, namely in fields related to neurosciences, oncology and vision, hosting also a PhD programme in these areas.

3.3.2 Funding sources and funding flows

A breakdown of the 2012 R&D funding indicates that the business sector and the public sector are by far the major funders, with shares of 46% and 43% respectively. The remaining sectors ("Higher Education", "Abroad" and the "Private non-profit" sectors) all have much smaller shares (4%, 5% and 2% of total funding respectively). The analysis of the funds provided by each sector to the remaining sectors shows a relatively low density in the research system, as the relative amounts involved in funding third-parties are typically small. The only exception to this pattern is the Government sector, which is one of the primary funding sources, which was responsible for providing a significant amount of resources to all types of research institutions in 2012, the main beneficiary

being the higher education sector (70% of government funds), followed by public research organisations (10%) and the private non-profit sector (12%). With regards to funding from the business sector, the vast majority of funds (91%) was dedicated to intramural research, which reveals a weak link with the external research sector. In relation to funds from abroad, all the four performing sectors are funded from abroad. The proportion of direct international funding has been low (between 6% and 5% in 2011 and 2012, respectively).

Over recent decades, structural funds have had an instrumental role in the development of the Portuguese R&I system. On average, the 2007-2013 NSRF Operational Programmes (OPs) dedicated €354m yearly to the national R&D budget (GBAORD) during the period of 2007-2013. This represents 20.5% of the national R&D budget over this period. It must be pointed out that the annual fluctuation that has been noticed in this contribution depends more on the cycle of NSRF implementation, and that it does not necessarily reflect a trend for structural funds for R&D in Portugal, as these funds are earmarked within each programming period.

When one compares the programming period of 2007-2013 with the preceding one of 2000-2006, a sharp rise on these framework OPs was noted, increasing from €136m in 2000-2006 to the already mentioned €354m in 2007-2013. For the new reference framework Portugal 2020, there is a new rise, with the funds allocated being on average €497m per year over the first two years, 2014 and 2015. It must be noted that all these figures refer to budgetary allocations, rather than actual executed investment, and they involve structural funds resources and national resources as well. When one refers strictly to structural funds, the EU allocation for Research, Development and Innovation in Portugal is €2,618m for the whole period 2014-2020 (see table below), which means an average of €374m per year.

Table 5 – Structural Funds allocation for RDI in Portugal, 2014-2020

Categories of Intervention	EU Amount (m€)	% R&D&I
Research and innovation processes in large enterprises	527.5	20.1
Investment in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities	81.9	3.1
Investment in infrastructure, capacities and equipment in large companies directly linked to research and innovation activities	146.8	5.6
Research and innovation infrastructure (public)	176.4	6.7
Research and innovation infrastructure (private, including science parks)	55.2	2.1
Research and innovation activities in public research centres and centres of competence including networking	520.1	19.9
Research and innovation activities in private research centres including networking	43.7	1.7
Technology transfer and university-enterprise cooperation primarily benefiting SMEs	343.9	13.1
Cluster support and business networks primarily benefiting SMEs	120.6	4.6
Research and innovation processes in SMEs (including voucher schemes, process, design, service and social innovation)	378.5	14.5
Research and innovation infrastructure, processes, technology transfer and cooperation in enterprises focusing on the low carbon economy and on resilience to climate change	223.8	8.5
Total R&D&I	2,618.4	100.0

An important aspect in relation to the structural funds is that they have been relevant for the development of the national R&I system not only for their direct contribution to R&D expenditure, but also more for the development of advanced human resources, as the European Social Fund has been contributing to the training of young scientists and other related activities. Despite the investment in developing the modern scientific system preceding the structural funds intervention, this support has been decisive for the development of this system, and also for the development of a large number of policy initiatives driven towards promoting innovation in the business sector. Further, the adoption of the structural funds rules has also meant the development of machinery for preparing, implementing and, particularly, evaluating the different programmes that to a large extent did not exist before.

As for the period that we have previously mentioned (2009-2013), an analysis of the FCT costs account indicates that the European Social Fund funding of the FCT activities has been on average €65m per year, whereas ERDF funding has been €43m per year. For the first year of the new reference Portugal 2020 framework, which was 2014, the equivalent amounts reversed in order of importance, with €56m under the ERDF and €46m under the European Social Fund.

Further to the contribution of direct structural funds, EU funding has also been provided by the FP programmes. Whereas in FP6, a total of 851 projects, involving 1,202 Portuguese partners received a total contribution of €266m, in FP7, a total of 1,692 projects involving 2,222 Portuguese partners received a contribution of €526m, the equivalent to 1.15% of the overall FP7 funding. Portugal has meanwhile set a target of 1.5% for Horizon 2020, the EU research framework programme to be implemented over the period 2014-2020. In the first year of Horizon 2020, Portuguese teams were allocated €146m, which is equivalent to 1.75% of the total funds provided under this framework in 2014, thus above the national target and making the country a net receiver rather than a net funder as before. The information until mid-2015 confirms this most recent trend of a good performance of national teams in Horizon 2020.

3.4 Public funding for public R&I

3.4.1 Project vs. institutional allocation of public funding

The main entities that govern competitive research funding in Portugal are FCT (the Foundation for S&T), ANI (the National Innovation Agency) and IAPMEI (the Institute for Competitiveness and Innovation), the former concentrates more on academic research funding, and the latter two on industrially-oriented research funding. A significant part of the financial resources for research of these three entities stems from the Operational Programmes, which are co-funded by national and cohesion funds, although important allocations also stem exclusively from national funding.

Further to competitive research funding, institutional block funding exists, which consists of direct allocations to institutions from the annual national budget. This type of funding has been mainly directed to the national public laboratories. Further to this, there is the funding of research at universities and other higher education institutions, but this has been calculated as a fixed percentage of the salaries paid to the teaching staff of those institutions.

Over the recent years, important changes have been made to the regulatory framework for the allocation of R&D funds. FCT has defined a new arrangement for the funding of those research units that belong to the national scientific system, in which funds started to be provided after the presentation of proof of executed expenditure rather than on an ex-ante basis to fund planned activities. A second source of change in the regulatory framework concerns the regulations for the measures to be implemented within the Operational Programmes of Portugal 2020, which were made public essentially over 2015. These changes were highlighted in chapter 2 with specific regard to the COMPETE 2020 OP.

There is some difficulty in drawing conclusions in relation to the trends of institutional and project funding, as some of the data available is provided as budget figures, and other as actual costs. Looking at the cost account of FCT, the indication is that (academic) project funding has been rising, with funding growing from €65m to €109m from 2011 to 2014. Furthermore, the institutional funding by FCT of academic research entities, which is based on regular evaluation, also went up from €47m to €54m between 2011 and 2014, though it topped in 2013 at €69m. However, the trend in these two types of expenditure is contradictory to the budget information for the relevant measures of the Operational Programmes, which indicates a reduction from €401m to €361m. When the figures are observed over a longer time-span, it is also clear that the current funding has not yet matched the pre-crisis funding, as the FCT funding for the research units was €85m in 2010.

What seems to be clear, however, is that institutional block funding has been declining, which means that total competitive funding (project-based funding and also institutional funding dependent on performance evaluation) has been on the rise. Block funding has declined as both national public labs grants and the budget allocations estimated for the higher education sector have experienced a significant reduction, from €881m in 2011 to €796m in 2015, although this decline is mainly related to wages restrictions imposed on the personnel of these institutions in recent years.

3.4.2 Institutional funding

In the earlier decades of the development of the S&T system, the main type of institutional funding used to be the block funding allocated to the national public labs. All of the existing public labs have a sectorial nature, with most of them depending on different ministries. This segment of the R&I system has however lost its relative importance over the decades. This long-term process has continued more recently, as the funds allocated for R&D under this item have declined from €176m in 2011, to €154m in 2013, and to €125m in 2014, though they suffered a small increase more recently up to €137m in 2015. The funding of these entities does not depend on efficiency or effectiveness criteria, but it is rather based on tradition and the number of tenured personnel in each lab.

The higher education sector has been financed essentially on a per capita basis, with funding to both universities and the remaining higher education sector being related to historical factors and the number of students in each institution. In 2015 there was a discussion between the Ministry for Education and Science and the higher education sector about the introduction of a new law whose intention is to put the funding of the institutions on a more competitive and performance-related basis, but this law has so far not been published. In relation to the participation of the higher education sector on the GBAORD, it is simply estimated as 40% of the funds allocated to the operational expenditure of the universities and polytechnic institutes, with most of that operational expenditure being related to the payment of salaries.

In 1994, a new scheme, the research Multiannual Funding, was initiated to provide institutional funding for research groups operating within universities and other academic institutions. This system has been since its beginning managed by FCT. Up until 2014 the research groups were broken down into a two-tiered system of 'research units', and 'associate labs'. In 2010 a total of 308 research units with a total of 9,558 researchers received €35m (€3,652 per researcher), whilst the 25 existing associate labs had 2,058 researchers, and received €44m (€21,137 per researcher). For that year (2010) the total FCT funding for research units was €85m.

From 2015 on there has been a change in that organisation of the academic research system, in the sequence of the [evaluation of the research groups that was carried out between 2013 and 2015](#) (link accessed on 21 October 2015). The new arrangement has generated a multi-tiered system. A total of 322 R&D units with 15,444 researchers were involved in the evaluation exercise, which was carried out in two different stages. In the sequence of the first stage, it was announced that 55% would proceed to the second

stage. Of the 45% that were not selected for the second stage of the evaluation, 31% received a classification of 'Good' or below. These units will receive less than €1k per researcher, per year, or no funds at all. The remaining 14% will receive further funding for restructuring, which will incrementally rise the average funding per researcher above the previous 31%. The remaining 55% of the 322 research units under evaluation, which integrate 10,992 researchers, making up 62% of the researchers in all the evaluated units, were selected for the second stage of evaluation. The results of the second stage of the evaluation process were disclosed by FCT in December 2014, with 11 units ranked as 'Outstanding', 52 as 'Excellent' and 104 as 'Very Good', while a few of those in the second stage were still ranked below those qualitative levels. After the appeals procedure, that closed in May 2015, [these results suffered a slight change](#) with the number of those units classified as 'Excellent' raising to 60 and the number of those classified as 'Very Good' falling to 97. The funding to be assigned to the research units evaluated in the second stage was foreseen to be about €70m per year, but in the sequence of the appeals procedure that amount raised to €77m per year. The funding per researcher rises exponentially for the units in the top levels, with the 3% units in the 'Outstanding' bracket to receive 18% of the funds and the 19% classified as 'Excellent' to receive 49% of the total funding. These two groups host, respectively, 6% and 26% of the researchers incorporated in the research units that were evaluated.

For this recent evaluation, FCT requested the services of international evaluators who were recruited by the ESF. Although the process was meant to be transparent, and in accordance with best practice standards, it has not been implemented without problems, and criticisms have been made in the press and also through public declarations made by prominent scientists (see Godinho & Simões 2015, see chapter 2 above). In this context, it was made public the "[Livro Negro da Avaliação Científica em Portugal](#)" (The Black Book on the Scientific Evaluation in Portugal), which gathered information about the public discussion that took place in the sequence of the evaluation of the research units undertaken by FCT in 2013-2015. That Black Book was the initiative of five Portuguese researchers, including a former deputy minister for Science, Technology and Higher Education, who eventually become the minister for Science, Technology and Higher Education in the government whose programme was approved by the Portuguese Parliament in December 2015.

In its [final report on how the evaluation was executed](#) (ESF 2015), the ESF addressed some of the main arguments that emerged in the public discussion in Portugal in the months after the evaluation was carried out. Despite a general conclusion that the integrated outcome of the evaluation process as presented by i) the final classification of research units, and ii) the consensus reports produced by the Review Panels (complemented by external assessment reports and in some cases reports from the appeal) is robust, balanced and fair. This is a consensual outcome from a well-balanced, coherent, consistent and independent process involving open and free discussions at panel level with the support of external reviews and in some cases site visits.

The ESF recognized several shortcomings and problems on how the evaluation took place. Within the concerns expressed in the report (ESF 2015), there is one aspect that deserves to be singled out. It has to do with the FCT funding decisions in the sequence of the evaluation proper, in section 2.2 above the ESF report is extensively quoted on this regard. The concern that is reflected on that part of the report relates to the fact that for the units that moved to stage 2 of the evaluation, a rule of thumb was applied to the budgets they presented. This meant that for units possibly similar on every respect, including past bibliometric performance, number of researchers and grading, except for the budgets they presented, a different amount of funds was allocated.

3.4.3 Project funding

FCT regularly publishes calls for the funding of scientific research projects. This has traditionally happened both through calls open to all scientific areas, which normally are published annually, or through calls targeting specific themes or domains. In the most

recent years, however, the first type of calls has been prevalent. Both AdI and IAPMEI also regularly publish calls, as part of their roles as co-managers of the Operational Programmes, for funding industrially-oriented, innovation-driven research projects, though these are mainly oriented towards the private business sector.

Looking at the costs account of FCT, the item 'R&D projects' has risen from €65m to €109m between 2011 and 2014. The funding of these projects clearly has a competitive nature. For the most recent calls the success rate has been of 13%. As for the 2014 call, whose results were published in August 2015, 689 out of 5,459 projects were approved, with a total expected funding of €118.7m. The projects are evaluated in accordance with the principles of independent refereeing, and funding is provided according to the perceived scientific merit. Whilst up until the 1990s only national experts used to take part in these evaluation panels, this situation has changed very significantly over the last two decades. For those scientific research projects funded by FCT, several criteria are taken into account, the [two main ones being](#): "a) the scientific merit and innovative character of the project; and b) the scientific merit of the research team". Based on these criteria, the evaluation and selection panels rank the project applications in accordance with international best-practices and project funding is thus allocated on the basis of international peer-review standards.

3.4.4 Other allocation mechanisms

No other relevant funding mechanisms have been available in Portugal recently, namely in connection with contract research undertaken by governmental organisations.

3.5 Public funding for private R&I

3.5.1 Direct funding for private R&I

In recent years, direct incentives to innovation have been mainly managed by COMPETE, the Competitiveness Factors OP of the NSRF 2007-2013. Within that OP, R&I funding was neither thematically nor sectorially focused. The dominant approach was characterised by generic incentive systems, which did not address specific industries, technologies or scientific fields. Notable exceptions to this were the collective efficiency strategies (particularly CTPs and Other Clusters).

In the new framework provided by Portugal 2020, the 'Operational Programme for Competitiveness and Innovation', whose short name is COMPETE 2020, is the natural continuation of the former COMPETE within the NSRF 2007-2013. This OP addresses mainly the three converging regions of continental Portugal, namely Norte, Centro and Alentejo. However, all the five regional OPs of continental Portugal share the same regulation as COMPETE 2020. The COMPETE 2020 comprises six axis, the most relevant of which is axis 1, which is dedicated to the strengthening of research, technological development and innovation. Axis 1 comprises a variety of policy tools to support R&I by business firms, namely:

- R&D Business Projects – these projects are promoted by business firms with the objective of developing new products, processes and systems or the introduction of significant improvements in existing products, processes and systems;
- Demonstration Projects – the objective of these projects is making visible and accessible advanced technologies and pilot units developed out of R&D activities, with the aim of showing before a specialized audience the economic and technical advantages of new technological solutions that may not yet be validated from a technological or commercial point of view;
- Mobilizing Programs – these typology includes a) 'collective projects' whose objective is to stimulate scientific and technological capabilities and skills, with high technological and innovation content and significant potential impacts and b) other types of partnership and cooperation for the effective transfer of knowledge and economic exploitation of the results of R&D among firms, conducted in effective collaboration between business and non-business entities of the R&I system;

- R&D Units – these are projects aimed at creating or strengthening R&D internal skills and capabilities within business firms;
- Protection of Industrial Property – this includes projects that, as a result of R&D projects supported by the OP, aim at promoting the registration of industrial property rights in the form of patents, utility models, designs, both in the national or international IP systems;
- R&D Internationalisation – these are projects to stimulate the internationalization of business R&D, through supporting the preparation and submission of applications to EU R&I programmes, or the participation in European-wide R&D industrial projects or yet the participation in international R&I networks;
- R&D Voucher – the aim of these vouchers is to allow firms to purchase R&D or technology transfer consulting services.

The R&D Business Projects, the Demonstration Projects, the Protection of Industrial Property projects and the R&D Internationalisation Projects can be submitted as both individual or co-promotion projects, being the latter led by a business firm but integrating non-business entities of the R&I system. For the Mobilizing Programmes typology, the only possibility is to present the submission as co-promotion projects. Further, within the part of COMPETE 2020 aiming at stimulating academic research, there is also the possibility of co-promotion projects being submitted, but with the leadership of academic entities and the participation of business firms as co-promoters.

In addition to the policy tools mentioned above, COMPETE 2020 also manages the so-called 'Collective Actions'. These include three different types of interventions, which are complementary of the incentives aiming directly at business firms. Within the typology of the 'Collective Actions', the most relevant action to mention here is the one dedicated to support the 'Transfer of S&T knowledge'. This aims to facilitate the transfer of relevant knowledge and support its further economic exploitation by business firms.

Most of the different types of projects mentioned above are managed by ANI, namely: the R&D Co-promotion projects, Demonstration Projects, Mobilizing Programmes, R&D Units, IPR Protection, R&D Internationalization Projects and the S&T Knowledge Transfer (one of the three types of support under the "Collective Actions" typology). The remaining projects are managed by IAPMEI.

In relation to demand-side policies, they have been promoted in the past but discontinued during the austerity years. In fact, in part due to budgetary constraints, the Portuguese government discontinued, or significantly curtailed, several demand-side innovation initiatives that were launched before 2011, namely in the fields of electric mobility, renewable energy and ICT use by school children (Godinho & Simões, 2013).

A new organisation in charge of public procurement was established in 2012, the Entidade de Serviços Partilhados da Administração Pública, I. P. (eSPap, the Institute for Public Administration Shared Services). The organisation is the follower of the National Authority for Public Procurement (ANCP) and resulted from the merging of public sector organisations that operated independently before its creation. eSPap's mission was defined as follows: "to ensure the achievement of efficiency and effectiveness gains, through a rational use of common public resources and the supply of shared services, thereby contributing towards the agility of the state and the country's sustainable development". However, procurement has been essentially guided by principles of providing the best quality solutions while at the same time minimizing public expenditure, rather than criteria associated with promoting innovation on the domestic supply side.

In 2014 it was announced the intention to have an update of the National Strategy for Ecologic Public Procurement 2008-2010. The main changes announced concerned the enlargement of priority products and the inclusion of new fields, for instance, food products. These changes were expected to be a driver for the creation of new markets. However, such update of the Strategy has not been made public so far. Still in 2014, a 'Coalition for Green Growth' was established, with more than 100 representatives of

associations and other entities. The entities associated in this initiative had an active role in the process of public consultation that led to the publication, in March 2015, of the '[Compromise for Green Growth](#)', a strategic document that puts forward a "vision for the long-term development after the post-troika intervention period". In the executive summary of that document it is stated that "a post-troika strategy implies [...] the promotion of a new cycle of structural reforms and selective productive investments in strategic areas, such as knowledge, industrial policy and the green economy, in order to promote green growth in a sustainable way." This strategic initiative is expected to play a role in promoting the combination of demand and supply-side initiatives with regard to environmental issues and sustainability.

3.5.2 Public Procurement of Innovative solutions

PCP/PPI landscape

The Portuguese public administration invested massively in its ICT infrastructure in the 2000s decade. However, the recent economic and financial difficulties have led to a more careful approach in terms of government ICT investments. A Strategic Plan for Rationalisation and Reduction of Costs with ICT in Public Administration was launched in December 2011 to reduce costs with ICT by €558 million annually over 2012-2016. In parallel to this Plan an entity (ESPAP) has also been created, stemming from the merger of three pre-existing entities, with the objective of promoting the rationalisation of the Public Administration's ICT resources together with making public procurement in general more efficient.¹³

In 2014 the government announced the intention to have an update of the National Strategy for Ecologic Public Procurement, after its initial enactment in 2007. The main changes should concern the enlargement of priority products and the inclusion of new fields, for instance, food products. These changes were expected to be a driver for the creation of new markets. An update of this National Strategy was not made public yet, but a new programming period for the strategy was announced in April 2015 (2015-2018), alongside the approval of the Green Growth Commitment.

PCP/PPI initiatives

In recent years, the commitment to use public procurement as an instrument to promote innovation has declined. The demand-side initiatives taken in the context of the Technological Plan, namely for renewable energy, electric mobility and public sector innovation, have been mostly discontinued.

Portuguese procurers participate in the buyers group of the EU funded Cloudforeurope PCP project (Institute for the public administration shared services) and in the SAEPP network of procurers that prepares a PCP on smart ambulance (INEM).

3.5.3 Indirect financial support for private R&I

Indirect incentives have been promoted under SIFIDE. This is a tax credit system for stimulating R&D in businesses, which allows for deductions off IRC (the business revenue tax) and its target audience are business firms. The following are eligible for these deductions: the equity of research and development entities; the costs of filing for patents and their maintenance fees; the costs of R&D audits; investments in the purchasing of R&D equipment, and; the salaries of researchers and auxiliary personnel involved with research and development. The Budget Law for 2011 extended the system up to 2015 (SIFIDE II), and improved the conditions granted to R&D performing companies. SIFIDE includes two kinds of incentives for companies performing R&D: a basic tax incentive, which corresponds to 32.5% of all eligible R&D expenditure made in the relevant fiscal year, and an incremental incentive, which corresponds to 50% of the increase in R&D expenditure when compared to the average of the two previous years.

¹³ <http://ec.europa.eu/digital-agenda/en/news/innovation-procurement-initiatives-around-europe>

The amount of tax credits approved under SIFIDE has been close to €100m per year. This system was reviewed in 2013 in order to positively discriminate those projects that involve cooperation with other entities and international cooperation, and which have open access to the results. The [Budget Law for 2014](#) (Lei nº 83-C/2013, December the 31st) extended (article 211th) SIFIDE II up to 2020.

As for the fiscal years 2012 and 2013, a total of respectively €147.2m and €153.4m were conceded as fiscal credits under this SIFIDE system. These figures compare a BERD value slightly above €1bn. Until December 2015 the applications for fiscal year 2014 were still under evaluation. The budget law for 2016 was not passed in Parliament at the end of 2015, but there are no signs that this fiscal regime will suffer any short term changes. It must also be pointed out that no formal evaluation of this system has been done at the time of writing (end of 2015).

Another type of tax incentives for R&D is the [regime of scientific patronage](#). This regime, which was initially enacted by Law 26/2004 and reviewed under Law 64/2011, provides tax incentives to both individuals and organisations that contribute to the financing of scientific activities of foundations, institutes, associations, higher education institutions, and other units or centres carrying out R&D activities. In 2012, 1,928 such entities participated in this system and the total deductions on their taxable income amounted to €21m. Despite this system allowing for support of research carried out in the private sector, it generally addresses scientific activities thus leaving outside its scope innovation oriented R&D. Further to its scope, the financial reach of this system is not comparable to SIFIDE. However, likewise SIFIDE it has not been object of any evaluation study.

3.6 Business R&D

3.6.1 The development in business R&D intensity

As one can see from Figure 9, BERD intensity in Portugal is rather low (about 0.6% of GDP in 2014) and on a steady decreasing path since 2009, although, during a few years in the run-up to the crisis and even in 2008, it has been increasing from 0.29% of GDP in 2005, reaching 0.75% of GDP in 2009. Since public support to BERD is not very significant, this trend is closely related to the behaviour of the business sector that increased BERD until 2008 and set it on a declining path (Figure 10). Based on Figure 10, the slight increase of BERD in 2009 (0.03% of GDP) has been supported by public sources.

Due to credit constraints and the subsequent decline in domestic demand, Portuguese companies (especially SMEs) either cut their domestic investments in R&D in order to make savings or started to focus on international markets. While moving towards Asian markets required an increase in the commitment to innovation, turning to Portuguese-speaking markets was less demanding on innovation capabilities.

In a sectorial breakdown, one observes from Figure 9 that business services are the main contributors to BERD financing. During 2007-2013 they constantly outpaced manufacturing (i.e. the second most important sector) by 0.1-0.2% of GDP. These two sectors account for more than 90% of the total BERD. We mention utilities as the third sector in order of importance. However, their contribution to BERD is marginal. The economic structure of the country has been changing fast resulting in a severe decline of the manufacturing sectors. In 2013, the services sector accounted for 76.2% of the total production, manufacturing and extracting industries for only 13.3%. Employment in high- and medium-high-technology manufacturing sectors as a share of total employment in Portugal is at about half of the EU average, at 2.9% versus 5.6% in 2013. The situation is better concerning employment in knowledge-intensive service sectors as a share of total employment, with 33.2% in Portugal versus 39.2% in the EU.

Figure 9 BERD intensity broken down by most important macro sectors (C= manufacture, G_N=services, D-E= Utilities)

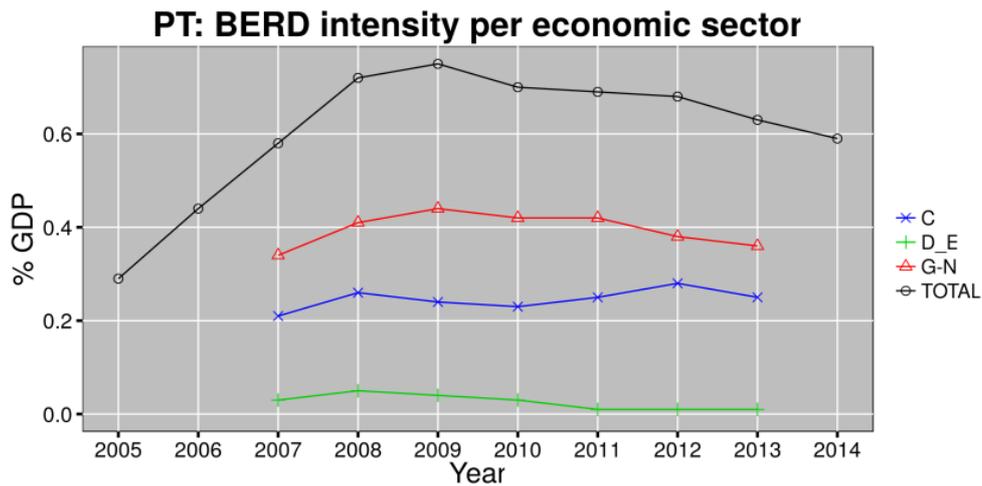
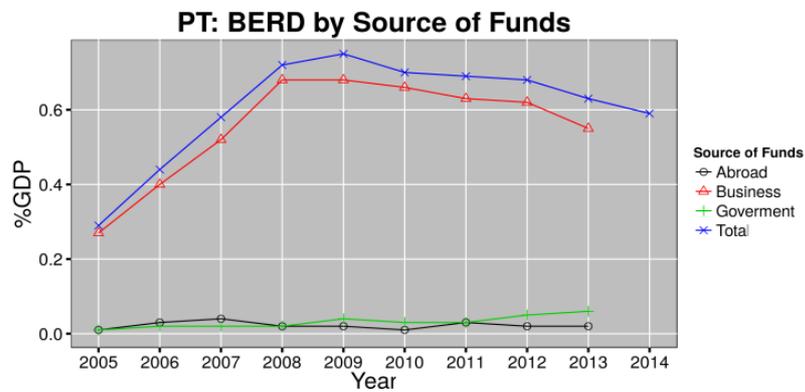


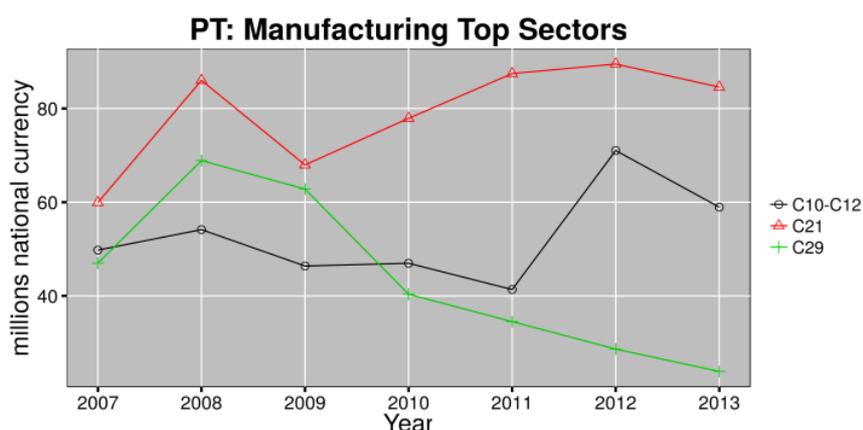
Figure 10 BERD by source of funds



3.6.2 The development in business R&D intensity by sector

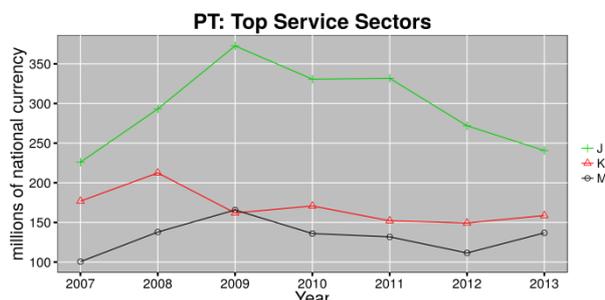
In manufacturing pharmaceuticals, food & beverage as well the automotive industry has received the largest amounts of BERD (Figure 11) in the above mentioned order of importance. As we can see on Figure 11, all three sectors were hit by the economic crisis. Pharmaceutical sector BERD started to recover as early as 2010 and is reaching nowadays its 2008 levels. Food & beverage BERD showed some signs of recovery in 2012, without a clear trend. Finally, the automotive sector BERD declined almost to complete disappearance mainly due to the closure of the semiconductor plant of the German group Quimonda hiring mainly highly-skilled employees. Further to this, there were a number of disinvestments in the automotive industry, especially by automotive components companies, as a result of the heavy contraction of the automotive market in Europe. However, in part due to the specific programme launched to support this industry, it was possible to keep the existing car-assembly plants, namely of AutoEuropa, the affiliate of Volkswagen.

Figure 11 top sectors in manufacturing (C10-12= food, beverage and tobacco, C21= basic pharmaceuticals, C29= motor vehicles, trailers and semi-trailers)



Compared with manufacturing, the main contributors to business R&D in the much larger services sector are somewhat more knowledge intensive services sectors, such as information and communication services (J), financial and insurance activities (K) as well as professional and scientific services (M). All three of them were hit by the crisis although to different extent and with a one year time lag in case of J and M. On the one hand, financial activities BERD is practically stagnating on its 2009 level and one observes a mild increase for the professional services BERD. On the other hand, there is an important decline in the case of information & communication services R&D.

Figure 12 top service sectors (J=information and communication, K= Financial and insurance activities, M=professional, scientific and technical activities)



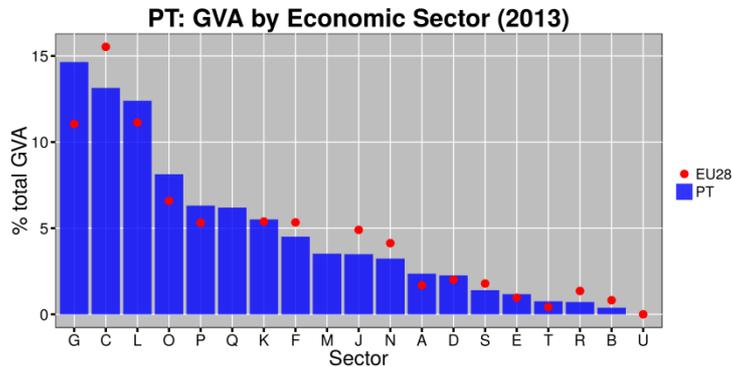
3.6.3 The development in business R&D intensity and value added

When looking at the contribution of the various sectors to the total gross value added, we notice that wholesale/retail as well as manufacturing are the most important sectors in this respect, which is in line with their importance in funding. Real estate activities, public administration services, financial and insurance services as well as education follow in terms of importance. The GVA shares of other sectors are relatively minor.

Comparing Figure 12 and Figure 13, we observe that the top BERD receiver services sectors (J, M) are contributing to less extent to the GVA. One explanation could be that these are smaller sectors within the country's economy or that they are operating with a low margin due to the strong sectorial competition.

Figure 13 economic sectors as percentage of the total GVA.

Top 6 sectors in decreasing order: 1) wholesale and retail, 2) manufacture, 3) real estate activities, 4) public administration, 5) education, 6) human health and social work activities



According to Figure 14 one observes that the manufacturing sectors with the highest GVA have a technological intensity of low to medium low (except for the automotive, which is medium-high). This is in line with the structure of the Portuguese economy, where more R&D-intensive sectors have a relatively minor share in the national economy.

Figure 14 GVA in manufacturing.

Top 6 manufacturing sectors: 1) Textiles, wearing apparel, leather and related products, 2) Food & Beverage, 3) fabricated metal products, 4) other non-metallic mineral products, 5) Motor vehicles, 6) Rubber and plastic products

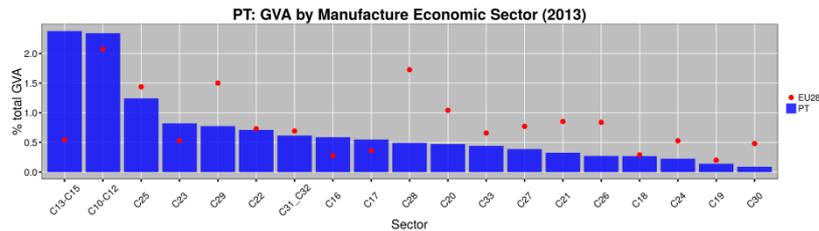
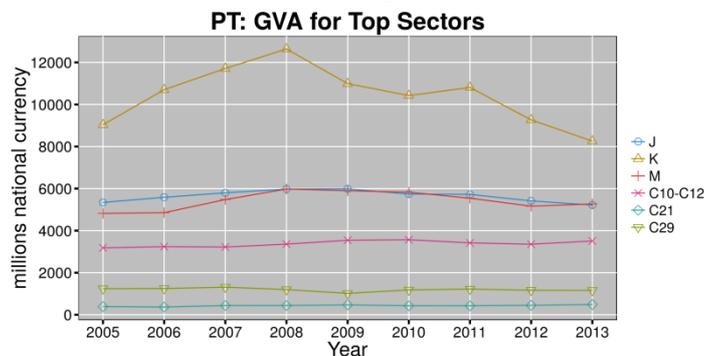


Figure 16 shows that the financial and insurance services was the main contributor to VA throughout 2005-2011. It faced a drop of ca. 10% in 2009 and a mild decrease afterwards reflecting contraction in crediting and investment activities. This sector is followed by both more and less knowledge intensive services sectors, such as ICT and wholesale & retail trade. High-tech economic sectors (manufacture of pharmaceuticals) are less important in the national economy. Except for financial and insurance services GVA, all other sectors mentioned in the analysis managed to maintain their GVA at factor cost throughout the last decade.

Figure 15 Value added for the leading manufacture and service sectors



Regular data about the contribution of foreign-owned firms to BERD are not available, but there is a perception that their contribution is not as high as in the other EU Member States¹⁴. According to the latest data available about the largest R&D performers in Portugal in 2011, four majority-owned foreign subsidiaries (Nokia Siemens Networks, Volkswagen, Barclays Bank and Bosch) were among the 20 top R&D performers, accounting for around 15% of the R&D expenditures of those top 20.

The EU R&D Scoreboard 2015 includes 5 Portuguese companies: PHAROL (Fixed Line Telecommunications), BIAL (Pharmaceuticals & Biotechnology), Credito Agricola (Banking), Energias de Portuga (Electricity) and Caixa General de Depositos (Banking). PHAROL was the first ranked among them (rank 653) and spent 125 million euros on R&D in 2014.¹⁵

Table 6 - EU R&D Scoreboard 2015: Portuguese companies ranked by R&D

EU R&D Scoreboard 2015 : World - 2500 companies ranked by R&D						
			Industrial sector	R&D 2014	R&D 1 year growth	R&D 3 years growth
653	PHAROL	Portugal	Fixed Line Telecommunications	125.0	-3.8	-16.0
1412	BIAL	Portugal	Pharmaceuticals & Biotechnology	44.9	-15.4	-2.6
1929	CREDITO AGRICOLA	Portugal	Banks	27.9	91.9	6.2
1969	ENERGIAS DE PORTUGAL	Portugal	Electricity	27.2	-12.4	-22.0
2093	CAIXA GENERAL DE DEPOSITOS	Portugal	Banks	24.5	-32.4	-13.0

3.7 Assessment

Concerning research funding in Portugal, the problem does not seem to be essentially one of striking a better balance between project and institutional funding, but rather whether the allocation of each of these types of funding is being carried out in the most effective and efficient way. In relation to the competitive funding granted to those research units that are funded by FCT, a relevant question is whether those that perform better (and sometimes only incrementally better) should be proportionally granted much greater funding. It seems sensible that the trade-off between the stimulus to the excellence and sustainability of the research system will not occur in a country like Portugal by adopting the same criteria as more mature and stable systems, although it seems clear that there is a need to renovate certain segments of the research system. The Portuguese research system is on average much younger than those of the advanced economies. It grew fast over the last twenty years, reaching publication levels per capita above the EU average in a short time period. As the system is maturing, it is still seeking a stability needed to develop further. Moreover, and this is a challenge that has been widely recognized, the science base has not been connected significantly with the economic activities. The incentives that have been provided, and the drive to favour a small group of research entities assessed has outstanding or similar, do not converge with the needs that have been diagnosed over the years.

A proportion of FCT funds are still allocated to 'international collaboration'. Agreements with several US universities and fees for participation in international research labs fall under into this category. In 2014, this item accounted for €44m, and though the total amount in this item has decreased over the austerity years, in historical terms this has had a very significant weight in the FCT account. There is no clear idea on the relative pay-back in comparison to other items of the FCT account since the majority of this expenditure has not been evaluated.

In relative terms, it is clear that institutional block funding has been declining, which means that total competitive funding (project-based funding and also institutional funding dependent on performance evaluation) has been on the rise. Block funding has declined as both national public labs grants and the budget allocations estimated for the

¹⁴ RIO Country Report on Portugal, 2014

¹⁵ <http://iri.jrc.ec.europa.eu/scoreboard15.html>

higher education sector have experimented a significant reduction, although this decline is mainly related to wages restrictions imposed on the personnel of these institutions in recent years.

Concerning the support of R&I activities, namely those developed by business firms, it is clear in the sequence of the main evaluations that were carried out in relation to the R&D and innovation support measures of the former NSRF 2007-2013, that the policy toolbox used to stimulate research and innovation is relatively comprehensive in Portugal (Mamede, Godinho & Simões, 2014). Over the years, Portugal has introduced those main types of policy initiatives that had been successfully tested in this field by other EU members. It is thus not surprising that Portugal has moved along the same lines as other countries, providing public funding for research and innovation, both through direct and indirect policy instruments. The account provided above of the main type of projects and actions promoted by the COMPETE 2020 operational programme confirms this perception. The policy tools and funding available for the period 2014-2020 provide adequate support throughout the main stages of the innovation process, from basic research to actions closer to the market, while at the same time providing incentive for either individual or co-promotion projects gathering entities of different nature, both in the business and the academic sectors.

4. Quality of science base and priorities of the European Research Area

4.1 Quality of the science base

Since the 1970s and until the beginning of the 2010s Portugal invested continuously in the creation of an advanced research capability, by implementing schemes for supporting PhD students through grants abroad and at home, by promoting doctoral studies in the public university system, and also by putting high standards for the contracting of university staff. This has led to the creation of a community of well-trained PhD holders, and to the rapid rise of the number of FTE researchers. Despite the growth in the GERD/GDP ratio that happened over the first decade of the 2000s, up to 1.58% in 2009, the growth in the research labour force was even faster, leading to a proportion of FTE researchers over the employed workforce that is more typical of countries with GERD/GDP ratios in the 2%-2.5% range. The training of this research workforce did not follow any sectoral or technological priorities, as it was essentially guided by principles of academic quality. This newly trained research workforce was mainly employed by universities and the research labs operating in their perimeter.

One very positive outcome of these developments was an impressive rise in the number of internationally refereed publications. As it is visible in the table below, the number of publications per thousand of population was almost 30% higher in Portugal than in the EU in 2013. This performance is partially based on a degree of internationalisation, as measured by international co-authorships, that is higher than what is the EU pattern (see 'share of international co-publications' and 'number of international publications per thousand population' in the table below). What is also perceptible is that the advancement that happened in the scientific publications in the most recent decades was mainly of a quantitative rather than a qualitative nature, as reflected by indicators like the 'percentage of publications in the top 10% most cited', in which the Portuguese performance is just similar to the EU average. Further, and in accordance with the analysis in the previous paragraph, Portugal is underperforming significantly, by almost 40%, the EU in what regards the 'share of public-private co-publications', denoting a lesser propensity of interaction between academia and the business sector. This weaker integration between science and innovation is also perceptible in the small proportion of doctorates that find a job in the business sector. A recent study indicates that only 4% of the PhD graduates in Portugal were employed by the business sector in 2012 (Advancis, 2015).

In terms of governance of the science system, no significant measures have been taken recently, apart from what has been described in other sections of the report regarding the evaluation of the research units. As it was mentioned in those sections (2.1.1 and 3.4.2), that evaluation favoured the concentration of funds in a small group of 'outstanding' units and in a few else classified as 'excellent'. In the initial terms of reference of this evaluation, it was also stated that there was an intention to promote the merger of smaller units and the establishment of multidisciplinary consortia. This sort of development happened to a certain extent, though in practice the evaluation did not had a significant impact in relation to these initially stated objectives.

Table 7 – Scientific performance as measured by publication indicators

Indicator	Portugal	EU average
Number of publications per thousand of population (2013)	1.85	1.43
Share of international co-publications (2013)	48.0%	36.4%
Number of international publications per thousand of population (2013)	0.89	0.52
Percentage of publications in the top 10% most cited publications (2010-2013)	11.03	11.29
Share of public-private co-publications (2011-2013)	1.1%	1.8%

4.2 Optimal transnational co-operation and competition

4.2.1 Joint programming, research agendas and calls

To enhance Portuguese involvement in the EUs' FPs, a National Office for Promoting Portuguese Participation in the Framework Programme (GPPQ) was established in 2007. GPPQ, who has been active in diffusing information and in promoting participation in H2020, is now under FCT and ANI. In FP7, the Portuguese return was slightly below 1 in relation to its funding of the programme, but higher than in FP6. In H2020 the situation seems to keep improving. In 2014 Portuguese teams were able to raise a total of €146m in H2020. This represents a 1.75% success rate over the total funds allocated to H2020 for that year and it is well above the €120m that the country contributed to the programme in 2014. This positive trend has continued in 2015, at least for the calls whose results have been announced, that indicate that Portuguese teams raised nearly 2% of the total budget available.

Despite these recent advancements, Portugal is still improving in its capability to collect the spillovers from an increased participation in international research efforts, and on the integration of the benefits of that participation into the strengthening of national research institutions and strategic projects. Specifically, national policies are still progressing along a learning curve on how to better manage the trade-off between increasing European collaboration and the capturing of benefits for Portugal, as spatial economies of scale are set within ERA. Such improvements are becoming more relevant, as an increased involvement in Horizon 2020 is envisaged as being critical, namely in relation to a national funding context that has been perceived in recent years as less favourable than in the past.

The involvement in the ERA-NETs that were started during FP6 provides a very interesting example of Portugal's transnational cooperation. FCT, as Project Owner and Project Manager, [participated in 61 ERA-NETs \(31 on-going\)](#) (link accessed on 21 October 2015), promoting cooperation with other scientific research funding agencies, ministries and research institutes of EU Member States, as well as those of associated and third countries. Most of these ERA-NETs were of thematic scope and were distributed by the four main research areas: Exact Sciences and Engineering, Life and Health Sciences, Natural and Environmental Sciences and Social Sciences and Humanities. The remaining ERA-NETs that are not directly included in those four domains are of a geostrategic nature and promote the cooperation between the EU and Latin America, India, and Africa and other Mediterranean countries. This area was considered by GPPQ as being one of those in which Portuguese participation has been more successful (GPPQ, Newsletters of May and November 2010). The criteria for making the decision to participate in ERA-NETs were related to both the research excellence of the Portuguese ERA-NET 'champions', the existence of a critical research mass in Portugal (Godinho & Simões, 2011), and the strategic relevance.

Examples of two relevant initiatives taken regarding the priority of internationalisation include also the setting up of the International Nanotechnology Laboratory (INL) and the development of the National Roadmap for Research Infrastructures, which is aligned with the ESFRI Roadmap (see point 4.2.2 below).

The first initiative dates back to 2005. Established as a joint-venture between the Portuguese and the Spanish governments, the INL was the first fully international research organisation to be created in Europe in the field of nanoscience and nanotechnology. It aimed to become a world reference in these fields. Unfortunately, however, the INL was not been immune to the effects of the budgetary cuts on both the Portuguese and the Spanish sides. The successive budgetary cuts have impaired INL's development and also its ability to become an international reference in its area.

While internationalisation has been a priority of national research policies, such orientation was essentially focused on either supporting the involvement of Portuguese researchers in international networks and partnerships, or their involvement in

international research *fora* and infrastructures (such as ESA, CERN, EMBO etc.). A more active attitude towards increasing the external coherence and international coordination of national research policies started to only occur more often recently, through the supporting of joint activities (INL is a good example), or the launching of joint calls with a certain degree of coordination of research agendas (the ERA-Nets are possible examples in this respect). These activities started in the previous decade and have been maintained in recent years, although the momentum for greater cooperation that was being created suffered a certain setback with the economic and financial crisis.

4.2.2 RI roadmaps and ESFRI

The design of the National Roadmap for Research Infrastructures took place between 2012 and 2013. FCT launched a public consultation of the Portuguese scientific community, enabling the collection of updated information on existing interest and the potential of participation in ESFRI Roadmap Research Infrastructures. In the second semester of 2012, those Portuguese research infrastructures that matched the concept put forward by the ESF were identified. In the second semester of 2013, a call for proposals was launched, to establish a national roadmap of research infrastructures of strategic relevance, which was open until the 30th of September. This call helped to map and to assess existing research infrastructures, in order to identify national priority areas. This allowed Portugal to develop a [National Roadmap of Research Infrastructures of Strategic Relevance](#) (link accessed on 21 October 2015) in alignment with the European Strategic Forum on Research Infrastructures (ESFRI).

40 research infrastructures (RIs) were included in the National Roadmap that was finally published in December 2014. The roadmap covers seven thematic areas, each with a number of research infrastructures as follows:

- 7 in Social Sciences and Humanities,
- 9 in Biological and Medical Sciences,
- 4 in the Energy field,
- 5 in Environment,
- 1 in Material and Analytical Facilities,
- 10 in Physical Sciences and Engineering, and
- 4 e-Infrastructures.

As underlined in the [National Roadmap](#), "Within each of the thematic areas, some of the RIs are already the result of a merger of two or more proposals. Some mergers occurred between different thematic domains, creating the multidisciplinary collaboration platforms that underpin modern frontier research". It must be pointed out, however, that the national roadmap does not provide information on the financial commitments to develop the forty RIs which were included.

In terms of inter-governmental RIs, the INL (see previous point in this report) is the leading entity in the 'Network of Micro and Nanofabrication Research Facilities in Portugal', one of the infrastructures that was created. This specific infrastructure will share access to micro-nanofabrication and design tools with the research community and with companies, in order to increase competitiveness in the strategic areas linked to the application of micro and nanotechnologies in the medical, environmental, electronics/energy, automotive and defence/aerospace fields. Of the forty RIs in the national roadmap, [24 are or plan to be linked to the ESFRI roadmap](#) (link accessed on 21 October 2015).

In accordance to the National Roadmap, the 4 e-infrastructure that were created (the seventh area referred to above) aim to sustain the already existing capacity and to support the increasing need for data production, data handling and virtual access. In the sequence of the national call for proposals that aimed at selecting the RIs to include in the National Roadmap and of the publication of the Roadmap itself, the next two stages will be the 'Funding' stage of the RIs included in the Roadmap, to occur over the period 2014-2020, and the periodic review of the Roadmap, with the first review expected for

2016. [In accordance to information provided by FCT](#), to perform the analysis needed for monitoring and evaluation.

4.3 International cooperation with third countries

The focus of Portuguese international research cooperation in recent decades has been on the EU partnership. In parallel, however, the concern with STI relationships with other, non-EU, countries has been pursued, along two main axes: the Atlantic links with the USA (including in the frame of INVOTAN/NATO projects), and the community of Portuguese-speaking countries, particularly African countries and Brazil. Simultaneously another secondary axis emerged, associated with the intention of developing relationships with Asia.

Besides the 'mainstream' cooperation within the EU framework, the 17th Constitutional Government (2005-2009) launched an ambitious programme of cooperation with several US Universities and the Fraunhofer Institute, labelled 'Partnerships for the Future', aimed at encouraging the carrying out of joint programmes in specific fields to provide an increased strength to the country's development. This initiative was pursued by the 18th and 19th Constitutional Governments (2009-2011 and 2011-2015), and was more recently re-labelled as "[International Partnerships](#)".

Portugal has also participated in the Ibero-American Programme of Science and Technology for Development (CYTED). This programme started in 1984 through an agreement signed by 21 Ibero-American countries. Within this context FCT has supported the establishment of scientific and technical cooperation programmes with teams in different parts of Latin America.

FCT has also supported the participation in joint projects with institutions from other countries in the framework of bi-lateral scientific and cultural cooperation agreements. It is within this framework that the cooperation with the Community of Portuguese-speaking Countries (CPLP) has been pursued, namely with Brazil. Similar agreements have also been established with China and India.

In parallel to the establishment and running of ERA-NETs, which was mentioned above in point 4.2, FCT was also active in promoting participation in several INCO-Nets, where the scope of coordination with third countries is more significant.

In 2012 an evaluation of the 'Partnerships for the Future' programme was carried out. Despite a general positive assessment of the programme, it was pointed out that in terms of 'value for money' the results could have been better. In other words, the expenditure incurred with this programme was considered too high, thus supporting the decision that was taken to reduce significantly the budget for this initiative in the years after 2012. In 2011 this programme accounted for almost 50% of the international cooperation budget of FCT (€20.7m over a total of €42.0m), while in 2014 it had gone down to slightly above 25% (€11.3m over a total of €44.0m).

4.4 An open labour market for researchers

4.4.1 Introduction

The conditions in the research labour market in Portugal have changed significantly. In 1982, there were still less than four thousand FTE Researchers. The latest figures indicate that the research system kept expanding until the early 2010s, as 37,813 FTE Researchers were accounted for in 2013. Whilst until the 1990s most of these researchers were employed in the public sector (2,095 in 1990) and in the university sector (3,938 in 1990), the situation has changed remarkably over the last two decades (1,386 and 25,760 respectively in 2013). Firstly, business sector R&D activities developed significantly and thus grew their share of researchers (1,001 in 1990, and 10,025 for 2013). Secondly, with the growing supply of PhDs and the creation of a diversity of post-doc positions, the proportion of non-tenured positions in academic institutions also rose significantly.

With the exception of the private business sector and, to a certain extent, that of the private non-profit research sector, research careers have been highly regulated. Those careers that provide access to tenured jobs, in public higher education institutions and in public labs, are regulated by dedicated statutes (see the next point), and as most post-doctoral positions are funded by FCT, these research jobs also depend on regulations provided by FCT. The trend for a greater autonomy of institutions to be able to contract their teaching and research, which started to emerge a decade ago, has meanwhile been reversed, as the financial rules for public contracting have been tightened up, as a consequence of the budgetary difficulties the country has been facing in the most recent years.

4.4.2 Open, transparent and merit-based recruitment of researchers

In general terms, the legal framework regulating the access to research positions in Portugal, and the practices associated with its implementation, guarantee "Open", "Transparent" and "Merit-Based" recruitment. Over the last decade, many institutions implemented more difficult tenure-granting procedures, whilst the recruitment of new researchers has become more difficult, on account of budgetary or legal restrictions.

The framework for contracting researchers into research careers in academic institutions is provided by: (a) The [Law of Work Contracts in Public Functions](#) (civil service), which regulates all labour contracts of civil servants, or the equivalent, such as university teachers who work for public universities or researchers with permanent careers in public labs; (b) The Statute of the Scientific Research Career ([Estatuto da Carreira de Investigação](#), Decreto-Lei nº 125/99, published on 20 April 1999), which regulates the careers of researchers with permanent careers in public labs; (c) ECDU, the Statute of the University Teaching Career ([Estatuto da Carreira Docente Universitária](#), Decreto-Lei n.º 205/2009, published on the 31st of August, 2009 this statute was published in its original form in 1979), which regulates the careers of university teachers who have permanent positions at universities, and; (d) The [regulation of the Researcher of the Science and Technology Foundation](#) ("FCT Investigator"), which is a "softer" regulation (as it is not a "Law") that regulates the contracts and work of those working as researchers during temporary periods (up to five years).

Recruiting procedures are quite standardised, as the existing legal framework imposes certain steps for the recruiting process. Vacancies for permanent positions (both tenured and other similar positions) at the university all have to be advertised. However, a proportion of those contracted have the statute of "invited (or visiting) lecturers". In some faculties these can comprise as much as 50% of the total academic staff. For these posts, vacancies do not have to be advertised, although those selected through this mechanism are normally "invited" for junior positions, and do not hold administrative or strategic responsibilities within the institution.

The process for recruiting for tenured positions is basically "Open", "Transparent" and "Merit-Based". Until several years ago a significant part of the calls for vacancies were not available in any other language except Portuguese, but this situation has been changing. The ECDU (Statute of the University Teaching Career), which was originally published in 1979, permits more flexibility in terms of contracting researchers working abroad, after its 2009 review. According to the ECDU's Article 37, competitions for the recruitment of full professors, associate professors and assistant professors should all be open to foreigners. Advertisements for these positions have to include a description of the job profile and the skills and competences required, and also eligibility criteria. Information on the selection process and criteria is available for candidates, and a minimum time period between the advertisement of the vacancy and the deadline for applications has to be defined. Applicants have both the right to receive feedback about the results of the recruitment process and have the right to appeal against the decision. The composition of the selection panel is published, and this needs to include members external to the institution.

Both the teaching career in the universities and the research career in the public labs consist these days of basically three positions, the one of the bottom that requires a PhD (Professor Auxiliar or Investigador Auxiliar), an intermediate position (Professor Associado or Investigador Principal), and the top positions (Professor Catedrático or Investigador Coordenador). To compete for these top positions in both careers an essential requirement is that the candidates have done the "Agregação" or "Habilitação" (habilitation"). In practice this requirement limits the possibility of outsiders to compete directly to those top positions. The same applies to the polytechnic institutes sector.

Traditionally, those working for both public universities and national research labs had well established careers, all holding permanent positions, or at least having access to them. Over recent decades, however, both institutions have been able to contract researchers with funding for short periods of time, ranging from a few months, up to five years. Moreover, since 2008, some universities (4 out of 18) switched to a Foundation statute, and new contracts celebrated by this sub-group of universities are regulated by private law, rather than by public law.

Universities have had their personnel budgets capped during the most recent years, which means that they have only been able to contract for the permanent careers whenever someone leaves (for retirement, or for other reasons). As the capacity to recruit had already been curtailed, this means that most universities are now starting to face a general ageing of their staff. This is paradoxical as at the same time there is a younger generation of well-trained researchers who are not able to compete for the university positions.

The programmes implemented offering post-doc grants and positions for post-doc researchers with three or five year contracts (firstly CIENCIA, 2008, and then more recently, FCT Investigator) have allowed the country to attract many high quality junior researchers from other countries. In the decade between 2000 and 2009, 34% of post-doc grants were awarded to foreigners (mainly from Spain, Italy and Brazil). This practice of contracting younger foreign researchers has certainly contributed to increase the internationalisation of the domestic research labour market. However, as the total number of post-doc grants and positions has declined more recently, a part of those foreign researchers has moved back abroad. Portugal has moved from being an attractive country for both national and foreign researchers in the early stage of their careers in the 2000s, to the opposite situation in the 2010s, with brain drain occurring in coincidence with the recession years.

The FCT Investigator Programme was implemented in 2012, with the aim of investing in human capital, by ensuring that the best researchers remain in the country and also by attracting high-potential researchers from abroad. Five-year contracts have been offered to post-doc researchers, with typically three to six years of experience after obtaining their PhDs. A position under this programme is attractive, as it provides professional stability and funding for a five-year period. A pool of researchers is selected annually through international competitions. In the 2012 call, 159 researchers were selected, in the 2013 call a further 210 were selected, whilst in the 2014 call 229 applications were recommended for funding. A fourth call was launched in 2015, with applications submitted until September 2015.

No evaluation of the FCT Investigator Programme has been carried out, but it was well received by younger scientists who had already been on one or two successive three-years post doc grants, as a FCT Investigator position provides five-year stability, though not directly opening a door to a tenured position. Overall, however, the creation of the FCT Investigator programme, which was meant to attract back some talented young national scientists working abroad and retain also those from other countries who moved to Portugal in the 2000s, was not enough to compensate for the significant reduction that happened in the offer of post-doc grants. This, with the previous continuous raising supply of new PhD graduates since the 1980s, has led to a situation of PhD unemployment or at least of under unemployment in the most recent years, which did

not happened before. In 2012, 4% of the PhD population in Portugal was unemployed, but 44% of these unemployed were those under 35 years old (Advancis 2015). This situation has certainly not eased meanwhile.

4.4.3 Access to and portability of grants

Apart the activity of some private foundations, the bulk of research grants is offered by FCT. The "[Regulation for Grants awarded by FCT](#)" governs the selection, hiring and legal regime applicable to all grants that are funded directly, or indirectly, by FCT. Article 14 of this regulation states that candidates applying for the grants awarded by FCT have to be: "Nationals or citizens of EU other member states; or Citizens of third states, holders of permanent residence license or beneficiaries of the status of long-term resident; Citizens of third states, whenever a reciprocity agreement may exist; Other citizens of third states, whenever the tender opening the competition foresees the possibility of an individual interview". Further it is stated that for those grants directly funded by FCT, "foreign citizens who are not resident in Portugal may apply, provided that their application is supported by a national host institution and all their workplan is to be carried out in Portugal". This clearly excludes the possibility of researchers affiliated in foreign institutions to apply for grants.

The "Regulation for Grants awarded by FCT" does not refer explicitly to the portability of grants, though as expected it allows for the grants provided by FCT being used abroad under certain conditions. Specifically, it is stated that "to those grants whose workplan is to be carried out on its totality or partially abroad, only citizens who can present proof of permanent residence may apply."

4.4.4 Doctoral training

Portuguese universities have enjoyed certain autonomy in developing new doctoral programmes, although most of those existing coincide with the scientific areas that have traditionally characterised their departmental and faculty structures. To establish a new programme (and this applies to both undergraduate and graduate programmes), at present universities have to submit a proposal according to a very detailed template which is produced by A3ES, the government accreditation agency for higher education. For a new programme to be launched, such proposals are submitted for peer-review evaluation, organised by A3ES. Further, to be able to create or maintain specific areas of doctoral programmes, universities are required to have their research units evaluated and accredited by FCT in those scientific areas.

Over the last decades, the number of PhD graduates has risen fast, with the milestone of more than 2,000 new PhD graduates being reached in 2012. All the main universities now offer PhD programmes, in which typically students have to attend advanced courses in the first year, and after that they have to write up their theses during the subsequent years. These programmes, which encompass all the main disciplinary areas, are organised in accordance with demanding scientific and pedagogic criteria, which are set by both the universities and by the existing regulations. A3ES is obliged to evaluate all new proposals for PhD programmes, and existing ones are subject to regular assessments which often lead to recommendations for significant change, the most drastic being the closure of a programme.

This increase and improvement of supply has, however, encountered some problems in recent years. An increasing number of new PhD graduates have experienced difficulty in finding jobs in the research labour market (Advancis 2015). The economic crisis has also meant that firms have not been contracting highly qualified personnel. Simultaneously, FCT has reviewed its policy of grants and financial support for doctoral training, which used to be more generous in previous decades. In 2007 FCT provided 2030 new PhD grants, while in 2015 it provided approximately only half that amount with 1,032 new PhD grants (information retrieved from the FCT site on this [link](#)).

4.4.5 Gender equality and gender mainstreaming in research

Portugal has one of the highest shares of female participation in the research workforce in the EU. After a rise until the early 2000s, [that share has stabilised at around 44-45% in FTE terms since 2002](#) . In the higher education sector that rate is even higher, exceeding 50%.

It is however known that the situation is not similar in terms of top posts in research and in higher education in general. The situation on this regard has not improved significantly in recent years, as mobility in the labour market has been restrained by the austerity policies.

Successive National Plans for Equality, Gender, Citizenship and Non-discrimination have been implemented. In December 2013, the Portuguese government approved [the fifth of these plans for the period 2014-2017](#). This plan has two strategic areas. The first one has to do with "guaranteeing the equality of gender in the central and local public administration", while the second one has to do with the "promotion of even treatment among women and men in public policies". One of the policy fields in which measures are foreseen in this second area, is education and research, and the plan sets out the intention of promoting and diffusing scientific research in connection to these issues, namely through the introduction of the category of 'Gender Studies' among the research lines funded by FCT. This has however not happened so far.

Further it has to be pointed out that there is no legislation establishing a mandatory share of women in research. Eventually this might be related with the fact that such a share is relatively high in Portugal.

4.5 Optimal circulation and Open Access to scientific knowledge

4.5.1 e-Infrastructures and researchers electronic identity

The main research e-infrastructure in Portugal is [b-on](#), the Online Knowledge Library, which was established in April 2004. It was initially managed by FCCN, which is now part of FCT. b-on allows an unlimited access for researchers in universities and research organisations to international scientific publications, through subscriptions that are negotiated by the Portuguese government with all the main publishers of international peer-reviewed academic journals. Researchers from the following institutions that participate in b-on have full access to the contents of these publications: Higher Education Institutions, Associated Laboratories, Public Labs, Public Administration, Non-Profit Research Organisations, and Hospitals. Portugal is currently paying €40.6m to the publishers of the contents of b-on over the three-year period 2013-2015. Presently b-on offers full access to 22,592 journals and 9,493 proceedings and in 2013 a total of 3.7m searches were conducted in b-on, with over 9.0m downloads.

In 2008, the [Scientific Open Access Repository of Portugal \(RCAAP\)](#) was established. RCAAP coordinates and facilitates the access to individual repositories of all subject material collected by universities and other research entities. The key objectives of RCAAP are as follows: to increase the visibility, accessibility and dissemination of Portuguese scientific research, and; to facilitate management and the access to information regarding the national scientific production, through the registration of scientific literature in specific information systems and their aggregation on the RCAAP portal. The RCAAP portal is the main result of the RCAAP project. This online portal gives access to thousands of scientific and scholarly publications, namely journal articles, conference papers and thesis and dissertations, all of which are provided by several Portuguese repositories.

Both b-on and RCAAP are government initiatives, with no private involvement in their setting up. For-profit organisations are even explicitly excluded from access to b-on. In contrast, RCAAP has a more open nature, so any sort of organisation or individual can access it to archive scientific documents or access them thereafter.

In 2013, FCT decided to promote the [registration in the ORCID registry of all those Portuguese researchers integrated into research units funded by FCT](#). ORCID offers a digital identifier which allows for the identification of each individual researcher. Registration on the ORCID portal was a precondition in order that researchers' output could be accounted for within the evaluation exercise of the national research units that was carried out by FCT between 2013 and 2015. Following on from this registration, researchers were requested to download their scientific output on the ORCID portal. This decision taken by FCT can be regarded as a possible step towards replacing the previous repositories of scientific production, such as the DeGóis curricula platform.

The [DeGóis system](#) which was established in 2003, offers a registry system where researchers could upload information on their profile, academic activities, prizes and awards, scientific productions and projects. DeGóis operates as a tool for gathering, supplying and analysing the intellectual and scientific production of Portuguese researchers. It allows for the search of curricula, according to content-related queries. With the objective of identifying the scientific domains of researchers' study, DeGóis allows for the establishment of relations between scientific productions and the OECD's Fields of Science table. By applying this international standard, the intention was to make it possible to compare the Curriculum DeGóis with other models originating from other scientific communities.

The decision to require registration with ORCID was taken in connection with using SCOPUS as the main database for the bibliometric evaluation of the research carried out by all the research units funded by FCT. These decisions by FCT were generally accepted, although some criticism was voiced. A group of prominent researchers (mainly in the area of computer science) [published a statement](#) in February 2014 which points out that there was a real decline in the use of ORCID, which by nature is an open system, with the exclusive consideration of research accounted for by SCOPUS, a proprietary system. The possible limitations of using just one type of bibliometric data source in an evaluation exercises is a subject that will have to be taken into consideration in the near future, as part of an attempt to balance the trade-off between costs and fairness of FCT evaluations.

4.5.2 Open Access to publications and data

A national policy on open access started to emerge before the end of the 2000-2009 decade. The main measure was the establishment of RCAAP in 2008, as reviewed in the previous point of this report. RCAAP played a role in increasing the visibility of Portuguese research through the availability of outputs on the Internet, whilst it also stimulated the development of open-access repositories in individual research entities in Portugal.

More recently, after launching a public consultation on this issue, FCT made public two documents in May 2014. The first of them regards an "[Open Access Policy for Scientific Publications Stemming from FCT-funded R&D Projects](#)" and the second one is a "[Policy for Managing and Sharing of Data and Other Results Arising from FCT-funded Research](#)". Whilst the former defines the general principles regarding open access, the second one sets out the guidelines to be followed in for data resources. The general assumption of these documents is that the results of research funded by public resources should be made widely available, and that access to them should be free. The policy on open access that was adopted requires that "all publications of research outputs, subject to peer-review, or another form of scientific review, should be deposited in one of the open access repositories hosted within RCAAP as soon as possible, preferably immediately on acceptance for publication. An embargo period is allowed, after which the full content of the publications should be made freely available, at no cost. The policy applies to papers in scientific journals, conference proceedings, posters, books and book chapters, monographs and Masters and PhD theses."

In accordance with this document, open access to the full content of the publications should be made available as soon as possible, although an embargo period is acceptable. This period can have a maximum duration of twelve months for refereed papers in the social sciences, humanities or arts, and six months for refereed papers and publications in all the remaining scientific areas. Furthermore, FCT recommends authors to protect their intellectual property rights by applying a license to access and re-use which is compatible with the new policy, including through a Creative Commons license. In relation to the 'Publication Processing Costs' demanded by some publishers from authors, these can be reimbursed as direct or indirect costs within FCT-funded projects or research units, on the condition of full access for the respective publications being granted, and after a CC-BY Creative Commons license has been applied for. These costs should not however go above "a value that will be established and updated according to the evolution of international best practices in policies on open access."

The Portuguese policy on open access can therefore be classified as "hybrid open access", in the sense that there are elements of the "green open access" model (researchers are requested to archive their published article or the final peer-reviewed manuscript in an online repository before, after, or alongside its publication, and an embargo period is allowed), together with elements of "gold open access" model (the payment of publication costs is shifted from readers, via subscriptions, to the funding agency).

[A recent study for the European Commission](#) (Archambault et al. 2014) provided an examination of open access in a total of 44 countries, including the EU28 and the ERA countries, over the period of 2008-2013. This study used the Scopus database, "which currently covers a broader range of journals from various countries and scientific disciplines than other comprehensive databases"; and it used a simple definition of OA: "freely available online to all (no money had to be paid, no registration to a service or website had to be made)". According to this study Portugal was among the four top European countries in terms of open access: "Looking at OA score adjusted for retrieval precision and recall, four countries have even reached an aggregate availability score above 70%—the Netherlands, Croatia, Estonia, and Portugal." In the Portuguese case, out of a sample of 7,190 papers, 1,169 were classified as "green open access", 1,887 were classified as "gold open access" and a further 2,636 as "other open access". This means that 71% of the Portuguese publications over the 2008-2013 period were within the open-access regimes, while for the EU28, the equivalent proportion was lower (59%).

The second document mentioned above, which defines the policy on the management and sharing of data stemming from FCT-funded research, encourages researchers "to share primary data and other data with the scientific community, by placing the data in open access databases (such as Genbank, for example), within the shortest time possible."

A possible problem of the new policy on open access is its enforceability, at least at the beginning of its implementation, as researchers are not fully informed, or they may choose to publish without granting open access, as the fees imposed by some publishers may be higher than that which is deemed as being considered "reasonable" by the funding agency.

5. Framework conditions for R&I and Science-Business cooperation

5.1 General policy environment for business

The Portuguese government has a pro-business stance. In line with the Memorandum signed with the troika (European Commission, European Central Bank and International Monetary Fund), there has been a concern to improve the business environment. This has been expressed in economic policy, namely in the concern to reduce labour costs, in the revision of insolvency regulations and in tax policy.

In this field, there have been two important developments in 2014: (1) the revision of company taxation came into force, with a phased decline in the main company income tax (IRC, the tax levied on collective bodies income): the standard tax for 2015 is 21% (17% for SMEs with profits below €15,000; and (2) the publication of a new Tax Investment Code (Decree-Law 162/2014, of October 31st), with a view to adapt it to the EU regulations on State aid for 2014-2020. According to the introduction of the above-mentioned legislation, a key change was the increase in the maximum tax credit rate under IRC and “the increase in the supplements assigned to investments in regions with a *per capita* purchasing power significantly below national average, which enable the creation or keeping of jobs or which contribute towards technological innovation or environmental protection”. The supplement of the investment tax credit as a result of the contribution towards technological innovation and scientific research may reach a maximum of 6% of relevant investment applications (arts. 4 and 9 of Decree-Law 164/2014). Another important feature of the Tax Investment Code is the definition of the rules regarding SIFIDE II, the company R&D tax credit system, until 2020. The tax credit corresponds to a base rate of 32.55 of eligible R&D expenditures plus an incremental tax. Expenditures with the wages of PhD holders are considered as 120% of the wages effectively paid.

A look at the World Bank Doing Business 2016 ranking shows that Portugal enjoys a good place, being ranked 23rd overall. However, this general position conceals a relatively wide performance variance. In fact, Portugal is ranked 13th in Starting a business and 8th in resolving insolvency, while holding the 65th and the 97th positions for Paying taxes and Getting credit respectively. The score for Starting a business is very high (around 96 in a maximum of 100), the average time to start a business being estimated in 2.5 days; this is a result of the initiatives taken in the second half of 2010s in the context of the Technological Plan, namely the launching of the ‘Company Now’ initiative. (World Bank Doing Business, Ease of doing business in Portugal, 2016)

Portugal has improved its position with regard to Resolving insolvency, getting a score of 84. The average time for the recovery process is estimated in 2 years, and the recovery rate is 73%. This seem to be too optimistic assessment, the more so as there is socially a negative stance with regard to failed entrepreneurs (the problem of second chance), and the real judicial and extra-judicial procedures are often too bureaucratized. Anyway, there is no doubt that efforts have been made on this issue, namely following the revision of the Company Insolvency and Recovery Code. The Programa Revitalizar (Revitalize Programme), launched on the February 3rd, 2012 intended to change the legal framework to make easier to recover businesses firms which are economically sound but which in financial terms may be close to insolvency. In this vein, two debt restructuring instruments were created: PER, the special process of revitalisation; and SIREVE, the extra-judicial system for firm recovery. SIREVE was subject to a revision to make it eligible only for firms with economic viability but suffering from financial difficulties. According to press information, the risk capital instruments created under Revitalizar had supported 49 firms until late 2014, investing slightly above €150 million ([Publico, 19 November 2014](#)). The 2015 NRP points out the objective of improving the effectiveness of those instruments.

5.2 Young innovative companies and start-ups

The set of policy measures addressed to young innovative companies and start-ups at both national and regional levels has been recently changed as a result of the launching of Compete 2020 OP. The main instruments available in Compete 2020 on this regard are the following:

- 'Skilled and Creative Entrepreneurship' programme (this falls under the Company Innovation and Entrepreneurship Support System): aimed at the promotion of skilled and creative entrepreneurship, the programme provides support to projects carried out by less than 2-years old companies in businesses with significant growth rates, including creative and cultural industries and the application of R&D for new goods/services. Projects by young or by female entrepreneurs are entitled a 10% increase in the incentive rate. The programme also encompasses 'Entrepreneurship vouchers' aimed at enabling young companies to have recourse to advice and management support services up to € 150,000.
- Initiatives on the Promotion of Entrepreneurship Spirit, in the context of Collective Actions: these are intended to support collective projects aimed at (1) strengthening cooperation, partnerships and support networks regarding skilled and creative entrepreneurship and (2) leveraging the support to the generation of innovative ideas, entrepreneurial initiatives and new company creation.

Besides this, there is a wide set of incubating infrastructures throughout the country. The concern with promoting entrepreneurship is widespread. However, in some cases (due for instance to the lack of critical mass and insufficient staffing) the quality of the services provided is not very good. This issue is raised by the 2013 Evaluation of the NSRF in the fields of internationalisation and innovation (IESE/Quatenaire Portugal, 2013). It is argued that there is "an atomisation of technology-based incubators". It is also mentioned the existence of a gap between the financing means available and "the needs of incubators as well as of project promoters".

In the context of the HCOP there are also incentives to entrepreneurship. However, these are chiefly in the context of employment policy, and focussed on combatting unemployment through the setting up of micro-firms than on promoting the creation of knowledge-intensive firms. Among the initiatives to fight youngsters' unemployment is the Investe Jovem, a programme aimed at promoting the creation of new firms by jobless youngsters, between 18 and 30-years old. The support provided has three vectors: the investment project, the creation of employment, and technical advice in the development of the project and the business plan.

With regard to measures aimed at promoting knowledge sharing and the development of SMEs capabilities, these are taken at the national and especially regional levels, including in Regional OPs. The main measures included in Compete 2020 and dealing with the above issues are the following:

- Promoting SMEs' Capabilities and Internationalisation Incentive System: this is exclusively addressed to SMEs, and is focused on supporting the upgrading of SMEs capabilities as well as SMEs internationalisation. With regard to SMEs capabilities, the main objectives concern the promotion of organizational innovation, using new organization methods and processes, enhancing flexibility and capacity to compete in global markets. This incentive system also includes Innovation and internationalisation Vouchers (see below);
- SMEs Productive innovation, with the aim of encouraging investment in projects carried out by SMEs with the purpose of launching new goods and services as well as of adopting new manufacturing, logistics, and distribution processes and new organization methods.
- Company R&D: R&D projects carried out by SMEs are granted tax rate increases (10% for medium-sized firms, and 20% for micro and small firms);

- R&D Teams: this measure is the continuation of similar initiatives already in place since the early 2000s; in Compete 2020 there is strong positive discrimination for SMEs; these are granted a maximum incentive rate of 50% of eligible expenditures, while the corresponding rate for non-SMEs is 15% only.
- Innovation and R&D Vouchers: these measures already existed in the former Compete; Innovation vouchers are addressed to finance the acquisition of innovation consultancy services (technological support, licensing, IPRs...), while R&D Vouchers concern the support to the acquisition of R&D and/or technology transfer services; in both cases, the maximum support amounts to €15,000;
- Collective actions, which may be carried out in the context of Competitiveness Clusters or not. These are addressed namely the following objectives: (1) Transfer of S&T knowledge (strengthening the transfer of S&T knowledge towards business firms and leveraging the economic valorisation of R&D results); (2) Networks and other forms of partnership and cooperation; and (3) Development of competencies and training, including the indirectly leverage of firms competences, the promotion of access to information, the promotion of international awareness and information about Portuguese products and services, the encouragement of company consolidation and transmission processes, and the decline of inter-firm information asymmetries.

5.3 Entrepreneurship skills and STEM policy

There has been a significant improvement in the qualification of Human Resources during the last 20 years, especially due to the effort put in developing higher education. The figures provided by the Innovation Union Scoreboard 2015 indicate that Portugal had one of the biggest improvements in Human Resources (IUS, 2015: 21); this was mostly due to the significant increase in the 'Youth upper secondary level education', which experienced a 6.8% growth. However, the level achieved is still below the EU average. This is due to the low performance in 'Population with completed tertiary education' and 'Youth upper secondary level education'; in contrast, 'New doctorate graduates' is above EU average, with a score of 117 (EU average=100). Improvement has also been recorded in PISA average scores: between 2003 and 2012, Portugal experienced improvements in all fields, to become closer to OECD average (CNE, 2015).

However, there is a mismatch between the output of the education system and the needs of the economic system. As the report on Education Policy disclosed on the 16th October 2015 by the Conselho Nacional de Educação - CNE (National Council on Education), in the last 15 years "the economy has not been able to absorb the skills produced by the education system" (CNE, 2015:21). According to that report the main consequences from this were the following: "relative excess of skills, trend towards the increase in youth employment, increase in emigration and potential wage decline for more skilled jobs". (CNE, 2015: 22). This account, however, does not provide a fully picture. The solution of the mismatch is not a decline in skills, but rather an upgrading of demand. This takes time, however, since it is not just a matter of incentives but rather of structural change (Mamede, Godinho & Simões, 2014).

Another face of the mismatch concerns the supply of skilled technicians for firms. The XIX Constitutional Government has put a strong emphasis on professional and vocational education as a tool to increase the adaptation of education to companies' needs. In this vein, an effort has been made to promote dual certification, following the German system. According to the CNE, the share of secondary students engaged in professional/vocational education in Portugal is slightly above EU average (56.2% versus 55.7%, respectively). The external evaluation of the vocational courses carried out in 2015 assesses the pilot experience of vocational courses as "frankly positive, providing a global response to the objectives" that led to its launching, suggesting that it should be pursued (Avaliação Externa, 2015:105). It recognises, however, some problems, namely the high waiving levels, the need for improving professional orientation, the difficulty for the students to return to the normal education stream, and the development of partnerships between schools and companies. The OECD skills diagnostic on Portugal

also makes a positive policy assessment, but remarks that decisions are still mostly taken at the central level of government (OECD, 2015: 129). The report identifies 12 skills challenges clustered in four groups: developing relevant skills; activating skills supply to reduce unemployment as well as the barriers to employment; using skills effectively (including entrepreneurship promotion, stimulating innovation and high-skilled jobs, and providing employers incentives to engage in skills development); and developing enabling conditions for an effective skills system. A Ministerial Decree was published in early October 2015 ([Ministerial Decree 341/2015](#), dated October 9th, 2015) implementing vocational education in both basic and secondary levels (initially it was limited to secondary education). The regulation echoes some of the recommendations of the above mentioned assessments. It assumes that students may later choose to return back to the normal education track, which runs counter most evidence and teachers' assessment ([Público, 2015](#)). This is one of the main criticisms raised by the opponents of this approach, who argue that the extension of vocational education will raise a "social cleavage" on the basis of families' education and wealth; it is also argued that "professional ways, from secondary education onwards, should be an option as worthy as higher education, but it should be done when students are mature enough to make it" (Bettencourt, 2015).

As mentioned above, regarding (post)graduates in science, technology, engineering and mathematics, in Portugal the problem is not the supply but rather the demand. In fact, the pattern of the industrial fabric does not enable to generate a significant demand of high-skilled labour; Portuguese firms' R&D expenditures are limited, and Portugal lacks a host of large business firms with a significant contribution towards R&D employment. Furthermore, the financial constraints entailed a reduction of the funds available to attract high-skilled labour to Universities and research centres; the positive contribution of the FCT-Investigator fell short the needs on this regard. The consequence was immigration of high-skilled people to other European countries as well as to the United States (Sistema de Segurança Interna, 2013). Even for medium-skilled workers the scarce demand together with the poor conditions faced in Portugal fostered immigration; the case of nurses is one of the most evident. While ignoring the issue or even suggesting that it was good for skilled people to go abroad and face harsher conditions abroad, the Government finally came to recognise the relevance of the issue. Portugal's NRP 2015 objective to promote high-skilled jobs and keep talents in Portugal is an expression of the change in Government's stance.

The adoption of the Bologna guidelines has made that concern development of transversal competences (critical thinking, problem solving, creativity, teamwork, and intercultural and communication skills) more visible, namely through the emphasis put on the development of soft skills. Problem solving capacity has been one of the features of Portuguese people; to a large extent, creativity and imagination emerged from the need to respond poor living conditions. Intercultural skills are another positive facet of the Portuguese: in general, people easily adapts to different cultures and conditions ([interview with Erin Meyer, Público, 2 November 2015](#)).

In the last ten years, significant efforts have been made to promote entrepreneurship education and culture. Entrepreneurship has figured high in the political agenda of the XIX Constitutional Government. In many secondary schools and higher education organisations there are courses dealing with entrepreneurship and new company creation. Contests have been launched to foster the commitment to entrepreneurship in Universities, as the one launched by COTEC Portugal. However, entrepreneurship does not feature as a discipline in all secondary and higher education curricula. The OECD skills diagnostic on Portugal points out promoting entrepreneurship as a key challenge for Portugal. It is argued that "a systematic promotion of entrepreneurship throughout the education system" should be implemented (OECD, 2015). Entrepreneurship curricula would have, according to OECD, a positive contribution on two grounds: to develop an entrepreneurial mind-set, and to provide "practical competences and skills to start and grow new ventures" (OECD, 2015: 91).

SME's staff training has traditionally been one of the weak links of Portugal's innovation support system. In spite of a few initiatives on this regard, the enhancing of SMEs' staff, including managers, has not figured high in the agenda. The Portugal 2020 Partnership Agreement, especially through the Regional OPs, the HCOP and Compete 2020 has made a contribution to change this state of affairs, since it includes measures aimed at supporting the training of SMEs' human resources, for both young and older SMEs, as well as coaching. Such support will, to a large extent, be managed on a regional basis. It is still to be seen, however, how such initiatives will be implemented, namely the quality of teaching staff and the instruments to ensure an effective engagement by training staff. A final reference is to be made to the existence of voucher systems: Innovation, R&D and Entrepreneurship. These enable SMEs to have recourse to specialised services in these fields (see section 5.2 above).

5.4 Access to finance

Venture capital and business angels networks

According to the Innovation Union Scoreboard 2015 (European Commission, 2014), Portugal's relative performance in terms of Venture Capital investments has been 68, which is below the EU average. This is not surprising, bearing in mind the limitations of Portugal's capital markets and its domestic market size (Godinho & Simões, 2011). Furthermore, the venture capital business is relatively young in Portugal and is not mature. In spite of public initiatives aimed at promoting venture capital companies and business angels, including the restructuring of public venture capital instruments and the creation of Portugal Ventures, the negative trend observed in the IUS 2014 intensified according to the IUS 2015 to reach -7.8%.

With regards to Business Angels (BAs), the EBAN Statistics Compendium 2014 (EBAN, 2014) provides a more positive picture. According to this source, Portugal was ranked 9th in terms of the number of BAs, and the average investment per BA was €22,000, which is very close to the figures exhibited by Spain and Germany. Portugal is mentioned among those countries which have exhibited a positive trend.

As mentioned in previous reports, since the late 1980s, there have been several public policy initiatives aimed at promoting the development of venture capital markets and, more recently, of BA networks. This has involved tax policy, but mainly the granting of specific financing support, under the successive Community Support Frameworks (see, for instance, Godinho & Simões, 2014a). Since 2011, there has been an increased policy commitment to entrepreneurship, and therefore to support to venture capital and BAs initiatives. Such support has been provided namely through the financial instruments axis of CFOP/'Compete'. Similar programmes are included in Compete 2020. In this context, two calls were launched in 2015, inviting the Financial Institution for Development (Instituição Financeira para o Desenvolvimento -IFD) to establish two funds of funds regarding the management of financial instruments: one of €69.9 million on debt/guarantee instruments, and another with the amount of €146.9 million on capital/quasi capital.

Portugal Ventures is the public venture capital organisation. It was created in 2012 as the result of the merger of the three public venture capital firms. It "focus its investments in innovative science and technology-based companies as well as in companies from more traditional tourism and industrial sectors, with significant competitive advantages and export oriented to global markets" (<http://www.portugalventures.pt/en/content/about-us>). As mentioned in the previous report, Portugal Ventures has launched an 'Ignition Programme', with three strands: calls for entrepreneurship; ignition networks, namely the Ignition Partners Network, with 45 deal flow partners, and the Ignition capital network, encompassing 15 investment partners; and Portugal Ventures abroad, with three accelerators in the USA. Another recent initiative of Portugal Ventures is the +Inovação +Indústria (+Innovation +Industry), which is aimed at contributing towards the Government intention to foster reindustrialisation. The initiative is focussed on innovation, and is addressed to both the

manufacturing industry and related services, such as R&D services, engineering and process development, the environment, integrative services, design, marketing (including digital marketing), and logistics.

According to the 2012 EVCA benchmarking study on the tax environment for the private equity and venture capital industry, the activities of Venture Capital Companies are regulated, and these manage Venture Capital Funds, some of which may be specifically addressed to industries or to a level of company maturity. In 2013, capital gains were taxed at a rate that could reach 31.5% (a basic rate of 25%, plus municipal and state surtaxes) (EVCA, 2013:155). However, the basic rate was reduced to 23% for 2014, and to 21% for 2015. The Budget for 2015 provides tax incentives for very young companies. There are fiscal incentives at fund level, whereas at company level, fiscal incentives are only granted for R&D expenditures. The benchmark analysis tables suggest that Portugal is situated in the middle of the league with regards to the tax environment for private equity and venture capital investments.

Concerning the future developments in the context of Portugal 2020, and namely of Compete 2020, support to venture capital and BAs will be continued, and probably increased.

The main revolving instruments are bank loans and credits. Financial structures are often unbalanced; many companies are undercapitalised and too dependent on short-term bank credits. The situation has worsened as a result of the austerity programme as well as of the problems felt by several banks, especially the fall of Banco Espírito Santo. Furthermore, financing costs in Portugal are higher than the EU average (Augusto Mateus & Associados, 2015). The financial health of Portuguese companies has suffered, demanding the launching of measures aimed at promoting company recapitalisation and mergers. The 2014 tax credit legislation has been a step in that direction. In the context of Compete 2020, the set of financial instruments to support companies is also expected to play a role on that regard, as it was recognised by the *ex-ante* evaluation of Portugal 2020 financial instruments (Augusto Mateus & Associado, 2015). This evaluation indicates that “the diversity of financial problems faced by Portuguese firms calls for a diversified set of instruments, and the amount of resources envisaged for that objective (around €1,700 million) is appropriate (Augusto Mateus & Associados, 2015: iv). Financial supply to leverage start-ups’ growth in later stages, particularly to scale up commercial activities, is limited; however, an increasing number of firms has been able to rise international funding.

5.5 R&D related FDI

In spite of the non-availability of systematic data about the contribution of foreign-owned firms to BERD, there is a perception that the contribution of such firms may not be as high as in other EU member countries. According to available data about the largest R&D performers in Portugal in 2011, four majority-owned foreign subsidiaries (Nokia Siemens Networks, Volkswagen, Barclays Bank and Bosch) were among the 20 top R&D performers, accounting for around 15% of the R&D expenditures of these top 20.

While there is a wide agreement in the Portuguese society about the need to attract R&D intensive FDI, there is no specific policy focused on that issue. Portugal’s FDI policy has been mostly carried out in three axes: the privatisation policy; the attraction of new foreign business investment; and the development of existing foreign subsidiaries. Promoting R&D activities has not been a major concern with the exception of a couple of cases regarding the third axis. Interestingly, the 2015 NRP just makes a reference to FDI in connection with the competitiveness of Portugal’s tax system.

With regard to the first axis, the main concern has been the attraction of financial resources, namely due to budgetary constraints. The privatisations led to an increase in direct foreign investment, namely Chinese firms.

The attraction of new FDI has been pursued. AICEP Portugal Global, the agency in charge of attracting FDI, has created a set of 'scouts' working together with its offices abroad to identify and approach potential investors. The main concerns, however, have been the level of investment, balance of payments and job creation (having in mind financial problems and a high employment rate), and not so much R&D and knowledge intensity. In general terms, however, the results of such efforts have been poor.

The third axis has to do with the development of existing subsidiaries. Again, the concerns with job creation (or job preservation) and balance of payments (promoting exports) have been paramount. The agreement entered into force with Volkswagen in April 2014 regarding an investment of €678 million for upgrading and strengthening of the capabilities and activities (including the investment in setting up a cross-cutting modular platform) of AutoEuropa, an automotive plant near Lisboa, was very relevant to keep one of Portugal's main exporters. However, it had no major implications in terms of R&D content, since the subsidiary is chiefly focused on assembling operations. More relevant from the R&D promotion standpoint was the decision of Siemens to locate new competence centres in Portugal, namely in the fields of software platforms (150 engineers recruited in 2014) and micro-networks and energy storage (launched in 2015).

5.6 Knowledge markets

The national intellectual property law follows broadly the same rules and procedures adopted across the European Union. Industrial Property is managed by the INPI, the National Institute of Industrial Property, while copyright is managed by IGAC, the general directorate of cultural activities. In contrast with industrial property, to benefit from copyright protection the registration with IGAC is not mandatory, though it is highly advisable. Portuguese residents can use INPI to access both the European regional systems (European Patent, Community Trademark and Community Design) and the international systems (PCT patent system, Madrid trademark system). Until 2006 INPI reported to the Ministry for the Economy, but since then [it was transferred to the Justice Ministry](#). In 2008 INPI introduced the provisional application for a patent, thus allowing users to benefit as much as possible of the priority date privileges while keeping for a latter moment a decision that implies higher costs for them. This novelty, together with an increased general awareness of industrial property and rising innovative capabilities, were behind a rising demand for invention protection. In 2015 the total applications for invention protection in Portugal reached for the first time more than 1,000 per year. Despite the trend, these figures indicate a demand for invention protection which still is much lower than in other similarly sized economies. As shown in studies which have been carried out on this topic, the weak demand is not only accounted for the industrial structure (Godinho & Rebelo 2007) or the cost of access to the system (CISEP, 2004), but more generally by lack of knowledge on how to use and benefit from industrial property. Actually, the direct cost of access is low in comparative terms.

Portugal has had a network of IPR support services in place for several years. The GAPI (Industrial Property Support Offices) network was launched in the late 1990s by INPI, the National Institute for Industrial Property. The network was intended to increase awareness about Industrial Property Rights (IPR) among researchers and business people. GAPIs were established in several universities, technological centres and business associations and played an important role in encouraging the use of IPR, in disseminating patent information, and in providing basic support services regarding IPR applications. However, as a result of the crisis, many GAPIs were merged with the OTICs (Technology Transfer Offices in universities and polytechnics), with a view to saving resources and gaining scale. Unfortunately, the end of public support for the initiative, together with budgetary constraints faced by public bodies, including INPI, led to the weakening, and even the closure of many of these support organisations. INPI continues to support the network, and to provide information and training services on IPR management. Furthermore, the Compete OP supplied funds for two projects geared towards the development of the GAPI network. Those projects were respectively GAPI 3

and GAPI Horizon. The former involved the GAPI offices located within higher education institutions, while the latter involved mainly the GAPI offices associated with the industrial technology centres. Both of them were implemented from the beginning of 2013 up to mid-2015.

With regards to the policies and instruments in place for developing knowledge markets for patents and licencing, the evidence is extremely limited. Up until the last decade, there was no active approach to technology and knowledge commercialisation by Portuguese firms and research institutions. This situation started to change with the creation of the GAPI and OTIC networks, mentioned in the paragraph above. The setting out of UTEN (University Technology-Enterprise Network) in 2007, which was a joint undertaking with the University of Texas, Austin, aimed to provide services for the commercialisation of research outputs. It developed a professional technology transfer and commercialisation network in Portugal, oriented towards international markets. These initiatives contributed to changing the perspective of universities and other research institutions in relation to knowledge commercialisation. In 2011-2012, an initiative was launched with a view to generating a virtual market for technology. However, for several reasons (namely Government change, the decline in +E +I activity, and troubles regarding the survival of AdI, the Innovation Agency), this initiative never fully materialised. High among ANI (the National Innovation Agency) objectives is the promotion of “technology transfer” and the collaboration between companies and Research organisations.

The development of the market for knowledge is among the objectives of Compete 2020. Under the Specific Objective 2 of Investment priority 1.1b (Promotion of Business Enterprise R&D investment) of Thematic Objective 1, there is a reference to support for “industrial property patenting and licensing” (Governo de Portugal, 2014b: 52). Compete 2020 includes several measures aimed at promoting the markets for knowledge, namely in the context of the following incentive systems: Company innovation and Entrepreneurship, which includes the acquisition of patents and technology licensing among eligible expenditures; and Collective actions, which provides specific support to projects aimed at company application of scientific and technological knowledge developed in Universities and research centres.

5.7 Public-private cooperation and knowledge transfer

5.7.1 Indicators

Funding: BES-funded/publicly-performed R&D

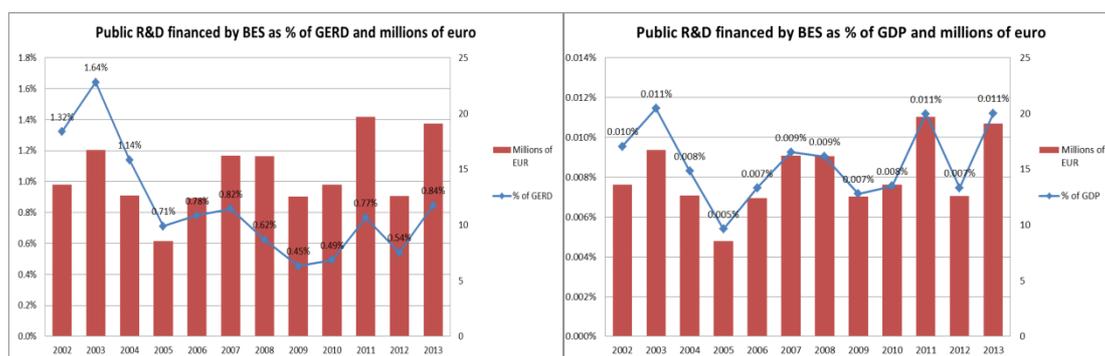


Figure 16 BES-funded public R&D in PORTUGAL as % of GERD (in €MLN) and % of GDP

The level of the Portuguese business enterprise (BES)-funded public R&D expenditure as a percentage of GERD decreased considerably between 2007 (0.82%) and 2009 (0.45%), then returned to a growing path in 2009 and 2011, followed by a pronounced drop on 2012 (0.54%) and a subsequent rise in 2013 (€19m and the equivalent of 0.84% of GERD).

The indicator expressed as a percentage of GDP follows the same trend as the BES expressed as a percentage of GERD, with the highest value 0.011% recorded first in 2003 and then in 2011 and 2013. The bars in the chart indicate that the fluctuations in the last years reflect changes in actual investment levels rather than being the result of variations in GERD and GDP.

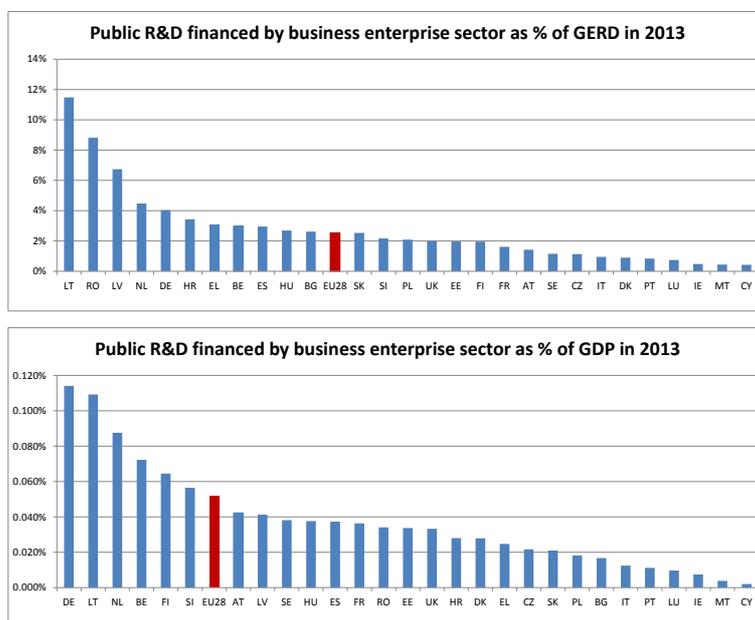


Figure 17 BES-funded public R&D as % of GERD and as % of GDP in 2013 in Member States¹⁶

The two charts in Figure 18 show the values of BES-funded public R&D in all EU-28 as percentages of GERD and GDP respectively. Portugal's levels are far below the one of the best performers and the EU-28 average for both indicators.

The very low share of privately funded R&D activities performed by the public sector has several reasons, going from institutional conditions (namely the low level of interpersonal and inter-organisational trust) through the lack of systemic policy approaches to deal with the issue, to the characteristics of Portuguese companies (focused on low knowledge-intensive activities) and to the characteristics of Portuguese universities (with several of them with little concern with industry needs and requirements) and the low incentives for universities' staff to follow dual careers.

On the demand side, the Portuguese entrepreneurs have only little experience in science-business co-operation, they favour activities which bring immediate gains and very often decide to import technology from abroad. On the supply side, the academia is not attracted by R&D commercialisation and until very recently was not incentivised to look for new sources of financing.

¹⁶ 2013 was chosen as the latest data series providing a full comparison within EU-28.

Structural funds devoted to knowledge transfer

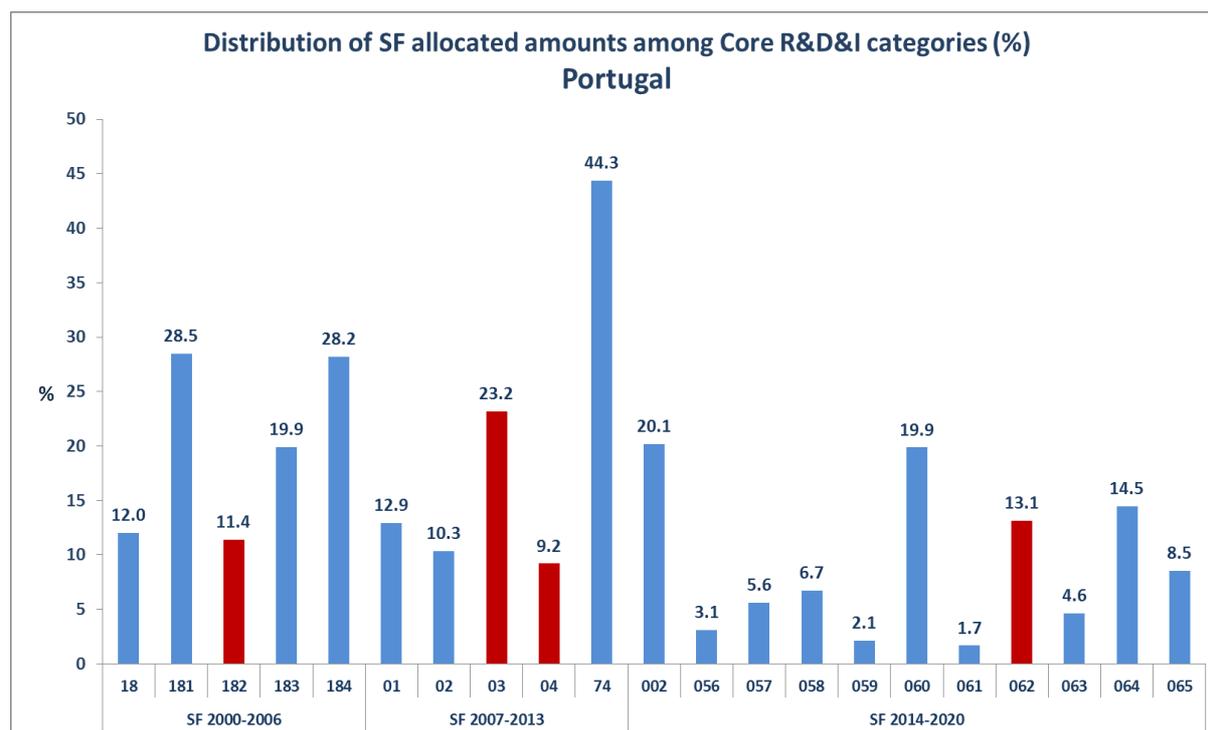


Figure 18 Structural Funds for core R&D activities 2000-2006, 2007-2013 and 2014-2020¹⁷. We use the categories: 182 (2000-2006), 03 and 04 (2007-2013) and 062 (2014-2020) as proxies for KT activities.

Portugal has allocated 13.1% of its structural funds for core R&D activities to "Technology transfer and university-enterprise cooperation primarily benefiting SMEs" (compared to 3.1% for 2000-2006 programming period and 32.4% in the 2007-2013 period). It is only slightly lower than the EU average of 15.7% (the EU average was 26.1% for 2000-2006 and 30.1% for 2007-2013).

¹⁷ Figure 18 provides the Structural Funds allocated to Portugal for each of the above R&D categories. The red bars show the categories used as proxies for KT. Please note that the figures refer to EU funds and they do not include the part co-funded by the Member State. The categories for 2000-2006 include: 18. Research, technological development and innovation (RTDI); 181. Research projects based in universities and research institutes; 182. Innovation and technology transfers, establishment of networks and partnerships between business and/or research institutes; 183. RTDI infrastructures; 184. Training for researchers.

The categories for 2007-2013 include: 01. R&TD activities in research centres; 02. R&TD infrastructure and centres of competence in specific technology; 03. Technology transfer and improvement of cooperation networks; 04. Assistance to R&TD particular in SMEs; 74. Developing human potential in the field of research and innovation.

The categories for 2014-2020 include: 002. Research and Innovation processes in large enterprises; 056. Investment in infrastructure, capacities and equipment in SMEs directly linked to Research and Innovation activities; 057. Investment in infrastructure, capacities and equipment in large companies directly linked to Research and Innovation activities; 058. Research and Innovation infrastructure (public); 059. Research and Innovation infrastructure (private, including science parks); 060. Research and Innovation activities in public research centres and centres of competence including networking; 061. Research and Innovation activities in private research centres including networking; 062. Technology transfer and university-enterprise cooperation primarily benefiting SMEs; 063. Cluster support and business networks primarily benefiting SMEs; 064. Research and Innovation processes in SMEs (including voucher schemes, process, design, service and social innovation); 065. Research and Innovation infrastructure, processes, technology transfer and cooperation of enterprises focusing on the low carbon economy and on resilience to climate change.

Cooperation: Share of innovative companies cooperating with academia

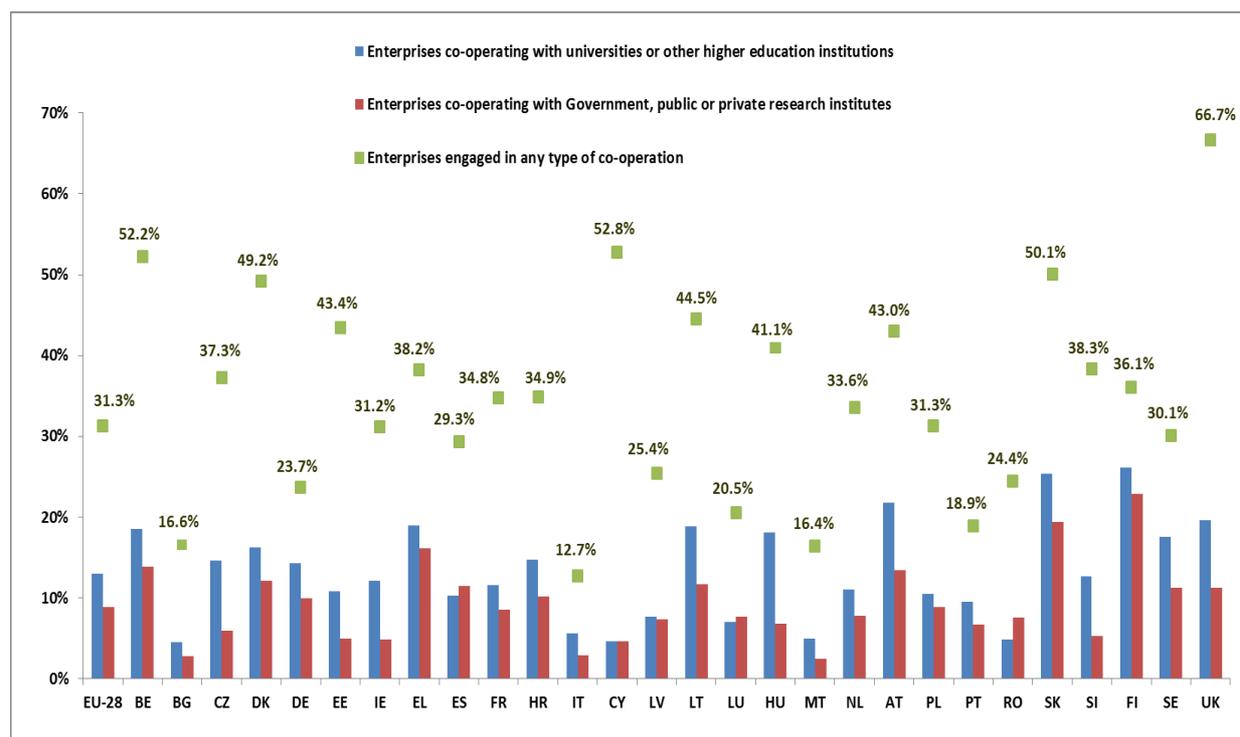


Figure 19 CIS survey 2012 – share of enterprises cooperating with academia

The Figure 19 illustrates the level of cooperation activities of innovative companies in the EU-28, according to the CIS 2012. The percentage of "enterprises engaged in any type of co-operation" (green dot) is in Portugal among the lowest in the EU (only 18.9%), far below the EU-28 average of 31.3%. The percentage of enterprises cooperating with universities or other HEIs (blue bar) is 9.5%, while the percentage of enterprises cooperating with government, public or private research institutes (red bar) is 6.7%. Both indicators are to some extent below the values of the EU-28 average, which are 13.0% and 8.9%. Portugal is ranked as "moderate innovator"¹⁸ by the Innovation Union Scoreboard.

Technology Transfer Offices (TTOs), incubators and technological parks

The University Technology Enterprise Network Portugal (UTEN) concluded a series of survey on the TTOs in Portugal. The first annual survey was conducted in 2010. The second survey, executed in 2011, repeated the same questions in order to update the information collected in the previous year and to enlarge the sample of respondent TTOs. Unlike the prior two years, in 2012 UTEN Portugal implemented the TTO survey under the European Commission's Recommendation on Knowledge Transfer, and supported by the European Council's Resolution on Knowledge Transfer. The latest fourth UTEN survey was launched in July 2013 and finalised in October 2013.

Highlights of the four waves of the UTEN network survey of technology transfer offices include:

- The respondent TTOs are relatively young (8-years old on average) and small, although their size increased from 2007 to 2012.
- TTO teams present a high level of formal education and training but relatively low industry experience.

¹⁸ The latest Innovation Union Scoreboard 2015 ranks Portugal as a moderate innovator.

- Among TTO staff, common high level qualifications include engineering or natural sciences and management or business administration, whereas law and biomedical are relatively rare.
- A considerable amount of human resources (in FTE) is allocated to grant applications and fundraising activities, preventing the TTOs from concentrating their resources and attention mainly on core activities, namely intellectual property management and support services for entrepreneurship and spin-offs.
- From 2007 to 2012, the TTOs' average budget registered an average decline of 3.3% per year. The largest share of the budget (55%) is spent on human resources with expenditures related to patenting, which experienced a noticeable decrease over the last two years.
- There was a strong concentration of revenue sources (70% of the total, approximately) on grants and the institution/university. Given the austerity measures that public institutions face (and will continue to face), this concentration puts a serious limitation on the future sustainability of TTOs.

Share of public-private co-publications

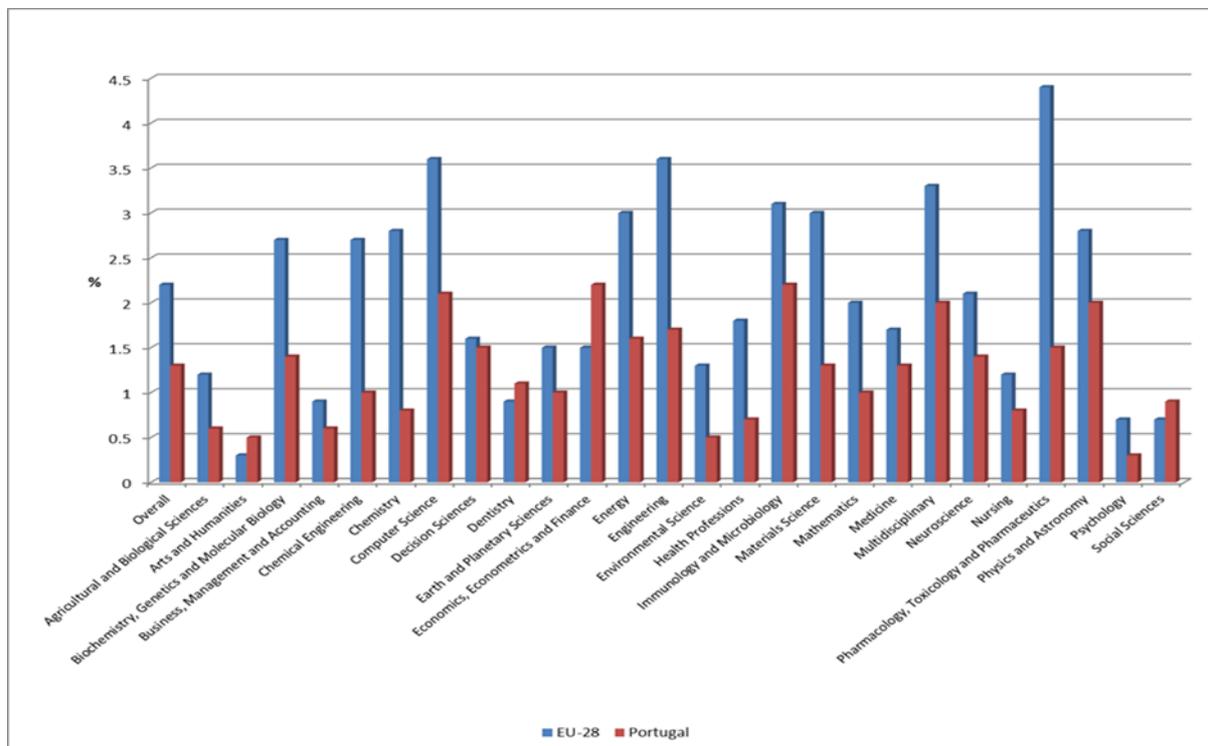


Figure 20 Co-publications by field 2003-2013 in Portugal. Scopus database

The Figure 20 shows the 2003-2013 average percentage of academia-industry co-publications by field in Portugal compared to the European average. The domains with the highest percentage of co-publications (excluding multidisciplinary publications) are pharmacology and pharmacy, physical chemistry, materials science, environmental sciences, food science and technology and economy.

With 21.7 co-publications per million population, Portugal is somewhat below the EU-28 average of 29 and relatively close to its neighbouring countries (Spain at 24.6), but very far from the Innovation Leader countries (Denmark stands at 182.1, Finland at 155.0, Germany at 57.8 and Sweden at 113.3).

Patenting activity of public research organisations and universities together with licensing income

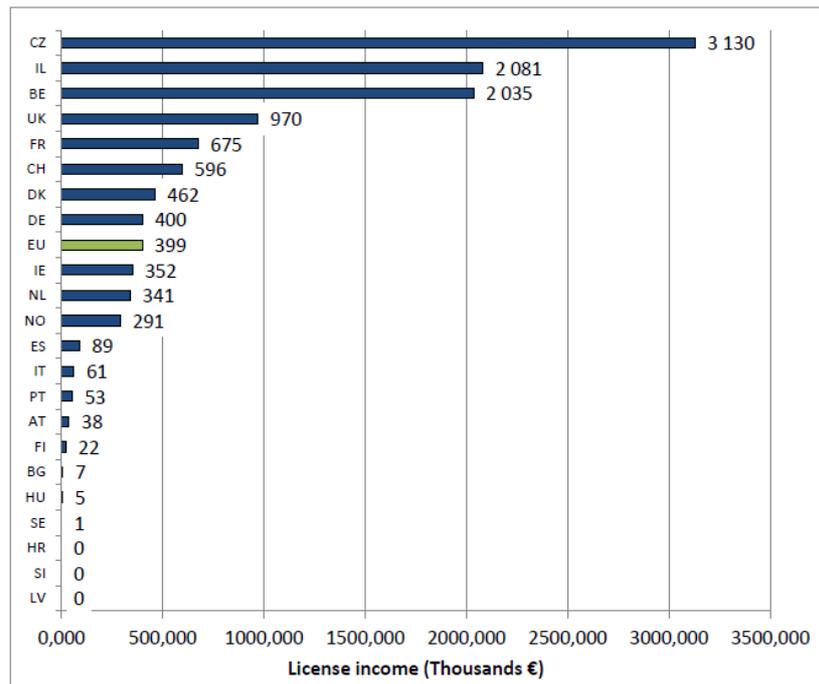
The Knowledge Transfer Study allows benchmarking the Portuguese performances with the other surveyed countries as well as with the EU average.

Portugal is ranked 9th in terms of registered patents, with 4 patents per 1,000 research staff, slightly below the EU average of 4.5.

Portugal is still below the EU average in terms of licencing, but has quite a good performance compared to other Member States. With 5.4 licence agreements per 1000 research staff Portugal positions itself in front of Germany, Belgium or France.

Licensing income per 1,000 researchers is also quite low, with €53,000 per 1,000 researchers, compared to €399,000 of the EU average.

Exhibit 3-35: Thousands Euros of license income per 1,000 research staff by country, EKTIS 2011 and 2012 results combined

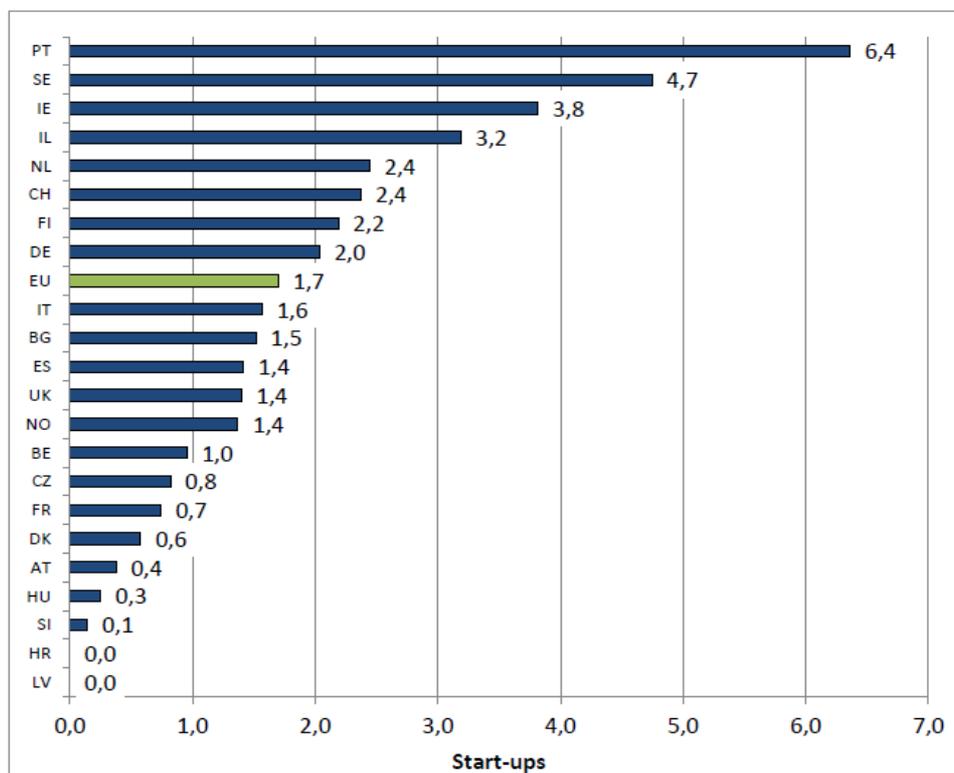


Source: MERIT, European Knowledge Transfer Indicator Survey 2011 and 2012.

Figure 21 License income per 1,000 research staff by country. EKTIS 2011-2012 survey

Companies

Exhibit 3-33: Number of start-ups per 1,000 research staff by country, EKTIS 2011 and 2012 results combined



Source: MERIT, European Knowledge Transfer Indicator Survey 2011 and 2012.

Figure 22 Number of start-ups per 1 000 of research staff per country. EKTIS 2011-2012 survey

According to the Knowledge Transfer Study, Portugal is leading in the number of start-ups per 1,000 researchers, with 6.4 start-ups per 1,000 researchers, well above the EU average of 1.7.

According to the Annual Surveys performed by The University Technology Enterprise Network Portugal (UTEN) by the end of 2011, the 18 TTOs from the network were responsible for executing 371 R&D agreements between their institution and companies, and creating 140 new spin-offs and 500 active spin-offs. According to the latest European Knowledge Transfer Survey Portugal produced the most start-ups per 1,000 research staff among all EU-28 MS (namely 6.4).

5.7.2 Policy measures

The GAPI (Industrial Property Support Offices) network launched in the 1990 was intended to increase the awareness about Industrial Property Rights (IPR) among researchers and business people. There were GAPIs in several universities, technological centres and business associations. They have played an important role in encouraging the use of IPR, in disseminating patent information and in providing basic support services about IPR applications. However, as a result of the crisis, many GAPIs were merged with the OTICs (Technology Transfer Offices in the universities and the polytechnic institutes), with a view to save resources and gain scale. Unfortunately, the end of public support to the initiative and the budgetary constraints faced by public bodies, including INPI, led to the weakening and even the closure of these support organisations. At present there are, according to information in the INPI website, 23 GAPIs.

One key measure which should contribute to knowledge transfer from R&D organisations towards the market is the University Technology Enterprise Network, developed by the IC² Institute (Innovation, Creativity, Capital). It is a network of professional Technology Transfer Offices (TTOs) focused on the commercialisation and internationalisation of Portuguese Science and Technology (S&T). From 2007 to 2012, the UTEN initiative served to build the network and engage the national and international participants. Its operations turned to developing a series of different networking initiatives. UTEN's main activities planned for the period 2013-2017 are: technology business incubation, international business acceleration and business development. During the past five years, UTEN has grown and evolved with customized training programmes and activities while benefiting from enhanced international partnerships. However, from 2007 to 2012, the TTOs' average budget decreased by 3.3% per year.

With regard to policies and instruments in place for developing knowledge markets for patents and licencing, evidence is extremely limited. In 2011-2012 there has been an initiative with a view to generate a virtual market for technology. The +E+I Office has worked on that, on the guidance of a former Secretary of state for Entrepreneurship and innovation. However, for several reasons (namely Government change, the decline in +E +I activity, and the troubles regarding the survival of AdI, the Innovation Agency), the initiative has never fully materialised. The launching of a FCT Technology Transfer Office (in connection with GAIN, the programme with the University of Texas at Austin) was also intended inter alia to promote patenting as well as the economic exploitation of patents either through outright sale or through licensing; however, to our best knowledge, it has not materialised so far. On the business side, there are some firms working on the matching of supply and demand in the market for technology, but with very limited resources and relatively weak international connections.

The available version of the CIOP, under Portugal 2000, makes a reference to the development of the market for knowledge. Under the Specific objective 3 of Investment priority 1.1 (Strengthening of the R&I infrastructure and the capacity to achieve excellence in R&I, and the promotion of competence centres, including those of European interest) of Thematic objective 1 there is a specific reference to the "strengthening of [knowledge and technology] valorisation processes, "namely through patenting and licensing" (Governo de Portugal, 2014b: 49). It is expected that ANI, the recently created Agência Nacional de Inovação, might play a role on that regard.

Tax incentives are also considered an important instrument for promoting business R&D activities. Indirect incentives have been promoted under SIFIDE. This is a tax credit system for stimulating R&D in businesses, which allows for deductions off IRC (the business revenue tax). The following are eligible for being deducted off IRC: the equity of research and development entities; the costs of filing for patents and their maintenance fees; the costs of R&D audits; investments in the purchasing of R&D equipment, and; the salaries of researchers and auxiliary personnel involved in research and development. The Budget Law for 2011 extended the system up to 2015 (SIFIDE II), and improved the conditions granted to R&D performing companies.

SIFIDE includes two kinds of incentives for companies performing R&D: a basic tax incentive, which corresponds to 32.5% of all eligible R&D expenditure made in the relevant fiscal year, and an incremental incentive, which corresponds to 50% of the increase in R&D expenditure when compared to the average of the two previous years. The amount of tax credits approved under SIFIDE has been close to €100m per year. This system was reviewed in 2013 in order to positively discriminate those projects that involve cooperation with other entities and international cooperation, and has open access to the results. The Budget Law for 2014 (Lei nº 83-C/2013, December the 31st) extended SIFIDE II up to 2020.

Another type of tax incentives for R&D is the regime of scientific patronage. This regime, which was enacted by Law 26/2004, provides tax incentives to both individuals and organisations that contribute to the financing of the activities of foundations, institutes, associations, higher education institutions, and other units or centres carrying out R&D activities. According to the status of scientific patronage, the beneficiary entities can benefit from an expense or loss for the year, up to the limit 8/1000 of the volume of sales or rendered services, in an amount corresponding to 130% of the respective total for purposes of IRC or from category B of the IRS the value of donations, ie, for every 100 euros attributed it is possible to rebate a value of 130 euros in tax payments. In 2012, 1,928 such entities participated in this system and the total deductions on their taxable income amounted to €21m.

5.8 Regulation and innovation

As far as the information that was possible to collect, there are no initiatives in place or planned regarding the impact of regulation on innovation. This issue has been considered neither by national nor by regional authorities in Portugal. Furthermore, there have been no suggestions in the public debate on innovation regarding this topic. It might be helpful to pay more attention to this, especially on what concerns the effects of the austerity measures on innovation.

5.9 Assessment of the framework conditions for business R&I

In general, the set of direct measures aimed at promoting business R&I is appropriate. They cover a wide set of issues, combining different instruments from tax incentives to financial incentives, including R&D and innovation vouchers. The positive effects of the measures implemented under Compete 2007-2013 were confirmed by the evaluation carried out by IESE and Quaternaire Portugal (2013), which found that policy measures had promoted companies' internationalisation and innovation commitment. In contrast, the evaluation of the cluster policy was less positive, underlining a set of weaknesses in policy design and implementation (SPI & InovTSD, 2013). This led to a revision of the cluster policy. It is however early to know whether such a revision will bear fruits.

The Compete 2020, launched in the context of the Portugal 2020 Partnership Agreement, has taken on board most of the R&I policy measures and guidelines existing in the previous Compete 2007-2013. This is in line with evaluation recommendations. Another positive development has been the launching, at regional level, of training initiatives to enhance company staff capabilities, including management capabilities. This is a very important issue which needs to be properly addressed. It seems desirable that the effort on this regard should even be increased, since there is a need to strengthen SMEs' in-house capabilities, including managerial capabilities.

Steps have been taken to combine demand- and supply-side policies. While Portugal's NRPs 2014 and 2015 leans towards a supply side approach, with a clear linear 'flavour', there are other measures, namely in the context of the Compete 2020, which are aimed at promoting demand, namely in the context of the measures on Company R&D, on R&D Teams (NITEC) and R&D and Innovation vouchers. The support to the creation of R&D teams in companies is particularly important, since they may enable the setting up of in-house capabilities. This measure was very successful when it was launched, but in recent years, namely due to insufficient promotion, its take-up significantly declined (Godinho & Simões, 2012). A full understanding of the systemic nature of innovation policy is important for policy initiatives like this one to induce change.

In fact, the availability of funds for business R&D does not ensure a behavioural change on its own. Many of the problems faced by Portugal have a structural nature, and cannot be solved by watering industrial firms with financial support alone. Behavioural change may be fostered by following not just direct measures to promote R&D but also a host of initiatives addressed to respond structural challenges.

6. Conclusions

This chapter provides an assessment of the performance of the national research and innovation system and identifies the main structural challenges faced by the national innovation system.

The main challenges faced by the national R&I system are listed in the Executive summary of this report. Another emerging challenge and a summary table with structural challenges are presented below.

Improving R&D employment conditions in the academic, government and business sectors to retain skilled and high-skilled human resources

Description

Since the outset of the crisis (Godinho & Simões, 2013), conditions have deteriorated with regards to the activity of the R&I system, increasing the potential for an irreversible loss of critical mass, due to a dynamic emigration of highly-skilled researchers (Sistema de Segurança Interna, 2013). This was recognised by the 2015 NRP, which underlines the need to the promotion of high-skilled jobs to keep talents in Portugal. This is an important change in political stance, which had previously omitted or downgraded the significance and the risks of the emigration of masters and doctors. The problem is not confined to academic research. It has also a negative influence on the business enterprise and in the government sector. In the first case, it is expressed in the decline in R&D expenditures, which is a result of the focus on survival in face of the crisis, of the harsh financial situation of firms, and of the privatisation of companies in which the Portuguese state had golden shares (as is the case of PT, a telecom company recently acquired by Altice, and EDP, the electricity and power company sold to Chinese investors).

Policy response

This challenge is to a large extent the consequence of the austerity regime followed in the last four years with a very significant restriction on public spending. It has also to do with the profile of the industrial fabric and the dearth of large firms with significant R&D outlays. However, since the government has only very recently recognised this issue as a challenge (in the 2015 NRP), the set of policies directly aimed at responding it is still limited. In fact, the three measures mentioned in the 2015 NRP – the FCT-Investigator, Doctoral programmes in Companies and SIFIDE II – are not new and they just provide a limited response given the scope of this challenge. The revision of SIFIDE II has provided improved conditions for the recruitment of high-skilled labour by firms, since expenditures with the wages of PhD holders are considered as 120% of the wages effectively paid.

Other policy measures which may contribute to respond the problem are those included in Compete 2020. Regarding the Research and technological development incentive system, the most relevant are Company R&D projects, which are likely to increase companies' demand for highly-skilled labour, R&D teams, which are intended to set up permanent R&D units especially in SMEs, and the R&D voucher, whose effect is mainly indirect, through the increase in demand for R&D services. In the context of the Scientific and technological research incentive system the programme which might have more significant impact on the demand for highly-skilled labour is the Development of Research Infrastructures, although the other programmes might have also some effect in creating job opportunities for masters and PhDs. A reference is also due to the promotion of Skilled and Creative Entrepreneurship, since new company creation in knowledge-intensive activities will open new opportunities for skilled jobs.

Policy assessment

The policy response has not been enough to solve the problem. This is due to three main reasons. The first has to do with the structural problems mentioned throughout this report which have a negative effect on the level of both R&D expenditures and R&D employment. The second stems from the depth of the austerity programme and from government attitude towards the issue. The fact that the government has recognised it corresponds to good news, but the previous attitude of denial or under-rating of the problems has not contributed towards a timely response. Finally, in spite of the likely positive effect of the measures pointed out above, they are not enough to redress the situation. Without an easing of the austerity policy and a significant increase in public funding to Universities to renew their staff, the mismatch between skilled labour supply and demand will persist in the medium term.

Table 8 – Structural challenges of Portugal’s R&D system

Challenge	Key issues
1. Strengthening in-house R&D as well as technological, organisational, marketing and managerial capabilities in business firms	<ul style="list-style-type: none"> • Promote business firms R&D • Promote the uptake by firms of the measures aimed at supporting the creation of R&D teams in companies • Promote the uptake by SMEs of measures geared towards organisational and marketing innovation • Promote the uptake of the measures on cooperative R&D projects involving SMEs • Promote the development of SMEs managerial capabilities • Promote training-action initiatives specifically addressed to small companies' characteristics.
2. Stimulating structural change, namely by fostering the emergence of new companies, both domestic and foreign-owned, particularly in knowledge-intensive activities	<ul style="list-style-type: none"> • Long-term commitment towards structural change • Promote entrepreneurship • Promote company spin-offs • Attract skill-intensive Foreign Direct Investments
3. Ensuring the sustainability of the research system and rebuild trust and the collaborative drive among the players	<ul style="list-style-type: none"> • Consolidating earlier achievements • Assigning a stronger political priority to research and innovation • Fighting the deterioration of research conditions • Promoting firms’ R&D • Create conditions to increase trust levels among the R&I system players • Improve policy implementation in a participatory way
4. Improving R&D employment conditions in the academic, government and business sectors, with a view to retain (and attract back) skilled and high-skilled human resources	<ul style="list-style-type: none"> • Assigning a stronger political priority to research and innovation • Fighting the deterioration of research conditions • Promoting firms’ R&D • Promote the uptake of existing incentives to the recruitment of masters and doctors in companies • Increase the funding assigned to the Investigator FCT programme • Launch initiatives to support the creation of research jobs at Universities • Create conditions for the circulation of skilled and high-skilled people between science and industry
5. Improving cluster policies and encourage collaboration between science and industry, avoiding a linear approach, and recognising that relevant knowledge contributions may come from both sides	<ul style="list-style-type: none"> • Create better conditions for the reorientation of the clustering initiative • Improve the working of the cluster initiative • Pursue the thematic approach stemming from the identification of Smart Specialisation priorities • Avoid a supply-side bias in R&I policy • Promote University-Industry collaboration on an equitable basis • Create conditions for the circulation of skilled and high-skilled people between science and industry
6. Keeping the trend of improving strategic policy design, systemic density and coordination among key players in research and innovation	<ul style="list-style-type: none"> • Improving governance • Building upon earlier positive initiatives to encourage coordination • Learn from the mistakes and promote participation and clear rules in policy decisions • Promoting firms’ participation in policy design

Source: authors' summary

References

- Academy of Finland (2012), *Independent assessment of Portuguese cooperation with US Universities in research and education – International programmes between Portuguese Universities and Carnegie-Mellon, Massachussets Institute of Technology (M.I.T.) and Univerisity of Texas at Austin.*
- Advancis (2015), *A empregabilidade dos doutorados nas empresas portuguesas.* Porto: Advancis Business Services.
- Archambault E., et al (2014), *Proportion of Open Access Peer-Reviewed Papers at the European and World Levels–1996–2013.* A study for the European Commission.
- Augusto Mateus & Associados/PwC (2013), *Avaliação Intercalar do COMPETE.* Lisboa
- Augusto Mateus & Associados (2015), *Avaliação ex-ante dos instrumentos financeiros do Portugal 2020, Lote 1: Instrumentos financeiros para apoio directo às empresas,* Lisboa, Augusto Mateus & Associados.
- Bettencourt, Ana Maria (2015), 'Um retrocesso sem precedentes', *Público*, 14 October, 2015.
- Caraça, João (1999), 'Ciência e Mudança', in M.M. Godinho and J. Caraça (orgs.). *O Futuro Tecnológico.* Oeiras: Celta.
- CISEP (2004), *Utilização da Propriedade Industrial: Um Estudo sobre Inovação em Portugal.* Lisboa: INPI.
- CNE (2015), *Estado da Educação 2014,* Lisboa: Conselho Nacional da Educação.
- Cooke, P. and Simões, V. C. (2013), *Final Report on Portugal.* DG RTD Expert groups advising on development of Smart Specialisation strategies in the EU 12 plus Greece, Portugal & Spain. Brussels: European Commission.
- COTEC Portugal (2013), [Barómetro de Inovação](#), Innovation Digest. Lisbon: COTEC and Everis (link accessed on 24 February 2015).
- EBAN (2014), *EBAN Statistics Compendium.* Brussels: EBAN.
- ESF (2015), *ESF Report on the Evaluation Process of the Foundation for Science and Technology (FCT) Research Units, 2013-2014.* A report prepared by Ms. Valérie Allspach-Kiechel, Dr. Janina Kancewicz-Hoffman, M. Nicolas Walter, Dr. Olivier White, Dr. Jean-Claude Worms for the European Science Foundation.
- European Commission (2014). *Innovation Union Scoreboard 2014.* Brussels: European Commission.
- European Commission (2015), *Country Report Portugal 2015,* Brussels, European Commission, COM(2015) 41 final, 26.2.2015
- European Council (2014). *COUNCIL RECOMMENDATION of 8 July 2014 on the National Reform Programme 2014 of Portugal and delivering a Council opinion on the Stability Programme of Portugal, 2014 (2014/C 247/20).*
- EVCA (2013). *2012 Pan-European Private Equity and Venture Capital Activity - Activity Data on Fundraising, Investments and Divestments.*
- FCT (2013). *Diagnóstico do Sistema de Investigação e Inovação – Desafios, Forças e Fraquezas rumo a 2020.* Lisboa: Fundação para a Ciência e Tecnologia.
- FCT (2015), *Evaluation of the Portuguese Foundation for Science and Technology.* Report of the Evaluation Panel.
- Godinho, M. M. (2012), 'Análise e caracterização do sistema de investigação e inovação em Portugal: Dinâmicas institucionais e falhas sistémicas', presentation to the workshop

- organised by FCT «O Sistema Nacional de Investigação e Inovação: Desafios, forças e fraquezas rumo a 2020». Lisbon, 11-12, December, 2012.
- Godinho, M.M. (2013), *Inovação em Portugal*. Lisboa: Fundação Francisco Manuel dos Santos.
- Godinho, M. M. and Rebelo, G. (2007), Avaliação da procura de patentes em Portugal, in *Sociedade e Trabalho*, 32.
- Godinho, M. M. and Simões, V. C. (2005), *R&D, Innovation and Entrepreneurship 2007-2013*, Report for the QCA/CSF Observatory. Lisboa: ISEG.
- Godinho, M. M. and Simões, V. C. (2009), *Erawatch Country Report 2011: Portugal*, JRC/IPTS, Luxemburg: European Communities.
- Godinho, M. M. and Simões, V. C. (2010), *ERAWATCH Country Reports Portugal 2009*. Brussels: European Commission ([link accessed on 24 February 2015](#)).
- Godinho, M. M. and Simões, V. C. (2011), [ERAWATCH Country Reports Portugal 2010, Brussels: European Commission](#) ([link accessed on 24 February 2015](#)).
- Godinho, M. M. and Simões, V. C. (2012), [ERAWATCH Country Reports Portugal 2011, Brussels: European Commission](#) ([link accessed on 24 February 2015](#)).
- Godinho, M. M. and Simões, V. C. (2014a), [ERAWATCH Country Reports Portugal 2012, Brussels: European Commission](#) ([link accessed on 24 February 2015](#)).
- Godinho, M. M. and Simões, V. C. (2014b), [ERAWATCH Country Reports Portugal 2013, Brussels: European Commission](#) ([link accessed on 24 February 2015](#)).
- Godinho, M. M. and Simões, V. C. (2015), [RIO Country Reports Portugal 2014, Brussels: European Commission](#) ([link accessed on 21 October 2015](#)).
- Governo de Portugal (2014a). *Portugal 2020: Acordo de parceria 2014-2020*. Julho de 2014, Lisboa: Governo de Portugal.
- Governo de Portugal (2014b), [Programa Operacional da Competitividade e Internacionalização](#), Lisboa: Governo de Portugal, December ([link accessed on 24 February 2015](#)).
- Governo de Portugal (2014c). *Estratégia Europa 2020: Ponto de situação das metas em Portugal, Abril de 2014*. Lisboa: Governo de Portugal.
- Governo de Portugal (2014d). [Estratégia de Investigação e Inovação para uma Especialização Inteligente – EI&I](#) ([link accessed on 21 October 2015](#)).
- Governo de Portugal (2014e). [Despacho Conjunto de 23 de Dezembro de 2014](#). ([link accessed on 21 October 2015](#))
- ICETA (2013), “Avaliação ex ante da Proposta de Acordo de Parceria para a Aplicação em Portugal dos Fundos do Quadro Estratégico Comum 2014-2020”, 22 de novembro de 2013.
- IESE/Quatenaire (2013). *Avaliação estratégica do Quadro de Referência Estratégico Nacional (QREN) 2007-2013*. Lisboa: Observatório do QREN.
- IUS (2015), [Innovation Union Scoreboard 2015](#) ([link accessed on 21 October 2015](#)). European Commission.
- Laranja, Manuel (2012), ‘Os sistemas regionais de inovação e a territorialização das políticas públicas’, presentation to the workshop organised by FCT «O Sistema Nacional de Investigação e Inovação: Desafios, forças e fraquezas rumo a 2020», Lisbon, 11-12, December, 2012.
- Mamede, R. P. (2014), *Structural challenges, innovation performance, and the rope of innovation policies in Portugal*, Report prepared for the High-level Economic Policy Expert Group ‘Innovation for Growth’, January.

- Mamede (2015), *O Que fazer com Este País*. Ed. Marcador, ISBN 9789897541797.
- Mamede, R.P., Godinho, M.M. and Simões, V.C. (2014), *Assessment and challenges of industrial policies in Portugal: is there a way out of the 'stuck in the middle' trap?*, in *Structural Change, Competitiveness and Industrial Policy: Painful Lessons from the European Periphery*, Aurora A.C. Teixeira, Ester Silva, Ricardo Paes Mamede (Eds.). Routledge, Taylor & Francis Group.
- NRP 2015, Programa Nacional de Reformas 2015, Lisboa: Governo de Portugal.
- Pavitt, Keith (1998), *Technologies, products and organization in the innovating firm: what Adam Smith tells us and Joseph Schumpeter doesn't*. *Industrial and Corporate change* 7.3 (1998): 433-452.
- Reek, Willelm (2013) *RIS3 Governance Guide - S3 Platform* (available at http://s3platform.jrc.ec.europa.eu/documents/10157/72857/Governance%20Guide%20RIS3_09_10_2013.pdf, accessed on October 10 th 2015)
- Simões et al (2011), *Estudo sobre a rede de PME Inovadoras da COTEC*, (Coordenação), Lisboa, COTEC Portugal 2011
- Simões, V.C. (2012), 'Os recursos do sistema de I&I: O problema da conversão', presentation to the workshop organized by FCT «O Sistema Nacional de Investigação e Inovação: Desafios, forças e fraquezas rumo a 2020», Lisbon, 11-12, December, 2012.
- Sistema de Segurança Interna (2014), [Relatório Anual de Segurança Interna 2013](#) (link accessed on 24 February 2015).
- SPI/Innov TSD (2013), Sociedade Portuguesa de Inovação and Inno-TSD, *Estudo de avaliação da estratégia e do processo de implementação das estratégias de eficiência colectiva tipologia clusters*. Lisboa: Observatório do QREN.
- Tavares-Lehmann, A.T., Coelho, A., and Lehmann, F. (2012), *Taxes and foreign direct investment attraction: a literature review*, pp. 89-11, in Rob Van Tulder, Alain Verbeke, Liviu Voinea (Eds.), *New policy challenges for European multinationals* (Progress in international business research, Volume 7), Emerald Group Publishing Limited.

Abbreviations

A3ES	Agência de Avaliação e Acreditação do Ensino Superior (Agency for Assessment and Accreditation of Higher Education)
AdI	Innovation Agency
ANI	National Innovation Agency
BERD	Business Expenditures for Research and Development
CFOP	Competitiveness Factors Operational Programme (short name: COMPETE)
COMPETE	Competitiveness Factors Operational Programme
COMPETE 2020	Competitiveness and Internationalisation Operational Programme
COTEC	COTEC Portugal - Associação Empresarial para a Inovação
CRUP	Conselho de Reitores das Universidades Portuguesas
CTP	Competitiveness and Technology Poles
ECDU	Statute of the University Teaching Career
ERA	European Research Area
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ESF	European Science Foundation
ESFRI	European Strategy Forum on Research Infrastructures
eSPap	Entidade de Serviços Partilhados da Administração Pública, I. P.
EU	European Union
EU 27	27 EU Member States (before Croatia joined the EU)
EU 28	28 EU Member States
FCCN	Fundação para a Computação Científica Nacional
FCT	Science and Technology Foundation
FDI	Foreign Direct Investment
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
FTE	Full Time Equivalent
GAPIs	Support Offices for Industrial Property Use
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GPPQ	Office for promoting national participation in the Framework Programme
HCOP	Human Capital Operational Programme
HERD	Higher Education Research and Development expenditures
H2020	Horizon 2020 - EU Framework Programme for Research and Innovation
Horizon 2020	EU Framework Programme for Research and Innovation
IAPMEI	Agência para a Competitividade e Inovação
ICT	Information and Communication Technologies
IMF	International Monetary Fund
INE	Instituto Nacional de Estatística (National Statistical Institute)
INL	Iberian International Nanotechnology Laboratory
INVOTAN	Comissão Coordenadora de Investigação para a OTAN (Portuguese commission for research within NATO)
IPR	Intellectual Property Rights
IPTS	Institute for Prospective Technological Studies
JRC	Commission's Joint Research Centre

NRP	National Reform Plan
NSRF	National Strategic Reference Framework
OECD	Organisation for Economic Co-operation and Development
OPs	Operational Programmes
OTICs	Knowledge and technology transfer offices
NGO	Non-Governmental Organization
PhD	Doctor of Philosophy
Portugal 2020	National reference framework for the period 2014-2020
QREN	Quadro de Referência Estratégico Nacional (National Strategic Reference Framework), 2007-2013
R&D	Research and development
R&I	Research and Innovation
RCAAP	Repositório Científico de Acesso Aberto de Portugal (Scientific Open Access Repository of Portugal)
RIIs	Research Infrastructures
RIS3	Research and innovation strategies for smart specialisation
SIFIDE	Sistema de Incentivos Fiscais à I&D Empresarial (Business R&D fiscal credits programme)
SME	Small and Medium Sized Enterprise
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
S&T	Science and technology
UMIC	Agência para a Sociedade do Conhecimento
UTEN	University technology Enterprise Network

List of Figures

Figure 1 Portugal's RDI governance system	17
Figure 2 Global thematic priorities matrix.....	26
Figure 3 Government deficit and public debt.....	32
Figure 4 Funding of the total GERD	33
Figure 5 R&D appropriations and government funded GERD in millions of national currency	33
Figure 6 Government intramural expenditure by sectors of performance.....	35
Figure 7 Direct and Indirect support to R&D	36
Figure 8 Fiscal consolidation and R&D.....	36
Figure 9 BERD intensity broken down by most important macro sectors (C= manufacture, G_N=services, D-E= Utilities).....	46
Figure 10 BERD by source of funds	46
Figure 11 top sectors in manufacturing (C10-12= food, beverage and tobacco, C21= basic pharmaceuticals, C29= motor vehicles, trailers and semi-trailers).....	47
Figure 12 top service sectors (J=information and communication, K= Financial and insurance activities, M=professional, scientific and technical activities)	47
Figure 13 economic sectors as percentage of the total GVA.	48
Figure 14 GVA in manufacturing.	48
Figure 15 Value added for the leading manufacture and service sectors.....	48
Figure 16 BES-funded public R&D in PORTUGAL as % of GERD (in €MLN) and % of GDP	68
Figure 17 BES-funded public R&D as % of GERD and as % of GDP in 2013 in Member States	69
Figure 18 Structural Funds for core R&D activities 2000-2006, 2007-2013 and 2014-2020. We use the categories: 182 (2000-2006), 03 and 04 (2007-2013) and 062 (2014-2020) as proxies for KT activities.	70
Figure 19 CIS survey 2012 – share of enterprises cooperating with academia	71
Figure 20 Co-publications by field 2003-2013 in Portugal. Scopus database	72
Figure 21 License income per 1,000 research staff by country. EKTIS 2011-2012 survey	73
Figure 22 Number of start-ups per 1 000 of research staff per country. EKTIS 2011-2012 survey.....	74

List of Tables

Table 1 – Main R&I indicators 2012-2014	15
Table 2 – Basic indicators for R&D investments	31
Table 3 – Key Portuguese Public R&D Indicators	32
Table 4 – Public Funding from Abroad to Portuguese R&D (in millions of national currency).....	34
Table 5 – Structural Funds allocation for RDI in Portugal, 2014-2020	38
Table 6 - EU R&D Scoreboard 2015: Portuguese companies ranked by R&D	49
Table 7 – Scientific performance as measured by publication indicators	51
Table 8 – Structural challenges of Portugal’s R&D system	79

Annex 1 – List of the main research performers

Top 10 private R&D performers Rank	No of business firms belonging to this group	Name	BERD (m€)	FTE in R&D	FTE Researchers	FTE PhD-holding researchers
1	5	Grupo Portugal Telecom	144.9	404	368	5
2		Bial – Portela & Ca. SA	55.6	81	76	20
3	9	Empresas SONAE	50.9	718	334	3
4		Nokia Siemens Networks Portugal	50.8	897	n.a.	n.a.
5	2	Grupo UNICER	40.5	23	23	3
6	2	Grupo Banco Comercial Português	40.2	143	n.a.	n.a.
7	10	Grupo José de Mello SGPS	24.5	254	198	9
8	6	Grupo Secil	19.0	109	66	0
9	3	Grupo BPIU	17.1	220	n.a.	n.a.

Note: The 10th performer did not allow the information to be published.

Annex 2 – List of the main funding programmes

Name of the funding programme	Timeline	Budget	Target group
Competitiveness and Internationalisation	2014-2020	Total: €4,414 Million Obj. 1: € 1,400 Million	-Companies -R&D organisations
Human Capital	2014-2020	Total: €3096 Million	-Schools -Education Organisations -Companies (Training)
Norte (Regional)	2014-2020	Total: €3,379 Million Obj. 1: € 403 Million	-Companies -R&D Infrastructures -R&D Organisations
Centro (Regional)	2014-2020	Total: €2,154 Million Obj. 1: € 169 Million	-Companies -R&D Infrastructures -R&D Organisations
Lisboa (Regional)	2014-2020	Total: €835 Million Obj. 1: €172 Million	-Companies -R&D Infrastructures -R&D Organisations
Alentejo (Regional)	2014-2020	Total: €1,083 Million Obj. 1: €68 Million	-Companies -R&D Infrastructures -R&D Organisations
Algarve (Regional)	2014-2020	Total: €319 Million Obj. 1: €39 Million	-Companies -R&D Infrastructures -R&D Organisations
Madeira (Regional)	2014-2020	Total: €403 Million Obj. 1: €30 Million	-Companies -R&D Infrastructures -R&D Organisations
Açores (Regional)	2014-2020	Total: €1,140 Million Obj. 1: €49 Million	-Companies -R&D Infrastructures -R&D Organisations

Obj. 1 corresponds to the Operational Programmes' cross-cutting objective 1: strengthening research, technological development and innovation.

The amounts indicated correspond to European Funds only, not taking into consideration National matching funds.

Annex 3 – Evaluations, consultations, foresight exercises

Augusto Mateus & Associados/PwC (2013). *Avaliação Intercalar do COMPETE*. Lisboa.

Augusto Mateus & Associados (2015), *Avaliação ex-ante dos instrumentos financeiros do Portugal 2020, Lote 1: Instrumentos financeiros para apoio directo às empresas*, Lisboa, Augusto Mateus & Associados.

ICETA (2013), "Avaliação ex ante da Proposta de Acordo de Parceria para a Aplicação em Portugal dos Fundos do Quadro Estratégico Comum 2014-2020", 22 de novembro de 2013.

IESE/Quatenaire (2013). *Avaliação estratégica do Quadro de Referência Estratégico Nacional (QREN) 2007-2013*. Lisboa: Observatório do QREN.

SPI/Innov TSD (2013), Sociedade Portuguesa de Inovação and Inno-TSD, *Estudo de avaliação da estratégia e do processo de implementação das estratégias de eficiência colectiva tipologia clusters*. Lisboa: Observatório do QREN.

Europe Direct is a service to help you find answers to your questions about the European Union

Free phone number (*): 00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.

It can be accessed through the Europa server <http://europa.eu>

How to obtain EU publications

Our publications are available from EU Bookshop (<http://bookshop.europa.eu>), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents.

You can obtain their contact details by sending a fax to (352) 29 29-42758.

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

*Serving society
Stimulating innovation
Supporting legislation*

doi:10.2791/493673

ISBN 978-92-79-57808-3

