Chapter 15
A Portuguese Tale on Knowledge-Based Society: Narrowing Bonds Between Higher Education and the Innovation System

Teresa Carvalho, Sara Diogo, and Rui Santiago

Abstract Within the knowledge society framework, higher education has become a driving factor for democratizing and rising equality in societies and consequently stimulating economic development (Panitsidou et al., Procedia Soc & Behav Sci, 46: 548–553, 2012). In Portugal, as elsewhere, higher education institutions (HEI) were expected to play a key role within the changing dynamics in the orientation of knowledge production and dissemination. Research and the national scientific system are closely connected to the higher education system, with knowledge production being mostly concentrated in universities, especially in public ones. In this context, HEIs are considered as a privileged locus of change framed by the knowledge society providing the new epistemological, ontological, and methodological logics as well as legitimacy for a new "political economy" of knowledge. However, this chapter has a double purpose. On the one hand, it intends to present an overview of the Portuguese higher education system and its relation to the research and innovation system. On the other hand, the paper seeks to analyze the contemporary conceptions of the "knowledge-based society" in the Portuguese state policies and HEI narratives, as well as the expected role assigned to academics in the new knowledge production, dissemination, and transfer systems.

Keywords Innovation policy · Higher education system · Academic careers · Research and development

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Introduction

Knowledge has become central to contemporary politics and policymaking across nations, especially evident in the prominence acquired within national higher education systems and in research and development (R&D) systems. It is this integration of education and science public policies into the social and economic structures of modern societies that sustained the acknowledgment of the transition from the information society (Bell, 1973) to the networked society (Castells, 2000) and, later, to the knowledge society, with knowledge being the fundamental capital of the twenty-first century (Castelfranchi, 2007). This last connotation emerged during the Lisbon Process (2000), with the strategic goal of "making the European Union (EU), on a world scale, the economic space based on innovation and knowledge that is more dynamic and competitive, capable of raising economic growth levels, with more and better jobs, and with more social cohesion" (European Commission, 2000, p. 4). In this sense, political discourse in Europe in the last decades have been using knowledge society as a meta-narrative, or as a governance tool, to accomplish European integration and enhance its competitiveness. Through the establishment of the European Research Area (ERA), the Lisbon Strategy became the tangible mechanism of the EU to enhance cohesion and social development and foster economic competitiveness based in R&D investment (Chou & Gornitzka, 2014; Chou & Ulnicane, 2015). Innovation and technology development are thus expected to be the result of a complex set of relationships among actors in the system, namely, enterprises, universities, and government research institutes (OECD, 2017).

This view of science as containing political and strategic value and simultaneously subsidiary to the economy is not new. In reality, this perspective of science has its genesis in World War II and in the context of competition and tension of the Cold War (FCT, 2014). However, in Europe, the orientation of science to economic development assumes hegemonic dimensions precisely with the Lisbon Process.

In Portugal, as elsewhere, higher education institutions (HEIs) were assigned a key place within this new changing context in the orientation of knowledge production and dissemination. Portugal has a binary higher education system, integrating both public and private universities and polytechnics. Research and, therefore, the national scientific system is closely connected with the higher education system (Heitor & Horta, 2012), with knowledge production being mostly concentrated in universities and, among these, within public ones (Conceição et al., 2006). Under the Lisbon Strategy framework and the construction of a knowledge society, Portugal (similarly to other OECD countries) has been redesigning science and technology (S&T) policies in recent years. By national innovation system, we refer to the linkages established jointly and individually among the different actors involved in the production, development, and diffusion of economically useful knowledge (Lundvall, 1992).

Within this definition in mind, this chapter first aims to present an overview of the Portuguese higher education system and its relation to the research and innovation system. The authors analyze contemporary conceptions of the

"knowledge-based society" in the Portuguese state policies and HEIs narratives, its impact on the relation between the higher education system and the research and development/innovation system, and in HEI narratives, missions, and identities. How has Portugal changed in response to competitive pressures of/in the global knowledge society/economy?

Overview of the Portuguese Higher Education System and the Evolution of Science and Innovation Policies in Portugal

Although the Portuguese higher education system is one of the oldest in Europe, the genesis of national scientific policy dates back to the late 1960s. Prior to 1974—the dictatorship period which was in force between the years of 1926 and 1974—the Portuguese research system was characterized by the central position that public laboratories held (Magalhães, 2001; Ruivo, 1991), and research was mostly carried out in governmental institutes and departments, not in universities. This political centralism and administrative structure were visible by the fact that research did not depend on a single ministry, but quite the contrary, assuming a plural or joint tutelage which could include, for example, the Ministry of Education, the Ministry of Agriculture, Health, etc. (Magalhães, 2001).

The integration of Portugal in the, by then, European Community (now EU) in 1986 signals the possibility of obtaining EU structural funds channeled to the emergence of the national scientific research system. The development of science and innovation policies in Portugal is thus intrinsically linked to the development of European policies, and science gets a new impetus in 1995 with the creation of the Ministry of Science and Technology and the Foundation for Science and Technology (FCT) in 1997. Today, the FCT, supervised by the Ministry of Science, Technology, and Higher Education (MCTES), is the national public agency to support research in science, technology, and innovation in all areas of knowledge. In fact, as Rollo et al. (2012) refer, the history of the FCT is intertwined with the history of science and technology itself and with the organization of science in Portugal.

From the mid-1990s, science and innovation policies in Portugal went through several developments with the new ministry created during the socialist government (1995–1999). The reorganization of research through disciplinary fields (i.e., Exact, Natural, and Applied Sciences, Technology and Social Sciences, Humanities and Arts) and evaluation of research units started in 1997 (Torgal, 2012), after which followed an increase in research units as it also increased the pace of their establishment and the number of positions for PhD holders (Torgal, 2012). Scientific production started to be concentrated in HEIs, particularly in universities, and developed in R&D units (officially established in 1998: Regulation 1/98 of R&D units) and state laboratories (Heitor & Horta, 2012; Santiago et al., 2008). These new structures are now accredited by the Ministry of Science and Higher Education according to

scientific and technological productivity and measured by the number of publications, patents, prototypes, etc. Though having less weighting, additional elements were also taken into account, such as postgraduate training promoted by research units, participation in R&D projects, application of knowledge to new products, resources applied to scientific activity, and the plans and objectives of the units (Heitor & Bravo, 2010; Heitor & Horta, 2012; Horta, 2010; Santiago et al., 2008).

Through these periods, it is undeniable that the design of public policies for science and innovation focused on promoting economic development and national competitiveness. However, from 1995 onwards, the linkage of research to the economy translates a clear incentive to the emergence of new modes of knowledge production capable of creating transferable scientific and technological knowledge, particularly for the business world (Santiago & Carvalho, 2011). In 2001, the Decree-Law 197/2001 created financial incentives for industries investing in R&D expenditure based on the argument that these incentives would help enterprises to become more competitive in the increasingly global market and would allow the country to attract more qualified investment (cf. Table 15.1). In 2005, under the "technological impact" metaphor as a motto of governance, the Portuguese government made an effort to increase the public investment in R&D, which was considered the highest in this sector across Europe (Heitor & Bravo, 2010). At the same

Table 15.1 Evolution of expenditure on research and development (R&D) activities in percent Gross Domestic Product (GDP), by sector of performance/implementation (1990–2017)

	Sector of performance (implementation)				
Years	Total	Enterprises	Government	Higher education	Private nonprofit institutions
1990	0,46	0,12	0,12	0,17	0,06
1992	0,52	0,12	0,12	0,24	0,07
1995	0,52	0,11	0,14	0,19	0,08
1997	0,56	0,13	0,14	0,23	0,07
1999	0.68	0,15	0,19	0,26	0,07
2001	0,76	0,24	0,16	0,28	0,08
2003	0,70	0,23	0,12	0,27	0,03
2005	0,76	0,29	0,11	0,27	0,09
2007	1,12	0,58	0,12	0,33	0,11
2008	1,44	0,72	0,11	0,50	0,13
2009	1,58	0,75	0,12	0,58	0,14
2010	1,54	0,71	0,11	0,57	0,15
2011	1,46	0,69	0,11	0,53	0,13
2012	1,38	0,69	0,07	0,50	0,12
2013	1,32	0,63	0,09	0,59	0,02
2014	1,29	0,60	0,08	0,59	0,02
2015	1,24	0,58		0,57	0,02
2016	1,28	0,62		0,57	0,02
2017	1,32	0,67	0,07	0,56	0,02
2018	1,35	0,69	0,07	0,56	0,02

Source: PORDATA (2020)

time, the private sector—especially the enterprises—strengthen its participation in R&D, while tax incentives were granted to industries that funded scientific and technological (S&T) knowledge and used the results of their research, or scientific and technological knowledge, to discover or substantially improve materials, products, and services or even improved industrial processes. Table 15.1 shows the growth of national public investment in R&D as well as the diversification of funding sources. Despite the diversification effort, the state remained the main actor and regulator of the scientific system, namely, through external evaluation processes (Decree-Law 125/99 and 91/2005).

The data in Fig. 15.1 comparing the Portuguese gross domestic spending on R&D with the OECD average shows an increase in Portuguese expenditure until 2009, after which time it starts to decrease and continued to do so during the next 3 years.

With respect to the analysis on the levels of expenditure by performance sectors in Portugal (cf. Table 15.1), there is an increase in the expenditure coming from enterprises during 2007 to 2012. The state and the higher education sector together represent the highest proportion of expenditure, except for in 2011 and 2012, when expenditure in these two sectors is slightly lower than that of enterprises; this can be explained by a decrease in state expenditure due to the economic crisis, which particularly affected Portugal with the 2011 bailout. In Portugal, the expenditure level on R&D activities in 2014 represented 1.29% of GDP, which is clearly below the value of 2.36% for the OECD countries and 2.04% for the EU (and, e.g., 3.16% of the Finnish expenditure). Figs. 15.2 and 15.3 show that in spite of the country's evolutionary efforts in this domain, Portugal is still positioned in the "semi-periphery" (Delicado & de Almeida Alves, 2013), i.e., in the tail of countries with the lowest percentages of R&D expenditure when compared to the OECD and EU expenditure share in R&D.

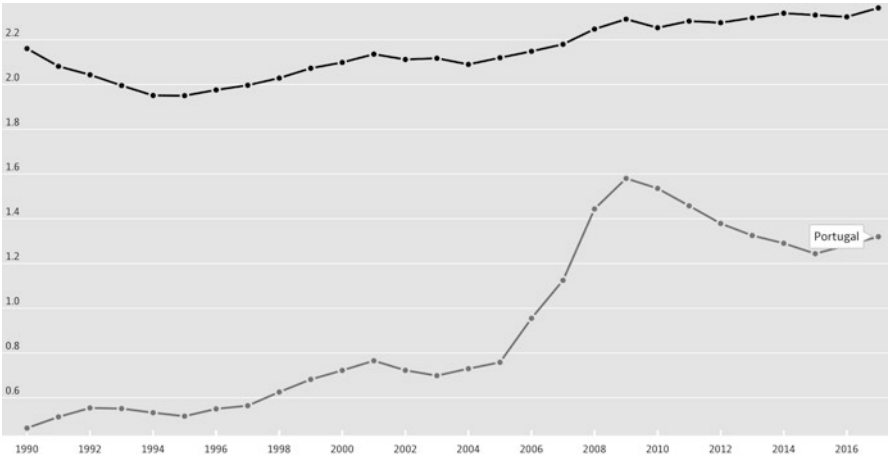


Fig. 15.1 Portuguese gross domestic spending on R&D compared to the OECD average (black line). (Source: OECD (2018a))

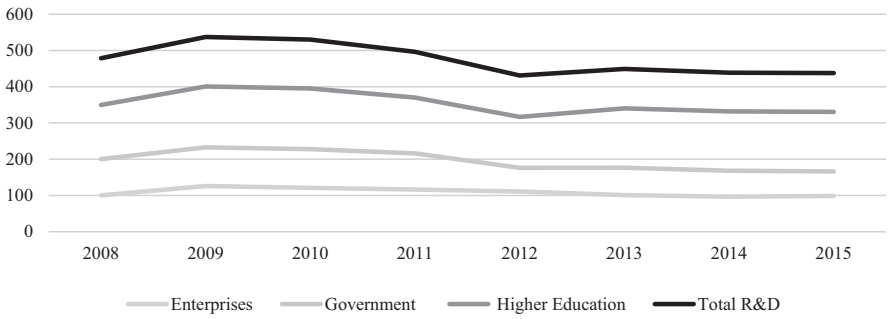
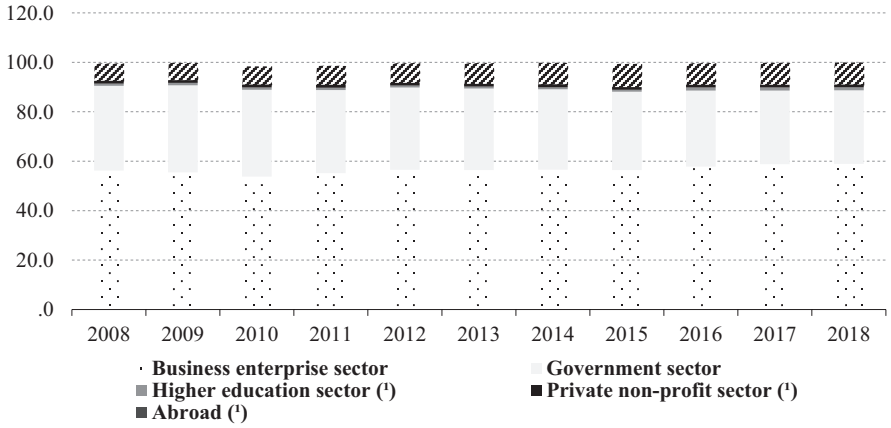


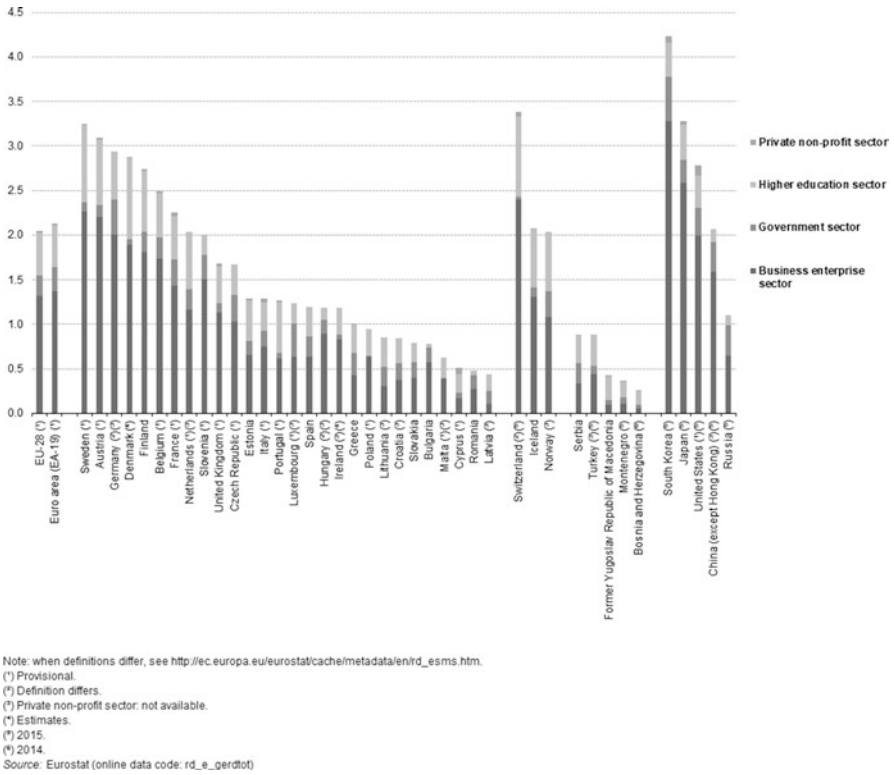
Fig. 15.2 Evolution of the gross domestic expenditure on R&D in Portugal by sector of activity. (Source: Adapted from the OECD (2019))



(1) 2017 instead of 2018.

Fig. 15.3 Gross domestic expenditure on R&D by source of funds, EU-27, 2008–2018 (% share of total). (Source: Adapted from Eurostat (2019a))

According to Eurostat (2019a, b), Sweden (3.25%) and Austria (3.09%) were scored highest among the EU countries in terms of R&D investment—and were also the only two member states to report a level of R&D intensity above 3% in 2016—followed by Germany (2.94%), Denmark (2.87%), and Finland (2.75%). Figures 15.3 and 15.4 evidence the European reality of strong participation of enterprises in expenditure in all 28 EU countries, followed by the State, Higher Education, and Private Nonprofit Institutions. From 2006 to 2016, R&D expenditure in the business enterprise sector rose from 1.12% of GDP in 2006 to 1.32% by 2016, which represents an overall increase of 17.9% (Eurostat, 2019a, b). The second largest sector performing R&D was the higher education sector, whose R&D intensity increased slightly faster, and up overall by 20.5% in the same period (2006–2016), reaching 0.47% of GDP by 2016.



Note: when definitions differ, see http://ec.europa.eu/eurostat/cache/metadata/en/rd_esms.htm.
(1) Provisional.
(2) Definition differs.
(3) Private non-profit sector: not available.
(4) Estimates.
(5) 2015.
(6) 2014.
Source: Eurostat (online data code: rd_e_gerdtot)

Fig. 15.4 Gross domestic expenditure on R&D by sector EU-28, 2006–2016 (%, relative to GDP). (Source: Adapted from Eurostat (2019b))

It should be noted that although R&D investment for the higher education sector initially rose faster than that for the private sector, the ratio in the 28 member countries of EU stagnated from 2010 onward. However, in the EU-28, the R&D expenditure in the government and higher education sectors was quite similar. Figure 15.4 confirms that Portugal (and Netherlands) had a relatively high ratio of R&D expenditure by the higher education sector. In the EU-28, during the period of analysis (2006–2016), R&D funding by the higher education and private nonprofit sectors was relatively small, just 0.9% and 1.7% of the total, respectively (Eurostat, 2019a, b).

According to the European Commission data (Eurostat, 2019a, b), the higher education sector played a relatively small role in funding R&D expenditure in most member states, exceeding 4% only in Cyprus (5.8%), Portugal (4.4%), and Spain (4.3%), as illustrated in Fig. 15.4.

The financing and regulatory activity of the Portuguese scientific system is expressed in the relevance placed in the evaluation of the research units, considering that it conditions the distribution of public funding for research activities. The adverse economic context combined with the influence of neoliberal policies works

as legitimating factors to the changes introduced in the last evaluation exercise, in 2013 (at the present, research units are still in the process of being evaluated) when compared to previous processes (1996, 1999, 2002, and 2007). In this evaluation exercise, the FCT worked with the Center for Science and Technology Studies of the University of Leiden to produce a bibliometric study of Portuguese researchers, based on the analysis of the Web of Science (WoS) publications (FCT, 2014). This shift translates a new epistemological and ontological perspective on the production and dissemination of knowledge in Portugal, mostly focused on the results which, in turn, were evaluated in terms of quantitative and predefined production targets. The evaluation was developed in partnership with experts from the European Science Foundation (ESF), thus translating the direct influence of European policies of excellence into research (McNay, 2015; Pruvot & Estermann, 2014). However, this evaluation process has proven to be one of the most problematic processes ever: It was extended for a long time and presented controversial results, leaving many dissatisfied. This discontentment merged mostly due to the differences between disciplines and the associations between the results of the evaluation exercise and the funding (Deem, 2016).

The results of this evaluation, associated with the decrease of public funding in science which was also translated to a decrease in research grants, place the Portuguese scientific and technological system in a very vulnerable position (Delicado & de Almeida Alves, 2013). The emergence of the XXI constitutional government in 2015 and the position of the new Ministry of Science, Technology, and Higher Education (Manuel Heitor) were, in this way, marked by the need to restore confidence in the system and in public policies (e.g., new attempts to tighten scientific research within the business environment and society as a whole), as well as the promotion of scientific employment.

Science and Innovation Policies in Portugal and Their Effects in the (Scientific) Employment

The development of public policies on science and innovation, very much sponsored by the Europeanization journey of the country, resulted in a continuous increase in the number of PhD holders in Portugal. To a large extent, this growth is a consequence of the massification of higher education in Portugal, considering that the increase in the number of students resulted in an increase in the number of professors, and obtaining a PhD degree was an essential condition to advance in the academic career. The status of the teaching career created in the late 1970s (through the Decree-Law 448/79) was based on five levels (trainee assistant, assistant, assistant professor, associate professor, and full professor); one could access the career with the bachelor's degree (in the category of trainee assistant), but continuity in the career was only possible after obtaining the doctor degree followed by a probationary period of five years as an assistant professor. Obtaining a doctor's degree was

practically restricted to those who had access to a career in higher education and was essentially financed by the state through HEIs.

The creation of a scientific research career is, at the same time, concomitant and dependent on the university career. The career structure and scientific research (Decree-Law 415/80 of 27th September) is created in close connection with the status of the university teaching career. This was defined in a subordinate way and dependent on the university career. In the preamble to the Decree-Law of 1980 (p. 3007), it states:

> Universities should have a body of researchers, certainly more restricted than that of Professors, but also necessary. It is important, however, to never lose sight of the special characteristics of these institutions. Therefore, it is justified, and even imposes, to assign the role of coordinator to the Full professor of the expertise field.

As such, the design of scientific research was clearly and exclusively associated with the higher education field.

The following data compares the number of existing researchers in Portugal with the number of these professionals in OECD countries' average (cf. Figure 15.5).

According to the OECD (2017), the average number of professionals doing research in the EU countries in 2006 was 6.1% per every 1000 employed people, while in Portugal, this figure was 4.8 percent. However, the number of researchers increased immediately after the introduction of Decree-Law 415/80, and this trend continues to grow until 2012. For example, in 1982, the value of this indicator for Portugal was 1 percent, increasing to 5.5 percent in 2007 (Observatory of Inequalities, 2017). In the EU, between 1995 and 2006, the number of researchers per 1000 employees rose from 4.8 to 6.1. For the same period, Portugal presents lower figures than the average of the OECD and EU countries although this

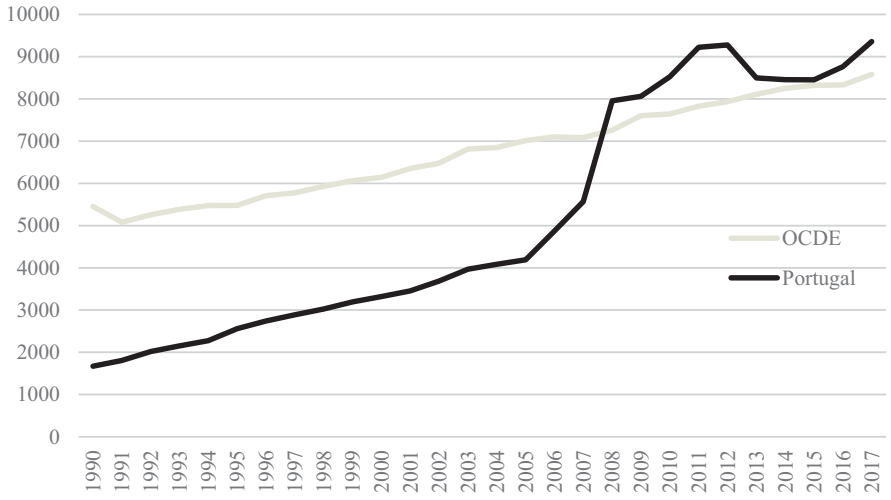


Fig. 15.5 Evolution in the number of researchers per 1000 employed in Portugal (1982–2016) compared with the OECD average (1990–2017). (Source: Adapted from OECD (2018b))

difference has been narrowing with the increase in scholarship provision granted by the FCT (FCT/MCTES 2017). In fact, despite an almost continuous increase, the proportion of researchers employed in Portugal is still lagging when compared with the OECD and EU average for the 27 country members. According to the Observatory for Inequalities (2017) data, this has been a trend since 1982 although Portugal has managed to slightly reduce the differences vis-à-vis these two organizations. Whereas in 1982 there was a difference of 3.8 researchers per 1000 employees between Portugal and the OECD average, in 2005, this difference was 3.2 (4.1 vs. 7.3). However, as a result of the funding coming from the EU structural funds, and of the national policies stimulating the development of science and research referred to earlier, the state is now encouraging the achievement of the PhD degree regardless the needs identified at the level of the academic career.

Portugal was not spared from the narratives on knowledge society influencing the definition of science and technology policies in the last years. As a result of the implementation of these policies, there was an extraordinary increase in the number of PhD holders in the country, at a time when HEI were not opening new positions—a situation that has been worsening due to the austerity policies promoted by the bailout in 2008 (Carvalho & Diogo, 2018a; Heitor & Horta, 2012). The increase in funding for training at the doctoral level has been mainly sponsored by FCT, which mostly comes from European funds, through the granting of PhD scholarships. Whereas in 1994 the total number of doctoral fellowships granted by the FCT were 945, in 2007, this value reached its peak with 2030 PhD scholarship holders—a number that has been decreasing since then. In 2013, for example, the total number of doctoral fellowships granted by the FCT was 613, significantly lower than that in 1994 (FCT/MCTES, 2017). As a matter of fact, from 2007 onward, the decrease in the provision of scholarships is more dramatic, particularly from 2012 to 2013 when there is an abrupt cut in scholarship grants. Except for the years of 2005 and 2007 when the number of PhD fellowships for the social sciences was slightly higher, the areas of engineering and technology sciences and the natural sciences obtained the largest number of scholarships during the period of analysis. Such distribution by disciplinary fields could be the driving factor explaining the inclusion of doctors in the entrepreneurial fabric since these areas are considered as having a closer connection to the business world. The commitment of national policies to increase the granting of doctoral scholarships has a direct effect on increasing the number of PhD holders in the country, as can be seen in Fig. 15.6, which shows the evolution in the number of PhD holders in Portugal from 2003 to 2012.

The Statutes of the University and Polytechnic Teaching Career, which have remained practically unchanged since the end of the 1970s, were substantially altered in 2009 (through the Decree-Law 207/2009). The career was reduced to three categories (assistant professor, associate professor, and full professor) with the doctorate being an essential condition to access the academic career. The responsibility for obtaining the PhD degree is transferred from the HEI to the individual (Carvalho, 2012). Concomitantly, there is a decrease in the number of higher education students and a decrease in public investment for this sector (Fonseca, 2012). In 2008, there were 24,115 academics in Portugal; the majority—around 60%

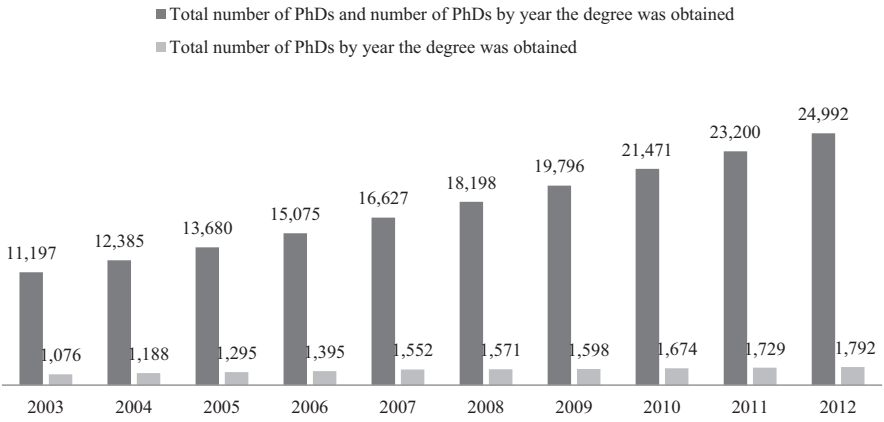


Fig. 15.6 Evolution of the total number of PhDs and number of PhDs by year they obtained their degree (2003–2012). (Source: Adapted from Barroca, Meireles, and Neto (2015, p. 20))

Table 15.2 Professor's distribution by academic rank in universities

Type		Position	2008	
			N	%
Tenure		Full professor	1125	7,9
		Associate professor	1969	13,8
		Subtotal	**3094**	**21,6**
Nontenure	Tenure track	Auxiliary professor	5386	37,6
		Assistant	1220	8,5
		Trainee assistant	72	0,5
		Subtotal	**6678**	**46,7**
	Nontenure track	Invited full professor	136	1,4
		Invited ass. professor	258	3,1
		Invited aux. professor	1002	7
		Invited assistant	2306	16,1
		Others	16	4,1
		Subtotal	**3718**	**31,7**
Total			**14,324**	**100**

Source: DGEES (2018)

(n = 14,324; Table 15.2)—were in the university sector and the minority in the polytechnics (n = 9791; Table 15.3).

Given the weak investment in R&D in the private sector, the employment of PhD holders largely depends on the opening of positions in HEIs, which, in turn, have proven incapable of absorbing all those people qualified with this degree. The substantial increase in higher education graduates, and particularly of PhD holders, is also explained by the efforts to introduce comparability within ERA. These efforts have been accompanied by transformations in HEIs framed by trends that translate to a decrease in state funding. Consequently, since the beginning of the millennium,

Table 15.3 Professors' distribution by academic rank in polytechnics

Type		Position	2008	
			N	%
Tenure		Principal coordinator professor	36	0,4
		Coordinator professor	678	6,9
		Subtotal	**714**	**7,3**
Nontenure	**Tenure track**	Adjunct professor	2109	21,5
		Assistant (1° and 2° triennium)	343	3,5
		Subtotal	**2452**	**25,0**
	Nontenure track	Invited principal coordinator professor	56	0,6
		Invited adjunct professor	1923	19,6
		Invited assistant professor	3506	35,8
		Others	1140	11,6
		Subtotal	**6625**	**67,7**
Total			**9791**	**100**

Source: DGEES (2018)

the number of PhD graduates has been growing without a similar correspondence to the available positions in HEIs. This situation has resulted in international and national concerns. In fact, the OECD draw attention to Portugal's growing supply of highly qualified manpower and the lack of structures and capacity to deal with this: "If the system expands at the current rate – and the official target is even higher – it is clear that the existing structures will not be able to utilise the growing supply of highly qualified manpower" (OECD, 2007, p. 68). This scenario raised social and political awareness (also due to pressures from the EU) leading Portugal to carry out the first census statistical operation in 2012 by the Directorate of Education and Science Statistics (DGEEC) about PhD holders in Portugal. In 2012, the number of Doctors in Portugal was 24,992—an extraordinary increase compared to the figure of 15,075 in 2006. The number of researchers grew faster than in any other OECD country (Heitor & Bravo, 2010). The increase in the number of researchers has consequently resulted in an increase in the number of international publications (Heitor & Horta, 2012), as can be seen in Fig. 15.7.

According to data from the DGEEC (2016), among the EU countries, Portugal had the largest increase in that decade in terms of scientific publications, from 510 (in 2005) to 1, 298 (in 2015). Nevertheless, despite these numbers, there are differences among disciplinary fields that should be highlighted. The largest number of publications are in Medical Sciences and Health, followed by Exact Sciences (Maths and Physics) and Engineering and Technology Sciences (DGEEC, 2016, p. 5). Curiously, it was in the multidisciplinary areas, Humanities and Social Sciences, where a more significant increase in the average annual growth rate can be observed. These data may represent a reconfiguration in what is socially defined as being the researcher profile in these areas (Lund, 2012) and may represent changes in the traditionally dominant professionalism (Fig. 15.8).

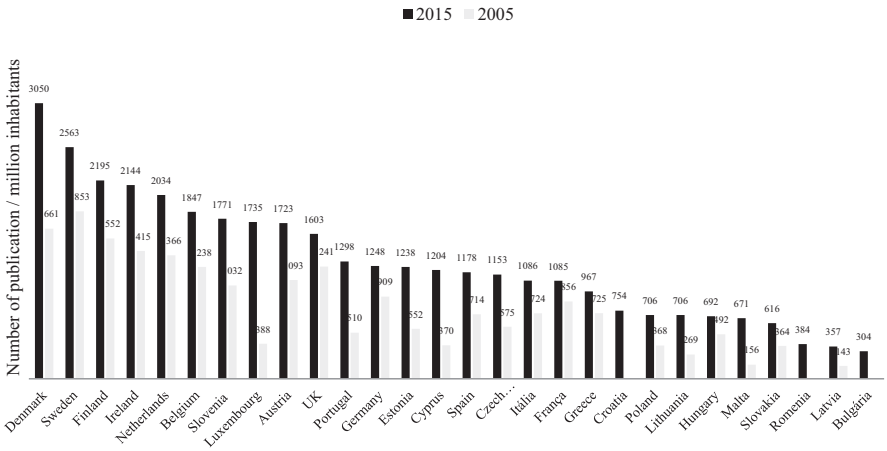


Fig. 15.7 Number of publications indexed to *Web of Science* per million inhabitants in the various countries of the European Union: 2005 and 2015. (Source: DGEEC (2016, p.3))

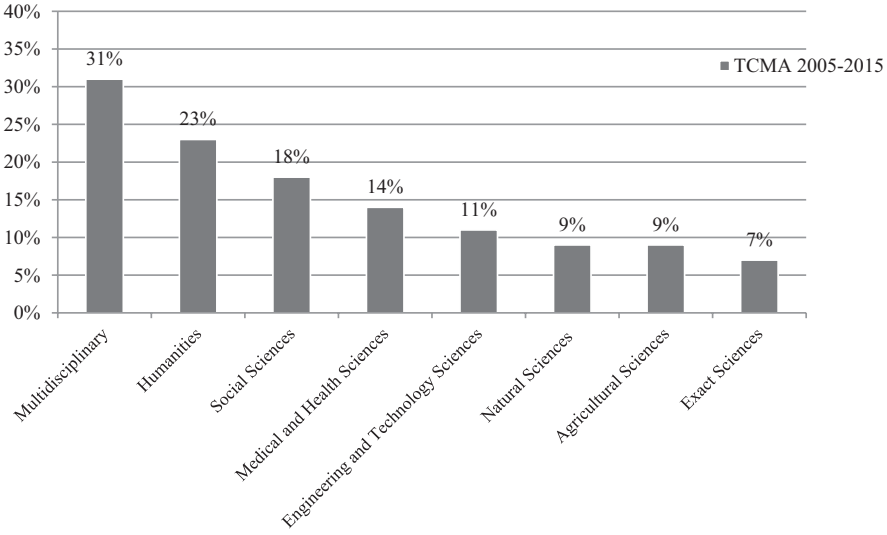


Fig. 15.8 Annual average growth rate (TCMA), between 2005 and 2015, of the number of Portuguese publications indexed in the Web of Science by disciplinary fields. (Source: DGEEC, (2016, p. 6))

In addition to the impact of scientific policies on the qualifications of Portuguese people and scientific production, it is also important to reflect on the employment conditions of this segment of the population. The vast majority of PhD holders in Portugal in 2012 were employed in higher education (83%), with a slight increasing trend of employment in industries (2% in 2006 to 4% in 2012) and nonprofit institutions (3% in 2006 to 5% in 2012) (Barroca et al., 2015). Not only did the number of

researchers/PhD holders increase (as mentioned previously), but also the number of those working in enterprises and in HEIs, between 2006 and 2014. During this time, these figures contrast with a decrease in PhD holders working in nonprofit institutions and government institutions. Concomitantly, industries tend to absorb more PhDs from the natural sciences and engineering areas than those from social sciences and humanities.

Probably more relevant than the analysis of the location will be the analysis of the employment situation of PhD holders. The implementation of European policies to encourage the so-called knowledge-based society and the changes that followed national higher education reforms have been translated into an increase in the precariousness of the working relations of younger populations (Teichler & Höhle, 2013; Höhle, 2015); similar trends tend to appear in Portugal. According to data from the DGEES, about 41% of doctors in Portugal have a temporary contract, and there are relevant differences in disciplinary fields. As can be seen in Fig. 15.9, the expression of temporary work is greater in the natural sciences; in opposition, the lowest expression is in agricultural sciences.

One consequence of the imbalance in supply and demand of PhD holders in the labor market is the precariousness of research work; however, this is just one facet. Another consequence of this imbalance is expressed in the increased migration of Portuguese researchers to other countries, a phenomenon known as "brain drain" (Delicado & de Almeida Alves, 2013). This migration, which is to a large extent forced (Gomes, 2015), translates the *solution* for the rising levels of unemployment among a highly skilled population. In fact, although unemployment rates in 2006 and 2009 were relatively low for PhD holders (0.47% and 0.44%, respectively), in 2012, these numbers raise up to 2.1% (DGEEC, 2012). In this way, it is possible to verify that the effects of implementing public policies of science and innovation in

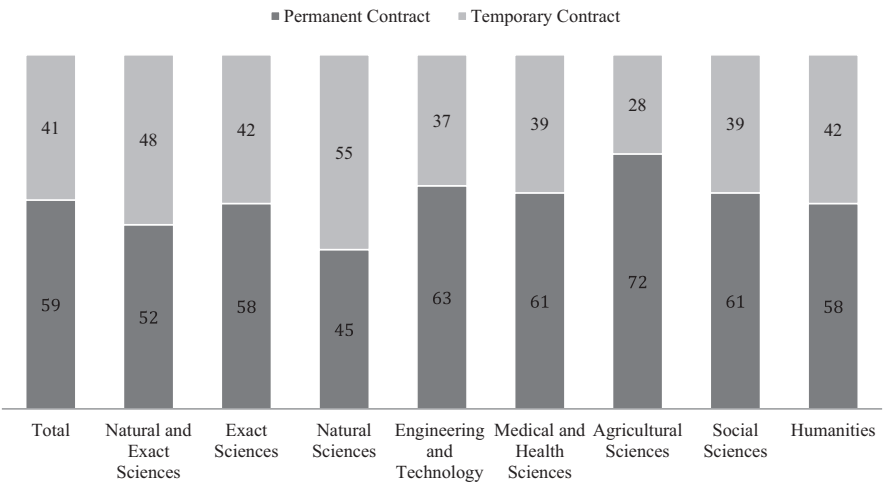


Fig. 15.9 PhDs employed by type of contract and scientific and technological area (discipline) of the PhD. (Source: Cotrim & Duarte (2012))

Portugal, within the European framework for the creation of the knowledge society, evidence fragilities in the national context. In fact, while it is true that these policies allowed a substantial increase in the level of qualifications of the Portuguese population, they also provided for a greater visibility of the national scientific production with the increase in the number of publications. However, such positive aspects were reached at the expense of strong social costs. The social tensions resulting from the precarious working conditions of PhD holders led to legislative interventions to regulate the work conditions of researchers (Decree-Law 57/2016). After a troubled period of political discussions and pressures from the various stakeholders involved, the final legislation focuses on the need to hire PhDs, based on greater independence of HEI from state funding:

> In the context of a well-known demand and great fiscal restraint, the scientific community and academic institutions are also encouraged to co-participate in the development of the country, namely through the creation of consortia, through the stimuli of sharing material resources of nearby institutions and through the raising of revenues by academic and scientific institutions to facilitate the hiring of young doctorates. (Decree-Law 57/2016)

These principles seem to reflect the change in the modes and locus of knowledge production in the national scientific system, which may be seen as reconfigurations in the way researchers are professionally seen and consequently treated.

The analysis of the employment situation of doctorate holders reveals that despite the incentives to increase their employment in the business sector, they are mostly concentrated in HEIs, even with a slight upward trend in employment in enterprises and nonprofit institutions (DGEEC, 2012). As a result, unemployment among PhD holders increased alongside the phenomena of brain drain (Carvalho & Diogo, 2018b; Delicado & de Almeida Alves, 2013; Gomes, 2015). For those who stayed in the country, the national inquiry to the working conditions of PhD holders also reveals that there was an increase in the precariousness of working conditions (DGEEC, 2017). Although relevant differences among disciplinary areas exist, it seems that the trends of having a degradation in working conditions, terms of appointment, and remuneration as verified in other countries (Altbach, 2000; Musselin, 2009; Carvalho, 2018; Carvalho & Diogo, 2018b) also exist in Portugal.

More recent political initiatives can also be interpreted in the frame of the European incentives to implement the so-called knowledge society. To the existent R&D units, new categories were introduced as the collaborative laboratories and the technological interface centers. Both are organizational structures that integrate public and private, profit and nonprofit institutions; however, the collaborative laboratories are funded specifically to produce knowledge with economic, social, and cultural impact. On its Web page, FCT specifies that “Collaborative Laboratories must consist of at least one company and one R&D unit associated with a higher education institution, funded by FCT, and may result from a technology interface center that already has this partnership structure” (FCT, 2019). The emergence of these new structures tends to stimulate the co-creation, co-diffusion, and social appropriation of knowledge. They can also be seen as an instrument to stimulate new modes of knowledge production in the Portuguese scientific system.

Conclusions

The narratives on knowledge society and especially on knowledge economy put a growing pressure on HEIs—in all parts of the world—to change. This is particularly evident in the EU context since the Europe 2020 strategy selected innovation as one of the seven flagships for promoting European integration; by strengthening the knowledge base, the EU expects to reduce differentiation between countries. Within this context, different state members have developed political and administrative initiatives to turn their own societies more knowledge oriented as it has happened in Portugal. In this chapter, an attempt has been made to specify and analyze the way science and technology policies have been evolving in Portugal to respond to European demands.

The scientific system in Portugal is relatively recent. Although Portugal has one of the oldest higher education systems in Europe, only recently did research become the focus of public policy concern. The Europeanization of science and technology policies since the beginning of the new millennium is translated in the support to increase the number of trained researchers as well as the number of research outputs and in attempts to separate the scientific system from the higher education system. These attempts are reflected in initiatives such as the evaluation of the R&D units, which emphasize the development of new modes of knowledge production; in the financial incentives conceded to enterprises to invest in R&D expenditure; and in the emergence of new research units, collaborative laboratories, capable of co-creating scientific and technological knowledge, particularly for the business world. The new millennium sets not only the national commitment to the Lisbon Strategy but also the growing concern with the training of more qualified individuals, as well as with the issues of control and evaluation of the national scientific system where the state remains the main actor and regulator of the country's R&D policies. Indeed, the financial and human efforts made to develop incentives and policies for more and better scientific employment were largely broken by the financial crisis of 2011, as highlighted throughout this chapter.

Although the increase in the number of PhD holders is a positive outcome of the national scientific and technological policies, with impact being an increase in the number of publications, the scientific capacity of the country is still mainly sustained in the higher education system.

The absence of a real scientific system has a strong impact on the existent imbalance in PhD graduates' labor market. In the development paths of the national higher education system and especially in the advancement of the R&D system, it is also necessary to take into account the role of performance evaluation exercises in the systems, the penetration of new perspectives on interpreting science in Portugal, highly emphasizing quantitative production metrics, which, in turn, have been shaping (some would even say *perverting*) the way to do science and disseminating it. Portugal is currently facing the paradox of the development and consolidation of its scientific system, with innovation policies that question the purpose of training PhDs without a plan or expectations of including them in the national

scientific system. In a system strongly dependent on higher education, especially in public higher education, it is paramount to rethink ways of promoting scientific employment and to translate it into innovation and economic development, effectively involving the business fabric in this national effort.

One should remember that obtaining a PhD is no longer exclusively associated with the academic career. Although the research career goes back to the 1970s, the existence of researchers was residual and confined to the sphere of higher education. However, the increase in PhD holders in line with the definition of policies, linking scientific knowledge to innovation, development, and economic competitiveness, translates into what can be considered as a top-down creation of a new professional group—the researchers. The creation of this group promotes a greater social division of labor as the traditional roles of teaching and research are separated. Researchers are responsible *only* for the development of research, preferentially applied, with an impact on economic development. In addition, political incentives have been continuously tried in order to move the locus of knowledge production to the economic domain. It is important to analyze—and this book and chapter represent a contribution in that sense—the reality of other countries to understand how European science and innovation policies can contribute to the creation of a fruitful environment promoting the emergence of a new professional group. It is also important to inquire about the potential consequences of this dualism of the academic career for the scientific and higher education systems.

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References

Altbach, P. G. (Ed.). (2000). *The changing academic workplace: Comparative perspectives*. Boston College Center for International Higher Education.

Barroca, A., Meireles, G., & Neto, C. (2015). *A empregabilidade dos doutorandos nas empresas portuguesas [Doctorates' employability in Portuguese industries]*. Advancis Business Service. http://uniarea.com/wp-content/uploads/2015/02/AEmpregabilidadedosDoutoradosnasempresasportuguesas.pdf

Bell, D. (1973). *The coming of post-industrial society: A venture in social forecasting*. Basic Book.

Carvalho, T. (2012). Shaping the 'new' academic profession. In G. Neave & A. Amaral (Eds.), *Higher education in Portugal 1974–2009: A nation, a generation* (pp. 329–352). Springer Netherlands.

Carvalho, T. (2018). New public management and the academic profession. In N. A. Teixeira & J.-C. Shin (Eds.), *Encyclopedia of international higher education systems and institutions*. Springer.

Carvalho, T., & Diogo, S. (2018a). Non-tenured teachers, higher education. In *Encyclopedia of International Higher Education Systems and Institutions* (pp. 1–5). Springer Netherlands.

Carvalho, T. & Diogo, S. (2018b). *Políticas de Ciência e Inovação no Quadro da Sociedade do Conhecimento. Efeitos no Emprego Científico* [Science and innovation policies in the knowledge society framework]. In M. M. Serrano & P. Neto (Eds.), *Inovação, Emprego e*

Políticas Públicas, [Innovation, Employment, and Public Policies] (pp. *343–364*). Alcochete: SmartBook.

Castelfranchi, C. (2007). Six critical remarks on science and the construction of the knowledge society. *Journal of Science Communication, 6*(4).

Castells, M. (2000). The rise of the network society. In O. Blackwell (Ed.), *The information age: Economy, society and culture* (Vol. I, 2nd ed., pp. 67–147). Blackwell.

Chou, M.-H., & Gornitzka, A. (2014). *Building the knowledge economy in Europe: New constellations in European research and higher education governance*. Edward Elgar.

Chou, M. H., & Ulnicane, I. (2015). New horizons in the Europe of knowledge. *Journal of Contemporary European Research, 11*(1).

Conceição, P., Heitor, M. V., & Horta, H. (2006). R&D funding in US universities: From public to private support or public policies strengthening diversification. In J. Enders & W. Jongbloed (Eds.), *Public-private dynamics in higher education: Expectations, developments and outcomes* (pp. 301–328). Transcript Verlag.

Cotrim, R., & Duarte, J. (2012). *Inquérito aos Doutorados 2012: Principais Resultados*. Direção de Estatísticas da Educação e Ciência (DGEEC).

Deem, R. (2016). Recent research evaluations in the UK and Portugal. In C. Sarrico, P. Teixeira, A. Magalhães, A. Veiga, M. J. Rosa, & T. Carvalho (Eds.), *Global challenges, national initiatives, and institutional responses: The transformation of higher education* (pp. 159–186). Sense Publishers.

Delicado, A., & de Almeida Alves, N. (2013). "Fugas de Cérebros", "Tetos de Vidro" e "Fugas na Canalização": mulheres, ciência e mobilidade. In E. Araújo, M. Fontes, & S. Bento (Eds.), *Para um debate sobre Mobilidade e Fuga de Cérebros* (pp. 8–31). Centro de Estudos de Comunicação e Sociedade, Universidade do Minho. http://www.lasics.uminho.pt/ojs/index.php/cecs_ebooks/article/view/1583/1496

DGEEC (2012). Inquérito aos Doutorados 2012: Principais Resultados (Survey of Doctoral Holders: The main Results). Lisbon, DGEEC-MCT.

DGEEC. (2016). *Produção Científica Portuguesa: Séries Estatísticas 2005–2015 [Portuguese Scientific Production: Statistical Series 2005–2015],* Directorate-General for Education and Science Statistics. http://www.dgeec.mec.pt/np4/%7B$clientServletPath%7D/?newsId=774&fileName=Destaques_SE_2005_2015.pdf.

DGEEC (2017). Inquérito ao Potencial Científico e Tecnológico (Survey to the Scientific and Technological Potential). Lisbon, DGEEC-MCT.

DGEEC. (2018). Evolução do número de docentes, por ano letivo, natureza do estabelecimento de ensino, tipo de ensino, estabelecimento de ensino, habilitação académica e sexo. [Evolution of the number of teachers, by academic year, nature of the educational establishment, type of education, educational establishment, academic qualification and sex]. https://www.dgeec.mec.pt/np4/461/ Accessed 23Nov 2019.

European Commission EC. (2000). *Towards a European research area science, technology and innovation key figures 2000*. European Commission.

Eurostat. (2019a). Gross domestic expenditure on R&D by source of funds EU-27, 2008–2018. Eurostats Statistics explained. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Gross_domestic_expenditure_on_R%26D_by_source_of_funds,_EU-27,_2008_-2018_(%25_share_of_total)_F5.png. Accessed 29 Jan 2019.

Eurostat. (2019b). Eurostat (2019). Gross domestic expenditure on R&D by sector EU-28, 2006–2016 (% relative to GDP). Eurostats Statistics Explained. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Gross_domestic_expenditure_on_R_%26_D_by_sector,_2016_(%25,_relative_to_GDP)_FP18.png. Accessed 29 Jan 2019.

FCT. (2014). História da Ciência – Política e organização da ciência. FCT Arquivo de Ciência e Tecnologia. http://act.fct.pt/historia-da-ciencia/politica-e-organizacao-da-ciencia-em-portugal-no-sec-xx/

FCT. (2019). Call for the attribution of the title of Collaborative Laboratory (CoLAB). In https://www.fct.pt/apoios/CoLAB/index.phtml.en

FCT/MCTES, PORDATA. (2017). Bolsas de Doutoramento concedidas por área científica [PhD Scholarships by scientific area]. Retrieved from http://www.pordata.pt/Portugal/Bolsas+de+doutoramento+concedidas+total+e+por+área+cient%C3%ADfica+–+FCT-243

Fonseca, M. (2012). The student estate. In G. Neave & A. Amaral (Eds.), *Higher education in Portugal 1974–2009: A nation, a generation* (pp. 383–415). Springer Netherlands.

Gomes, R. M. (Ed.). (2015). *Fuga de cérebros: retratos da emigração portuguesa qualificada*. Bertrand Editora.

Heitor, M., & Bravo, M. (2010). Portugal at the crossroads of change, facing the shock of the new: People, knowledge and ideas fostering the social fabric to facilitate the concentration of knowledge integrated communities. *Technological Forecasting and Social Change, 77*(2), 218–247.

Heitor, M., & Horta, H. (2012). Science and technology in Portugal: From late awakening to the challenge of knowledge-integrated communities. In G. Neave & A. Amaral (Eds.), *Higher education in Portugal 1974–2009: A nation, a generation* (pp. 179–226). Springer Netherlands.

Höhle, E. (2015). From apprentice to agenda-setter: Comparative analysis of the influence of contract conditions on roles in the scientific community. *Studies in Higher Education, 40*(8), 1423–1437.

Horta, H. (2010). The role of the state in the internationalization of universities in catching-up countries: An analysis of the Portuguese higher education system. *Higher Education Policy, 23*(1), 63–81.

Lund, R. (2012). Publishing to become an "ideal academic": An institutional ethnography and a feminist critique. *Scandinavian Journal of Management, 28*(3), 218-228.

Lundvall, B.-Å. (Ed.). (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. Pinter.

Magalhães, A. M. (2001). *Higher education dilemmas and the quest for identity: Politics, knowledge and education in an era of transition.* (PhD Thesis), University of Twente, Twente, Netherlands.

McNay, I. (2015). Learning from the UK research excellence framework: Ends and means in research quality assessment, and the reliability of results in education. *Higher Education Review, 47*(3), 24–47.

Musselin, C. (2009). The market for academics. Routledge.

OECD. (2007). *OECD reviews of National Policies for education: Tertiary education in Portugal*. OECD Publishing.

OECD. (2017). *Gender equality in the OECD and around the world: An overview*. OECD Publishing.

OECD. (2018a). Gross domestic spending on R&D compared to the OECD average. https://data.oecd.org/gdp/gross-domestic-product-gdp.htm Accessed 29 Nov 2018.

OECD (2018b). Evolution in the Number of researchers per 1000 employed. https://data.oecd.org/gdp/gross-domestic-product-gdp.htm. Accessed 29 Nov 2018.

OECD. (2019). *Main science and technology indicators, 2019*. OECD Publishing.

Panitsidou, E., Griva, E., & Chostelidou, D. (2012). European union policies on lifelong learning: In-between competitiveness enhancement and social stability reinforcement. *Procedia - Social and Behavioral Sciences, 46*, 548–553. https://doi.org/10.1016/j.sbspro.2012.05.158

PORDATA. (2020). Survey on the National Scientific and Technological Potential (IPCTN; Annual National Accounts) https://www.pordata.pt/en/Portugal/Expenditure+in+research+and+development+activities+(R+D)+as+a+percentage+of+GDP+by+sector+of+performance-1133

Pruvot, E. B., & Estermann, T. (2014). *Define thematic report: Funding for excellence*. European University Association.

Rollo, M. F., Meireles, P., Ribeiro, M., & Brandão, T. (2012). História e Memória da Ciência e da Tecnologia em Portugal. O Arquivo de Ciência e Tecnologia da Fundação para a Ciência e a Tecnologia. [History and Memory of Science and Technology in Portugal. The Science and Technology Archive of the Foundation for Science and Technology]. *Boletim do Arquivo da Universidade de Coimbra, 25*, 233–261.

Ruivo, B. (1991). As instituições de investigação e a política de ciência. In J. M. Gago (Ed.), *Ciência em Portugal* (pp. 25–48). Imprensa Nacional—Casa da Moeda.
Santiago, R., & Carvalho, T. (2011). Mudança no conhecimento e na profissão acadêmica em Portugal. *Cadernos de Pesquisa, 41*, 402–426.
Santiago, R., Carvalho, T., & Relva, R. (2008). Research and the universities' image. *European Journal of Education, 43*(4), 495–512.
Teichler, U., & Höhle, E. A. (Eds.). (2013). *The work situation of the academic profession in Europe: Findings of a survey in twelve countries*. Springer Science & Business Media.
Torgal, L. R. (2012). University, society and politics. In G. Neave & A. Amaral (Eds.), *Higher education in Portugal 1974–2009: A nation, a generation* (pp. 67–87). Springer Netherlands.

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