Universidade de Aveiro Secção Autónoma de Ciências Sociais, Jurídicas e Políticas
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INÊS MARIA DE MATOS PROENÇA

A SUSTENTABILIDADE DO SISTEMA DE INVESTIGAÇÃO PORTUGUÊS: O CONTRIBUTO DA EMPREGABILIDADE DOS INVESTIGADORES DOUTORADOS

CREATING A SUSTAINABLE RESEARCH SYSTEM IN PORTUGAL: THE EMPLOYABILITY OF THE DOCTORATE RESEARCHERS

dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Ensino Superior (Mestrado Europeu Erasmus Mundus em Ensino Superior), realizada sob a orientação científica do Doutor António Magalhães, Professor Associado com agregação da Faculdade de Psicologia e de Ciências da Educação da Universidade do Porto

Dedico este trabalho à minha família e aos meus amigos, que sempre me apoiaram.

o júri

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agradecimentos

"Would you tell me, please, which way I ought to go from here? That depends a good deal on where you want to get to" (Lewis Carrol)

Agradeço bastante a disponibilidade e dedicação do meu orientador, Professor Doutor António Magalhães, que sempre me incentivou a reflectir sobre todas as decisões nas diversas etapas da minha tese, de acordo com os objectivos que me propunha alcançar, dando-me a liberdade para escolher o caminho a seguir e ajudando-me com os seus conhecimentos, as suas orientações, sugestões, conselhos e tempo dispendido. O processo de realização da minha tese foi deste modo um processo bastante agradável de constante descoberta e reflexão.

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palavras-chave

Sustentabilidade, Empregabilidade, Sistema de Investigação Português, Papel do Estado, Investigadores Doutorados

resumo

O presente trabalho propõe-se discutir a forma como a empregabilidade dos investigadores doutorados poderá contribuir para o desenvolvimento de um sistema de investigação sustentável em Portugal e, por conseguinte, o papel do Estado enquanto promotor de emprego e de empregabilidade. Enquanto que, por um lado, as políticas desenvolvidas em Portugal tentam responder da melhor forma aos desafios lançados pela globalização, ao aumento da concorrência internacional em termos de investigação e aos objectivos da Estratégia de Lisboa; por outro, embora haja alguma consistência entre as áreas científicas em que são atribuídas mais bolsas e em que são criados mais empregos, parece haver uma crescente desproporção entre a empregabilidade e o emprego dos doutorados, nos seus números totais. O papel do Estado assume especial relevância na questão da sustentabilidade do sistema uma vez que a sua intervenção no emprego e na empregabilidade, tanto a nível público como privado, influencia em grande escala o sistema de investigação. Para além disso, o sistema de investigação depende, em termos gerais, dos fundos do Estado, que em grande parte têm origem em fundos da União Europeia. É identificado o risco de o sistema não conseguir manter plenamente o seu actual funcionamento no caso de haver um corte naqueles fundos, o que demonstra que o sistema de investigação tem algumas fragilidades a nível de sustentabilidade. A sustentabilidade do sistema de investigação depende de vários factores, sendo certo que a empregabilidade será um deles, pois os investigadores doutorados receberam um investimento na sua formação, por parte do Estado, e esse investimento poderá ser desperdiçado, caso não haja condições e estruturas para aproveitá-lo.

keywords

Sustainability, Employability, Portuguese Research System, the role of the State, Doctorate Researchers

abstract

This dissertation intends to discuss how the employability of the doctorate researchers may contribute to the development of a sustainable research system in Portugal, and therefore the role of the state, while simultaneously promoting employment and employability. While, on the one hand, policies developed in Portugal intend to respond to the challenges of globalization, to the increase in the international competition in terms of research and to the aims of the Lisbon Strategy; on the other hand, although there is some consistency between the scientific areas in which more scholarships are granted and the ones in which more employment is created, there seems to be a growing disproportion between the total number of the doctorates' employability and employment. The role of the state assumes special relevance on the issue of the sustainability of the system since its intervention in the employment and employability, both in the public and in the private sector, largely influences the research system. Besides, the research system depends largely on state funds, having its origin in European Union funds. One can identify the risk of the system not being able to fully keep its current functioning in the case of a cut in funding, which shows that the research system has some fragility in terms of sustainability. The sustainability of the research system depends on several factors, employability being certainly one of them, as doctorate researchers have been the object of state investment, and this pool of talent may be wasted if there are no conditions and structures to use it.

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Introduction

We are in a context of constant change, competitiveness, globalization and adaptation to new realities. In order to face the challenges imposed by globalization and the increasing competition with regard to research, in the era of the so-called "knowledge economies and societies", the European Union decided to take measures to strengthen its research area, the enactment of the Lisbon Strategy being one of them. The European countries have launched their own plans in order to increase their research capacity and try to reach the European targets. Portugal introduced a "Technological Plan" to face the new challenges of modernisation of the country, as a governing measure. The key areas for this aim are, according to the plan, knowledge, technology and research. Governance instruments like the programmes for providing PhD Scholarships or increasing employment for doctorates were introduced through the "Commitment to Science" framework as an operationalization of some of the aims of the Technological Plan. In this context of new policies and changes at different levels (worldwide competition, European guidelines and national policies), in 2005 the Minister of Science, Technology and Higher Education requested a country review, to be conducted by the Organization for Economic Co-operation and Development (OECD), so that this international body could assess the Portuguese Tertiary Education, including a chapter on "Research, Innovation and Internationalization". This report analyzed the multiple aspects of the Portuguese Higher Education and Research System and presented some conclusions, including some areas of concern.

One of these areas of concern was related to the growing supply of highly qualified manpower and the lack of structures and capacity to deal with it:

> 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. The expansion of highly qualified manpower and of research personnel is clearly desirable but it is equally clear that the present structures and rules will need to be changed if optimal economic and social benefits from the increased supply are to be reaped (OECD 2006: 68).

This was the starting point for the design of the research problem of this dissertation. This concern stated by OECD relates to two dimensions: sustainability and employability. The sustainability of the Portuguese research system is a very broad area, affected by many different factors. The aim of this dissertation is to find out whether the employability of the doctorate researchers is one of these factors, and to what extend it contributes to the sustainability and what is the role of the state on this matter.

Therefore I have formulated the following research problem:

"How does the way the state deals with the employability of doctorate researchers at the system level contribute for the sustainability of the Portuguese research system?"

This thesis is divided into four main chapters, and the conclusion. The first chapter presents the conceptual framework and the way the research problem will be discussed, through a brief introduction of the European context and the key issues addressed in this dissertation. The second chapter provides a historical overview with an emphasis on sustainability and policies regarding doctorates and sets out the present design of the Portuguese Research System. The third chapter introduces statistical data on employability and employment of doctorate researchers, as well as an analysis of the main policies in this field. The fourth chapter discusses the data of the third chapter in the scope of the sustainability and elaborates on the claims by the Association of grant-holder researchers concerning their work conditions. Based on the previous data and analysis, conclusions will reflect on the extent to which employability contributes to the sustainability of the system, what is the role of the state and what is the contribution of the governing and governance tools.

As to the methodology, I will use both quantitative and qualitative approaches and I will use secondary data. Concerning the quantitative approach, I will use and interpret existing official statistics about the number of doctorates, employment, scholarships and type of occupation. The qualitative approach will be used in the analysis of policy documents regarding employability and employment.

1st Chapter: Introduction to the Research Problem and Conceptual Framework

Introduction

The main objective of this chapter is to introduce the core of the research problem and main concepts to be used in the study. The European context, as well as the knowledge societies / economies and globalization will be addressed hereby, so that a better understanding of the broader context where the Portuguese research system operates is provided.

I will describe the context (globalization, the European Research Area and the knowledge societies), in which the sustainability of the Portuguese research system is to be currently be perceived. Then, I will define how sustainability will be understood and focus on the main issues regarding sustainability of the Portuguese research system. The concept of "research system" will be defined and explained why I use this concept and not, for instance, "scientific and technological system". I will then define "employability" relating it to the role of the state and how it will be addressed on this dissertation. Finally, I will define what is meant by "researchers".

1. Introduction to the Context and Conceptual Framework

1.1 - Globalization, the European Research Area, the Knowledge Economies / Societies and Sustainability of the Portuguese Research System

The world has been the scenario for changes of power relations, technological advancements, reconstruction, new emerging democracies, regional integration and other processes that became out of control of the nation states alone. Globalisation has had a great impact on higher education and research, being also linked to the emergence of knowledge economies and knowledge societies. According to Weert, the idea of knowledge societies date back to the late 1960s but the term has become fashionable in the last few years and an important target for many governments (Weert 1999: 49). He refers

to social theorists like Daniel Bell, Peter Drucker and Alain Touraine who concluded that "knowledge has become the constituting principle of modern societies" (Weert 1999: 54). It is also becoming a "production factor and a commodity that can be bought and sold" (Weert 1999: 52). This is in line with World Trade Organisation and its General Agreement on Trade Services (GATS), in which Education was included. It is also related to Gibbons Mode 2 (Gibbons et al 1994), which describes an increase in the production of knowledge in the context of application. The production of knowledge is very much connected nowadays to industry and new technological developments. Caraça argues that the scientific and technological knowledge supported the economical growth and social evolution in the last 200 years and are nowadays "integrated elements on the operational ground of the modern societies" (Caraça, 1993: 50). This author points out science and technology as "crucial resources for the functioning of the current economic and social system" and as being "at the same time strongly impelled and conditioned by the needs created by its own societal use" (Caraça, 1993: 50). This is the reason why studying the sustainability of the Portuguese research system is relevant. The sustainability of the research system is linked to the sustainability of the creation of a major factor in the current economies: knowledge.

Indeed the creation of knowledge became a crucial area in which there is much worldwide competition for the best talents and for capacity building. The "Lisbon Strategy", for instance, is a supranational strategy at the European level and comprises a "wide range of initiatives" (Marginson and Wende 2007: 46) with regard to education policy. In the 2000 summit of heads of state and government it was declared that the European Union (EU) should become by 2010 "the most competitive and dynamic knowledge economy in the world" (European Communities, 2004: 6). In order to achieve this goal, the Lisbon Strategy set the target of increasing the investment of its GDP in R&D from 1.9% to 3% by 2010, both from public and private sources.

Although Education was only included for the first time as a competency of the European Union in the Treaty of Maastricht in 1992, "Research and Technology have been part of the Treaties from the beginning" (Beerkens, 2008: 411). According to Beerkens, the European role in research is not as sensitive as the role in education and it might be "explained by the fact that the European dimension in research has been pursued mainly by promoting and (financially) facilitating cooperation" (Beerkens, 2008: 411). Even though,

it was in the Lisbon European Council of 2000 that the European Research Area was formally decided, after the vision launched by the European Commission (Olsen and Maassen 2007: 7). The European Research Area was created with the following main objectives: to achieve a better integration of national research policies, to encourage researchers to work together at the European level, to stimulate co-operation between universities and industry and to lower the political and administrative barriers to that co-operation (Van Vught, 2008: 20). The heads of state decided to take this initiative because of their awareness that "European investments were seriously more limited than those of the USA and Japan" (Van Vught, 2008: 20) and that the creation of the European Research Area (ERA) would be a way to be more competitive and help the development of the 'European Knowledge Society'.

According to Beerkens, the Framework Programmes (FP) constitute the "single most important European action in the field of research" (Beerkens, 2008: 411). Besides the FP, at policy level it is also important to point out the role of other European Programmes that have an impact on the domain of research, "particularly the regional and social policy activities funded by the EU structural funds" (Van Vught, 2008: 19). Indeed research is not limited to the policies developed particularly regarding this field. Van Vught also mentions some organizations that are especially relevant for research at the European level: "the research and technology policy domain in Europe is a comprehensive multi-actor environment, in which a multiplicity of 'intergovernmental' associations and organizations exists".(Van Vught, 2008: 20), for instance the European Space Agency (ESA), the European research center for particle physics (CERN), the European Molecular Biology Laboratory (EMBO) and the European Science Foundation.

Despite all the efforts and policies aiming at the development of research in Europe, the Lisbon Strategy is not being able to reach its targets. According to Van Vught, "the 3% GDP target for 2010 appears to be very hard to reach" and the "'knowledge gap' between Europe and the USA is large and appears to be growing" (Van Vught, 2008: 23). The author highlights the gap between the rhetoric about knowledge society and the "realities of budgetary and other priorities". Europe is being the scenario for a number of changes and new policies regarding Higher Education and Research and the consequences of these are still hard to predict. The European Commission itself assumed the fact that the

targets of the Lisbon Strategy are not being met, in the Mid-Term Review of the Lisbon Strategy:

> [t]oday, there is general consensus that Europe is far from achieving the potential for change that the Lisbon strategy offers. While both the diagnosis and the remedies are not contested, the reality is that not enough progress has been made (European Commission, 2005: 7).

In this mid-term review, the target of the 3% GDP was maintained, although more emphasis was put on growth and jobs, being actually education and training one of the key areas defined. According to the European Commission, "[p]rogress towards the Lisbon target for EU research and development spending (3% GDP by 2010) is largely in the hands of Member States" (European Commission, 2005: 22).

In 2008 a new cycle of the Lisbon Strategy was launched and in a Communication of the European Commission from December 2007 it is possible to read that:

> Whilst Member States have set targets committing themselves to significantly increasing R&D investments which would help the EU approach its 3% of GDP target by 2010, the evidence does not yet reflect this ambition (European Commission, 2007: 6).

Sustainability itself has therefore to be understood in a context in which investing in the creation of knowledge and advancement in individuals' education and qualifications is crucial for the development of the economy. It is also a context within which Portugal, as part of the EU is adopting the Lisbon Strategy and is trying to reach its targets through the current national policies. The European context, as explained, is in itself a context in which Europe tried to reach certain targets to overcome the USA as a leading research area in the world. The sustainability at national level is therefore also related to a complex supranational Strategy and context, besides the national policies.

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1.1.1 - The Sustainability of the Portuguese Research System

The concept of sustainability is not an easy one to define, since it depends much on the field (be it research, agriculture, finance, economics, business, tourism, etc.). One of the most well known and used definitions of sustainability is the one used by Brundtland in the 1987 report of the World Commission on Environment and Development "Our

Common Future": "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The definition of 'sustainable' in the Oxford Advanced Learners Dictionary is: "that can be kept going or maintained" (Oxford Advanced Learners Dictionary, 1995: 1205), which can be understood as something that can be maintained indefinitely with the existing resources. According to the World Conservation Union, there are three main pillars for sustainability: economic growth, environmental protection and social progress. UNESCO adopted also a fourth pillar form the "Gross National Happiness" concept, which is Culture.

In this work, I will be addressing sustainability essentially in economic and social terms. The Portuguese state is funding the creation of highly qualified human potential, the employment for this potential in the public sector and the encouragement of employment in the private sector. This may not be economically sustainable, especially because Portugal is very dependent on external funding, mainly from the EU (ERAWATCH, 2008). I am not arguing for a radical solution for the economic sustainability, for instance the total interruption of PhD scholarship schemes. I am for social sustainability in the sense that it is important that the state invests in the advancement of people's education, because of the indirect social benefits this will bring to the country and because knowledge is assuming the role of a major economic factor for the advancement of the country. Moreover, the "pursuit of knowledge for its own sake is an objective (…) because it is often unclear in advance whether a particular line of research might have practical benefits" (Barr, 2003:322). In this sense the PhD scholarships provided for Portuguese students might, *per se*, be a way of increasing knowledge, and this knowledge does not have to be restricted to the needs of the researchers' labour market. However, this investment should be in line with the capacity building in the research system, to support the growth of human capital, and in line with the dimension and specificities of the system.

ERAWATCH is a public service for the support of European Research Policy that maintains inventories of the EU Member-states' research systems' profiles. It presents some challenges for the current research policies in Portugal, most of them related to sustainability concerns. The inventory was updated in the website on the 8th of December of 2008 (downloaded on 11th February 2009) and was based on sources such as the Portuguese Science and Higher Education Observatory (*Observatório da ciência e do Ensino Superior*), the Support Offices for Industrial Property Promotion (*Gabinetes de*

Promoção da Propriedade Industrial) and the Portuguese Research Liaison Office. The challenges are related to the sustainability of science growth, the internationalization, the stimulation of R&D performance in the private sector, the coordination with societal needs, the development of a sustainable and coherent research system, the balance between supply and demand for new scientists and finding alternatives to a possible decrease in EU funding. With regard to the first challenge, "sustainability of science growth", ERAWATCH points out the increase in the number of internationally refereed publications by Portuguese scientists as a result of the investment in the training of young scientists, namely through PhD grants since the late sixties. The number of internationally refereed publications has been growing at a two-digit annual rate. At this pace in one decade Portugal will have the same level of scientific publications per million inhabitants as the US or the average of the European Union. ERAWATCH highlights the "critical need to find proper resources (financial, political and through stakeholders' involvement) to guarantee the sustainability of the path that has been followed" (ERAWATCH, 2008). The challenge for sustainability in this case is linked to the necessary resources to maintain the level of publications that is being reached. The second challenge pointed out by ERAWATCH is related to internationalization of the Portuguese science as a response to globalization. According to ERAWATCH successive governments have been mentioning the enlargement and deepening of the involvement of Portuguese organizations in the Framework Programme as a political challenge. It is recognized that important steps have already been taken through the PhDs trained abroad who have been integrating existing networks and establishing links with foreign academics, and through agreements with leading US universities like MIT, Carnegie-Mellon, Texas at Austin, Stanford and Harvard. The third challenge is the stimulation of R&D performance in the private sector. ERAWATCH recommends that "investment and allocation of funds for industrial R&D shall increase, and the R&D outcomes shall be materialized in patents and technological advancements". This is related once again to sustainability, since the state, besides funding the R&D in the public system also has to give financial incentives to the development of the R&D private system. The fourth challenge, the "Coordination with societal needs" comes in line with my definition of sustainability not only in economic but also in social terms. ERAWATCH points out once again the lack of clear agenda for research by the private sector, and therefore "most of the research promoted within universities and public

labs has had a strict academic focus" (ERAWATCH, 2008), which will be the object of further elaboration (see bellow), when focusing on research in the context of application and Gibbons mode 2 of knowledge production. The fifth challenge, the "development of a sustainable and coherent research system" and the sixth challenge, "Balancing the supply and demand for new scientists" are presented by ERAWATCH as closely connected. They are of extreme relevance for this work, the fifth challenge being the one I am trying to respond to, by using the perspective of the employability of doctorate researchers.

In what concerns the development of a sustainable and coherent research system, ERAWATCH considers that important steps have been taken in that direction over recent years through the "creation of proper mechanisms for funding and evaluating university research teams on a regular basis". Therefore one may conclude that funding and evaluation are other factors that contribute for the sustainability of the system. The declining of the public labs is mentioned as well as the announcement of the reform of the public labs system, which "entails the closure of some of the existing labs (namely the Industrial Technology Lab INETI), the merger of others, and the creation of new ones". According to ERAWATCH, it also provides for "the establishment of medium-term consortia that will involve public labs, associated labs (*LaboratóriosAssociados*) and the universities". As was already mentioned, the challenge of balancing the supply and demand for new scientists is related to the challenge of the sustainability of the research system. It is argued that "the supply of new PhDs has grown steadily over recent decades", and this is regarded as a positive situation in its nature (probably due to the social benefits of the advanced training) but has created, according to ERAWATCH an important imbalance.

According to this source, the Portuguese research system has not been able to absorb the new doctorates and therefore many young PhDs have been seeking work abroad. A programme has been established for stimulating the employment of PhDs, under the "Commitment with Science" (*Compromisso para a Ciência*) as will be explained in more detail further on, and through it "medium-term contracts have been offered typically involving the new scientists as post-doctoral researchers in existing R&D labs" (ERAWATCH, 2008). This measure is seen as having possible positive short-term effects in increasing publication rates. However, according to ERAWATCH it will "not be able to sustain a long-term development of the research system". The last challenge is also

related to sustainability in economic terms. ERAWATCH recommends that Portugal finds alternatives to a possible decrease in EU funding. It is argued that there may be a "decrease in the amount of EU structural funds available for science in the medium/long term". Portugal has been relying strongly on EU structural funds grants and "there are grounds for concern about what might happen afterwards". Thus, research policies need "to find alternative sources of funding in the context of the annual public budgeting exercises".

If we take into consideration the recommendations of ERAWATCH, it is possible to conclude that the sustainability of the research system will be attained if the system becomes more economically independent and at the same time responsive to social needs. The research system will also be sustainable if the country does not depend so heavily on the EU funds to operationalize most of the activities of the research system. Indeed, according to the ERAWATCH inventory, the contribution of European funds for national research is very significant, corresponding to an average of 26% of the national R&D budget:

> (…)the funds originated in EU sources were Euro 360 million in 2007, Euro 346 million in 2008, and Euro 560 million in 2009. These figures are equivalent, on average, to 26% of the national R&D budget in the period 2007-2009 (ERAWATCH, 2008).

All these issues reflect a real problem related to the sustainability of the research system. It is relevant to highlight also the last topic, since this "possible decrease in EU funding", in which the Portuguese state relies so much, will bring consequences if the state does not find other alternatives. As the state is the major actor in the coordination and funding of the research system, I will try to analyze how the way the state deals with the employability of doctorate researchers at the system level can contribute for the sustainability of the system.

1.2 –The concept of Research System

It is important to clarify what is hereby understood by a research system and why this concept is used instead of "scientific and technological system", which is present in some literature, for instance *Do saber ao fazer: porquê organizar a ciência*, by Caraça.

According to the Dictionary of Business and Management of the University Press, any kind of system is generally speaking an "assembly of components or elements connected together in an organized way to produce outputs; the components of the assembly are affected by being in the system and the behaviour of the system is changed if any component leaves it" (A Dictionary of Business and Management of the University Press). Research is, in turn, according to "A Dictionary of Education" of the University Press, "the systematic search for answers to certain questions, often using empirical evidence but also using logical arguments and reflection on social understandings. The search may aim at discovering facts, putting forward theories, increasing understanding, and/or changing practice" (A Dictionary of Education of the University Press). Another concept is that of Research and Development, rather than Research alone. "Research and development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD Factbook 2008: Economic, Environmental and Social Statistics, online version available at http://masetto.sourceoecd.org/vl=6689095/cl=15/nw=1/rpsv/factbook/070101.htm). Caraça also uses this definition of R&D and adopts the distinction of the OECD's Frascati Manual of 1981 to highlight the three mains categories of R&D activities (Caraça, 1993: 68-69). In the Frascati Manual of 2002 the definition is the same: "basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view" (OECD, 2002: 30); "applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective" (OCED, 2002: 30); and "experimental development is systematic work, drawing on knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed". (OECD, 2002: 30). The basic research was denominated by Gibbons as "mode 1" and the applied research was denominated as "mode 2" type of research (Gibbons et al 1994).

A research system can be generally defined as the assembly of components or elements connected together in order to produce knowledge that may be used to devise

new applications. The components of the system and the system interact in such a way that the components are affected by being part of the system and the system is influenced by any change in the components. These components are thus the structure behind the creation of knowledge. In this line of thought, the creation of knowledge is the main aim of any research system.

The Portuguese research system is composed of a private sector and a public sector. When we talk about private sector we are mainly referring to research carried out in enterprises, while the public sector is usually divided between the research carried in the universities and the research carried in the public laboratories. The private sector does not have still a strong role in the system and in the public sector some changes have happened in the last years about the role of the Public laboratories and the Universities, as will be shown later.

Caraça uses the concept of "scientific and technological system" rather than "research system" since in his perspective science and technology are nowadays very closely connected. On the one hand "the advancements on science depend in large scale on the invention of proper scientific instruments" (Caraça, 1993: 67), and on the other hand "the application of scientific knowledge impelled strongly the technological level of the organizations and societies that experienced it" (Caraça, 1993: 68). Science is defined by Caraça as the "whole of the organized knowledge over the mechanisms of causality of observable facts, obtained through an objective study of the empirical phenomena", while technology is the "whole of the scientific or empirical knowledge directly applicable to the production, improvement or use of goods and services" (Caraça, 1993: 68). Caraça uses the UNESCO definition of a scientific and technological system at the national level as the articulated set of the scientific and technological resources (human, financial, institutional and of information) and of the activities organized with the aim of discovering, inventing, transferring and fomenting the application of scientific and technological knowledge, for the achievement of national objectives in the economic and social fields (Caraça, 1993: 71). R&D is very connected to the scientific and technological system, since it is part of the system. This means that a "research system" is indeed an integrating part of a broader scientific and technological system.

I choose to use the concept of research system because I am particularly interested in the research activities rather than on the broad concepts of science and technology.

These concepts might encompass many more activities, for instance technical consultancy, quality control, specialized medical care, services in botanic gardens, museums and natural reserves and many other activities under the category of "other scientific and technical activities" that are part of the science and technology activities (Caraça, 1993: 69). According to the Frascati Manual, "in certain cases, the theoretical criteria for distinguishing between R&D and related scientific and technological activities are particularly difficult to apply", because "institutions or units of institutions and firms whose principal activity is R&D often have secondary, non-R&D activities" (OECD, 2002: 38-39). Thus, we may sometimes refer to the scientific and technological system, but keeping in mind that our main focus is on the research system itself.

It is also important to clarify the concept of researcher. According to Caraça, and in line with what was said about the research system as being part of a wider science and technology system, there are different types of professional categories of human resources allocated to research and development besides the researchers, like for instance the technicians and the assistants (Caraça, 1993: 128). Caraça, in his work comprises the whole of the human resources allocated to R&D. However, for the same reason I use the concept of "research system" rather than "scientific and technological system", I will use the concept of "researcher" rather than discussing the whole of the R&D human resources. Even though all the professional activities in R&D are important, for the purposes of this thesis I am particularly interested on the researchers. They assume a crucial role, since "they are the responsible for the conception and creation of new knowledge, new products and processes" (Caraça, 1993: 128). Researchers are, according to ERAWATCH, "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned" (ERAWATCH, 2008).

In our study the focus is on fulltime doctorate researchers, nevertheless sometimes we might refer to researchers in general always making the distinction clear.

1.3 - Employability and the role of the state

Employability is a concept that has been in the literature for many years, although "the term is used in a variety of contexts with a range of meanings and it can lack clarity

and precision as an operational concept" (Hillage and Pollard, 1998: 1). Hillage and Pollard conclude, after a review of the literature, that employability "is about work and the ability to be employed" and "for the individual, employability depends on the knowledge, skills and attitudes they possess, the way they use those assets and present them to employers and the context (e.g. personal circumstances and labour market environment) within which they seek work" (Hillage and Pollard, 1998: 2). According to "A Dictionary of Education", employability is "the extent to which an individual possesses the skills and qualities required by employers in a suitable employee ". Employability is therefore much related to the individual and its potential for being employed. The potential for being employed depends on the individual's 'employability assets', which "comprise their knowledge (i.e. what they know), skills (what they do with what they know) and attitudes (how they do it)" (Hillage and Pollard, 1998: 2). When we talk about the employability of doctorate researchers we are therefore talking about their potential to be employed, and when at the system level there are policies related to the improvement of employability, this can be understood as policies to increase the doctorates' potential to be employed, through the provision of knowledge and skills assets (while attitudes are in general more about the individual himself).

In Portugal, both ERAWATCH and OECD highlight the issue of the employability of doctorate researchers and link it to matters of sustainability, as discussed above. According to ERAWATCH, "the fact that the supply of new PhDs has been in excess of demand created an employability problem, which has been addressed through the offer of medium-term contracts (3 to 5 years) to young researchers in R&D organizations" (ERAWATCH, 2008). The policies that have been undertaken recently comprehend measures to stimulate the employment of doctorate researchers both in the public and the private sector, through the "Commitment with Science" programme. The target of this action is that between 2007 and 2009 1000 doctorate researchers will be employed (Commitment with Science Website). According to the numbers in the FCT website, in the first edition of the programme in 2007 625 vacancies were filled, and for 2008 and 2009 there were therefore a few more than 300 vacancies left (FCT Website). It is clear from these numbers that even if this Programme employs 1000 doctorates between 2007 and 2009, this number is much lower than the number of PhDs that are being concluded

annually. We will analyse this situation in more detail and through the different areas of knowledge on the third chapter.

According to Ruivo, there has been a change in the relative importance of the state sector (I use the designation "state sector" because it was originally used by the author, meaning the public laboratories) and the higher education sector in terms of the evolution of human resources (Ruivo, 1998: 162). While in 1967 56.8% of the full time researchers were working in the state sector (Public Laboratories), in 1988 only 20.9% of the researchers were assigned to this sector (Ruivo, 1998: 162). The higher education sector represented in 1967 23.6% of the full time researchers, while in 1988 the figures point out to 63.8% (Ruivo, 1998: 162-163). Indeed, this trend became stronger and nowadays the higher education sector is still the one with more fulltime researchers, since 90% are assigned to public universities (OECD, 2006: 68). However, and as it will be explained in more detail in the next sections, the private sector does not perceive the benefits of employing doctorate researchers. Thus, the state is at the same time the main provider of high qualified manpower, through PhD scholarships (and therefore the main stimulator of employability) and the main creator of employment places for the doctorate researchers, since the private sector is not receiving them. Besides, it is also the state that is funding the programmes to increase employability and employment in the private sector. An example for the stimulation of employability is the PhD scholarships in entrepreneurial context. In this case, and according to the Innovation Agency (*Agência de Inovação*), the monthly scholarship is paid in equal parts by the FCT and the company where the PhD student is developing his work, and the other types of subsidies (subsidy for the presentation of work in scientific meetings, subsidy for the graphic execution of the thesis and subsidy for the payment of tuition fees) are supported by the FCT (Innovation Agency website, FCT website). In the case of the subsidy for tuition fees, they are paid by FCT directly to the University (Innovation Agency website, FCT website). An example of the role of the state in the promotion of employment is the programme for employment of 1000 doctorates between 2007 and 2009 within the "Commitment to Science" framework (Commitment to Science Website), since it is open not only for the public but also for the private sector, as will be explained in the third chapter.

1.3.1 - The European Charter for Researchers

With regard to the issue of employability and its relation to sustainability of the Portuguese research system, one should not forget the European context and European Institutions' guidelines. In March 2005 the Directorate-General for Research of the European Commission adopted a set of recommendations concerning duties and rights of the researchers as well as a code of conduct for their recruitment. It was based on the principle that "sufficient and well-developed human resources in R&D are the cornerstone of advancement in scientific knowledge, technological progress, enhancing the quality of life, ensuring the welfare of European citizens and contributing to Europe's competitiveness" (Directorate-General for Research 2005: 4), the European Charter for Researchers is an important step towards the improvement of European scientists working conditions. It aims at improving the recruitment and making the selection procedures more transparent, and it suggests ways of assessment. If taken seriously by the member-states, funders, employers and researchers, this charter may make the research careers in Europe more attractive. However, according to the European Commission, "take-up of the voluntary Charter and Code has been limited so far" (European Commission, 2008: 3).

Final Comments

National policies concerning the research system have been developed according to a process organized to respond to the targets of the Lisbon Strategy and the demands of the knowledge economies and worldwide competition in the creation of new knowledge. As the system is expanding using new potential that has been created by PhD scholarships, the issue of sustainability arises, since the employability of the new highly qualified researchers may be affected by a possible lack of capacity in the country to create employment. Besides, the investment in research by the private sector is still very low in Portugal. The state is the main funder of almost all activities in the system, including the incentives for the private sector. Moreover, the funds presently used by the Portuguese state for the research system come in great part from EU funds. A possible cut in these funds can have important consequences if the system does not find alternatives for its sustainability.

2nd Chapter: Historical overview and present design of the Portuguese research system

Introduction

The main objective of this chapter is to provide an overview of the historical and current situation of the Portuguese research system. The historical overview aims at understanding how the system has developed and its specificities as well as the specificities in the context of the Portuguese society. The type of society and the type of system frame the political decisions regarding sustainability.

I will provide a brief historical overview of the Portuguese research system with an emphasis on the PhDs training. I will describe the current situation of the research system and develop the argument that the state plays a crucial role in the system, being simultaneously the major provider of employability and employment for the doctorate researchers.

1 – Historical Overview

For our study it is of extreme relevance to analyze how science and research developed, especially in the second half of the last century to have a better understanding of the particular current characteristics of the system, how it has developed and the characteristics of the society where it is located. This is essential to understand the policies that are being undertaken and to understand, given the characteristics of the Portuguese society and state, what would be acceptable or not to do in order to reach the sustainability of the system.

Although the first universities in Europe were founded in the medieval age, they did not represent the development of science and research, being very different institutions from the universities as we know them nowadays. In the beginning universities were functional institutions for the transmission of knowledge and for serving the interests of certain groups, incompatible with the research and seeking of knowledge that would only begin with the modern universities. The first university in Portugal was created in Lisbon in 1290 (and later on transferred to Coimbra) and like the other Medieval Universities in Europe it was a "corporation whose function was the transmission of accumulated knowledge and whose aim was to produce officers to work for the King or the Church" (Caraça, 1998: 42).

In Portugal the modern discourse regarding the higher education system only took place after it became a Republic in 1910. In fact, until 1911 there was only one University in Portugal, the University of Coimbra, and it was in this year, with the Republican regime that two other universities were created in the country: the University of Lisbon and the University of Porto. "The modern narrative, political integration by the state of the higher education institutions and the statement of institutional missions according to the modern public narratives of universities (introducing Humboldtian inspiration)" are, according to Magalhães the three components that combined together allow us to talk for the first time about a higher education system in Portugal (Magalhães, 2001: 241-242). It was also by this time that science was officially recognized as one of the core functions of the University and its members, through the "New University Constitution" in 1911.

Before modern times research and science were developed in a very loose connection with the universities. In Portugal several Academies were founded during the 17th and 18th century, being the Royal Science Academy of Lisbon (denominated Science Academy of Lisbon after the Republic was implemented) one of the most important. These Academies were in general focused on the humanities although they had some scientific concerns (*Instituto de Camões, Ciência em Portugal* webpage). However the Academies have experienced many difficulties. The political and economical situation of the country was not favourable, due to the instability created by the French invasions between 1807 and 1811, then the liberal regime and the civil war of 1832-34. Besides all that was mentioned, while most of Europe was already in-depth in the industrial revolution, most of the Portuguese economy was still based on the agriculture (Magalhães, 2004: 236). One can actually only speak about an industrial structure in Portugal after 1881, almost in the 20th century.

The Portuguese Public Laboratories were founded in the 19th century with an initial research focus on agriculture and health (Magalhães, 2001: 328). However their institutional development has only taken place during the "*Estado Novo*", the dictatorial regime in Portugal that lasted from 1926 until 1974 (Resolution of the Council of Ministers, n. 198/2005, 2nd December 2005).

In the end of the 19th century and beginning of the 20th century Portugal went through some economical and political instability that made it more difficult for science to advance. In 1926 there was a military coup that led to the creation of a Corporative state in

1933. The period between 1926 and 1974 is known as “Estado Novo” and its authoritarian character, that by 1926 seemed to be “a remedy for the apparently never-ending instability” (Magalhães, 2001: 248), ”deeply marked and in many ways still marks, the development of the country and its higher education system and institutions” (Magalhães, 2001: 248). It was in this period, between 1933 and the end of the 1950s, that the Public Laboratories expanded their activity to all the sectors of economic activity, having maintained its shape since then until recently (Ruivo, 1998: 169). They were “mainly active in applied research, and at a political level they were supposed to serve the industrialization process” (Magalhães, 2001: 328). However, the Public Laboratories were characterized by “short term policies, directed to clear objectives and modest investments in science and technology” (Resolution of the Council of Ministers, n. 198/2005, 2nd December 2005, my translation).

The Portuguese Research System is according to Ruivo characterized by the central position occupied by the Public Laboratories in the system as well as its pluralist global organization (Ruivo, 1991: 25). Research tended to be mainly carried out in governmental departments and institutes rather than in the Universities (Magalhães, 2001: 326). According to Magalhães, the political and administrative centralism “places the state in control of knowledge production in general and also of the input of the latter into economic development in particular” (Magalhães, 2001: 326). The organization of the system can be regarded as pluralist, since “research did not, and does not, depend upon only one Ministry, assuming, instead, a plural tutelage, including, for instance, the Ministry of Education, the Ministry of Agriculture, Industry, Health, etc.” (Magalhães, 2001: 326).

The Public Laboratories were the main actors, in terms of expenses of R&D in the country, during a long time. It happened, as in other European periphery countries due to the strong tradition of direct state intervention in the production of knowledge (Ruivo, 1998: 168). Actually, another feature that according to Ruivo may also be found in other very interventionist states (Ruivo, 1998: 170) was a state institute for basic research more close to the universities, the Institute for High Culture *(Instituto de Alta Cultura)*, that after the 1960s assumed an important role in the development of scientific research in Portugal, “mainly by creating new research centres and grants to provide for research training abroad” (Magalhães, 2001: 328). However the research done in the universities was not very influenced by the Institute, since it was structured in an individual and fragmented

basis, lacking connection between faculties of the same university and even different sections of the same school (Magalhães, 2001: 328).

The "Estado Novo" was ideologically characterized by the Catholic and ruralistic components of the political actions (Magalhães, 2001: 249). Indeed, Salazar, the President of the Council between 1933 and 1969, "mistrusted the industrial development and urban cosmopolitan ways of life" (Magalhães, 2001: 250). Mass education was also not an objective in this political period. The country was getting gradually internationally more isolated and the gap between the advancements in terms of science and technology was growing bigger in comparison with other European countries, especially before the 1950s.

Despite all that was referred concerning "Estado Novo", from 1945 on, "strong international and national pressures were felt to introduce some aspects of modernization" (Magalhães, 2001: 260). Indeed, after the Second World War, the United States of America had an important role in helping the reconstruction of the European scientific basis, fomenting cooperation models (Ruivo, 1998: 91). According to Ruivo, by that time the two main objectives of the USA external policies were to prevent intra-European hostilities and to face the possible threat of political intervention and Soviet military invasion during the "Cold War" (Ruivo, 1998: 92-93). Both objectives led to the creation of OECD (at the beginning called "European Organization of Economic Cooperation" and from 1961 on, "Organization for Economic Co-Operation and Development") in 1948 and NATO ("North Atlantic Treaty Organization") in 1949 (Ruivo, 1998: 93). The former was created with the objective of distributing funds of the Marshall Plan to help European countries to reconstruct their economies (Ruivo, 1998: 99) while the latter was created to provide a common defence (Ruivo, 1998: 93). Portugal benefited from the influence of international organizations in the diffusion of scientific policies. For instance, NATO with its Scientific Committee helped develop the scientific basis, through training of researchers (through scholarships) and basic research that would have an impact in the long run (Ruivo, 1998: 93; 280) and OECD influenced through its studies and analyses of the Portuguese situation (Ruivo, 1998: 280; Caraça, 1993: 178). Other Organizations like the United Nations, UNESCO and later the European Communities (which we will further discuss in more detail) helped create a culture of scientific policy in Portugal (Ruivo, 1998: 280).

For a long time the Portuguese research landscape was characterized by the low percentage of doctorate researchers (Ruivo, 1998: 163). Indeed, Ruivo highlights the migration of Portuguese students to foreign universities, especially in the United Kingdom, since the middle 1960s until the early 1970s (Ruivo, 1998: 163). The Calouste Gulbenkian Foundation, the Luso-American Foundation, the Institute of High Culture and NATO assumed a very important role in providing PhD scholarships for these students (Ruivo, 1998: 163).

An important step for the Portuguese Research System was the creation in 1967 of the JNICT, the National Foundation for the Scientific and Technological Research (*Junta Nacional de Investigação Cientifica e Tecnológica*), that started operating fully in 1969 after the nomination of its first president (Ruivo, 1998: 218). The main functions of JNICT were the planning, coordination and promotion of the scientific and technological research in Portugal (Ruivo, 1998: 218). It was then, for the first time, that the Portuguese state took clearly "the task of co-ordinating and managing science and technology" (Magalhães, 2001: 328). However the scientific and technological research would only become formally recognized by the Parliament as a national political priority about 20 years later, in 1988 (ibid.). JNICT worked under the supervision of the Presidency of the Council of Ministers until 1975, being afterwards integrated at times in ministries responsible for Economy and at other times in ministries responsible for Culture (Ruivo, 1998: 218).

The 1970s were "characterized by a reform promoted by the Minister of Education at the time, Veiga Simão. The 'Law of the Bases of the Educational System of 1973' was passed and the expansion of the higher education with the creation of the New University of Lisbon, the University of Aveiro, the University of Minho and the Catholic University, and the regime of concession of equivalence to the doctor degrees obtained abroad" (Heitor et al, 2004: 260). In fact, this Minister promoted not only the expansion but also the diversification of the higher education system, at a geographical and institutional level (Magalhães, 2001: 270). Besides new public Universities, there was also the creation of public institutes, polytechnics, and high schools all over the country (Magalhães, 2001: 270). It is important also to highlight the creation in 1971 of the first 'private' University in Portugal, the Catholic University (Magalhães, 2001: 270). Also "the academic career was reviewed and revised, improving the working conditions of the academic staff" (Magalhães, 2001: 271). Indeed, Heitor et al, referring to the field of engineering (and this

would probably apply to all fields of knowledge) state that the awarding of equivalence to the doctoral degrees obtained abroad contributed to the rejuvenation of the professors (Heitor et al, 2004: 260).

In what concerns the PhDs, JNICT has created a scholarship programme for technical specialization that was cancelled in 1974 (Ruivo, 1998: 235). NATO's scholarship programme was still very important for the training of researchers abroad, namely in basic research, although the official Portuguese discourse was mainly focused on applied research (Ruivo, 1998: 235).

In 1974 the democratic Revolution brought changes in terms of the organization of the research system, namely with regard to Public Laboratories. These were reorganized, having its activities and outcomes "articulated with economic needs and sectorial policies" (Magalhães, 2001: 328).

The lack of continuous and organized coordination, as well as the development of the universities and their own R&D structures since the late 1970s contributed for the evolution of the Portuguese research system under a "very disperse organizational model" (Magalhães, 2001: 326).

The Public Laboratories lost their central role in the Research system, mainly due to the creation of new universities in 1973, which were linked to the regions where they were located, and started to assume an active role on research (Magalhães, 2001: 330). Besides, the creation of Master and PhD programmes in the 1980s also incremented the research undertaken in the universities (Magalhães, 2001: 330).

The Institute for High Culture (*Instituto de Alta Cultura*) was reorganized in 1978, changing its designation to National Institute of Scientific Research (*Instituto Nacional de Investigação Cientifica* – INIC).

In the period between 1978 and 1985 "NATO's scholarships lost their importance in terms of training of highly qualified human resources" (Ruivo, 1998: 249). JNICT created a programme of Technical Assistance Scholarships, which had nevertheless a very small dimension (Ruivo, 1998: 249).

It is important to refer that since the 1980s the universities and the Public Laboratories "have enhanced the creation and development of interface institutions between research and enterprises", but the "Portuguese economic agents do not appear to have the same pattern of attitude towards R&D and science and technology transfer that one can find in

the core countries nor does the economy have the structures that such articulation involves" (Magalhães, 2001: 327). Ribeiro also states that the Portuguese Universities have been creating connections more easily with European companies than with national ones (Ribeiro, 1998: 48). Caraça also refers to the lack of effort of the private sector over the development of research, when compared to central countries. This author highlights the crucial role of the state in this domain, since it is the state that "assumes the substantial funding of the growth in R&D activities while it also has to stimulate and encourage the private investment in science and technology through appropriate funding mechanisms" (Caraça, 1993: 132).

A crucial step for the development of the research system was the adhesion of Portugal to the European Communities in 1986 (Ribeiro, 1998: 48). According to Caraça, it was the start of "a new period in the development of the scientific and technological system" (Caraça, 1993: 156). This author refers to the substantial financial resources mobilized for the support of R&D activities. Caraça highlights the Framework Programmes for research and technological development (Caraça, 1993: 156). These were "directed for the support of excellence R&D activities accomplished through inter-institutional and transnational cooperation" (Caraça, 1993: 156). From 1990 on, the Community Support Framework played an important role, especially through the CIENCIA programme, which is a specific programme for the "support of research infrastructures in priority domains" (Caraça, 1993: 156-157). According to Caraça, "the intervention of the programmes that were co-funded by structural funds is not limited (…) to the physical infrastructures", PRODEP, CIENCIA, PEDIP, PEDAP and STRIDE are active in the areas of training, innovation and support to networking (Caraça, 1993: 157). According to Ribeiro, these programmes constituted a significant contribution to the internationalization of the Portuguese scientific and technological system (Ribeiro, 1998: 48). This author states that in the first (1984-1987) and second (1987-1991) Framework Programmes for research and technological development, beyond of the financial support, the Portuguese scientific and technological system also benefited from the "integration in European networks, the access to new areas of research, the creation of critical masses and a level of excellence in research and the reinforcement of contacts with foreign centres". Besides, in 1987, an important "Human Resources Training Programme" started. "JNICT became the most important agency for scholarships, providing around 700 scholarships in that year, which represented a

quantitative and qualitative change, while INIC, INVOTAN and the Calouste Gulbenkian Foundation provided less than 80 in that year" (Ruivo, 1998: 270-271). The main guidelines of this programme were the substantial increase of the number of researchers, the transnationalization of education and science and technology and the possibility of the applicants not being connected to any institution, unlike before (Ruivo, 1998: 270-271). According to Ruivo, the fact that researchers that were not linked to an institution could receive a scholarship has contributed to the availability of more qualified individuals for the scientific and technological market (Ruivo, 1998: 270-271). The scholarship holders were provided with some degree of protection through the "Scholarship Holder Statutes", which stated their duties and rights. The intention was to improve the human resources in the private sector, especially enterprises, to help develop there research units (Ruivo, 1998: 270-271). For the first time there were scholarships for students holding the *licenciatura* degree, allowing them to carry out research earlier before, and also post-doc scholarships (Ruivo, 1998: 270-271). Scholarships for the improvement of assistant personnel were also foreseen (as has already happened before, in the Programme of Technical Specialization) (Ruivo, 1998: 270-271). In summary, these were the types of scholarships provided:

- "Scholarships for young researchers", for higher education students carrying research as team members, applied to all fields;
- "Scholarships of scientific research, for *licenciatura* holders, to allow them to integrate in research projects in the country or preferably abroad, preparing post-graduate studies – masters and PhDs;
- "Scholarships for Specialization in Science and Technology", for technical and assistant personnel and short-term for researchers;
- "Post-doc scholarships" (Ruivo, 1998: 270-271).

In 1989 a new programme for the support of advanced training was released, the "Programme for the Advanced Training of Human Resources", financed by the European Social Fund (Ruivo, 1998: 270-271)

Portugal has significantly increased its involvement, especially in financial terms, in the III Framework Programme (1991-1994) (Ribeiro, 1998: 51-51). The IV Framework Programme (1994-1998) has integrated new areas of activity, such as, the research on the European transports policy and oriented socio-economic research, and social sciences were for the first time included (Ribeiro, 1998: 51-51). The V framework programme (1998-2002) "differs considerably from its predecessors" (Fifth Framework Programme Website). According to the European Commission "it has been conceived to help solve problems and to respond to major socio-economic challenges facing Europe" and "it focuses on a

limited number of research areas combining technological, industrial, economic, social and cultural aspects” (Fifth Framework Programme Website). The VI framework programme (2002-2004) differed from the other framework programmes in the sense that all the projects had to be transnational and in terms of focus it dedicated special attention to small and medium enterprises without adequate research capacity, so that they could profit from research activities carried out by research performers (research institutes, universities, etc.) (European Commission, “The Sixth Framework in Brief”). The Seventh Framework Programme, which is currently in force (2007-2013) aims at furthering the construction of the European Research Area, through the following goals: to gain leadership in key scientific and technology areas, to stimulate the creativity and excellence of European Research, to develop and strengthen the human potential of European research and to enhance research and innovation capacity throughout Europe (Seventh Framework Programme Website). The budget for the seven years of the FP7 is 54 billion Euros. This programme assumes that knowledge is the Europe's greatest resource and tries to build more connections between research and industry through the "Technology Platforms" and "Joint Technology Initiatives". It also includes the creation of the European Research Council which funds the best European research activities, promoting excellence. FP7 is divided into 4 specific programmes: "Cooperation", "Ideas", "People" and "Capacities". "Cooperation" emphasizes the funding of transnational research activities through priority areas; "Ideas" focuses on 'frontier research' and is a competency of the European Research Council; "People" supports the mobility and career development of the researchers; and "Capacities" is focused on improving infrastructures and facilities for the accomplishment of better research, and also on "regional clusters" and research for and by small and medium enterprises (SMEs). Hence, clearly the Portuguese research system has been benefiting much from the Community Support Framework and European Research Framework Programmes.

After JNICT has been dismantled, the research policies have been coordinated at the central level by the Ministry of Science and Technology. This Ministry organized its coordination and support for research activities within the framework of a Foundation for Science and Technology (*Fundação para a Ciência e Tecnologia*) (FCT), an Institute for S&T International Co-operation, and an Observatory for Sciences and Technologies. Indeed, FCT is nowadays a very important actor in the system, taking some of the

activities that were previously attributed to JNICT. It was created in 1997 and the main functions are:

- To promote, finance, accompany and evaluate science and technology institutions, programs, projects and qualification of human resources;
- To promote and strengthen support infra-structures for scientific research and technological development;
- To promote the diffusion of scientific and technological culture and knowledge, and their teaching;
- To stimulate the update, interconnection, reinforcement and availability of science and technology information sources. (FTC Webpage, English version)

The Public Laboratories are not coordinated by the Ministry, which only evaluates them. Most of the policies were geared towards university research centres. Therefore, the characteristic of the Portuguese research system as having a strong presence of the Public Laboratories "has been mitigated by the last two decades of political development, while the second characteristic - the pluralist organization - seems to perpetuate and enhance itself in the present context" (Magalhães, 2001: 331).

2 - The present design and dynamics of the Portuguese research system

Recently some studies were made about the situation of research in Portugal. The OECD Country Report from 2006 about Tertiary Education in Portugal includes a chapter on "Research, Innovation and Internationalization". This report is a result of the approach of the Portuguese Minister of Science, Technology and Higher Education, José Mariano Gago, to the OECD in June 2005 to conduct a review of the Portuguese higher education system, under the Education Committee's programme of national reviews. This OECD Report was based on a Background Report made by the Ministry of Science, Technology and Higher Education. It describes the general landscape of Portugal in terms of Research, Innovation and Internationalisation. Research is perceived as a key area for Portugal to become more competitive, since it has to diversify its economy structure and "move gradually away from a reliance on traditional low value-added products" (OECD 2006: 63).

In the context of the European research policies, the government has been developing a national strategy, following the implementation of the Lisbon Strategy. This Strategy's main goal is the modernisation of Portugal, being its central instruments education, research and the connections between these, society and economy. (OECD 2006: 63) Therefore, Research and Innovation assumes a central position in the strategy of growth and competitiveness of the country, denominated as "Technological Plan". This is in line with the Knowledge Economies' concepts and concerns and with the fact that sustainability has to be perceived in this context.

This Plan's key targets are:

- To raise the share of graduates in Science and Technology in the population aged 20-29 by 50%, to raise PhD production to 1500/year (to double new PhDs/ 1000 population aged 25-34)
- To double GERD financed by the Government and tripling the BERD/GDP ratio.
- To double the total number of R&D personnel of the population, more than double number of researchers /1000 population
- To increase by 50% the number of scientific publications per million population (OECD 2006: 63)

According to the OECD Report, in terms of public investment, the implementation of the plan is going in the right direction, since in 2007 the state budget had a net increase of 77% in Science and Technology funds for the Ministry of Science, Technology and Higher Education (MCTES) and 90% of net increase in national funds for Science and Technology. The number of PhDs is also increasing, although a need to strengthen and qualify post-graduate education has been identified (OECD 2006: 63).

The increase of scientific productivity is regarded as an outcome of this effort. Another fundamental aspect is the fact that the main stakeholders in the system - identified by the OECD briefly as the government, research and innovation policy makers and university leadership - agree upon the efforts to the modernisation (OECD 2006: 64).

Despite all these modernisation efforts, much still has to be done so that Portugal reaches the aims of its own strategy. The OECD report points out at a number of issues and concerns that have to be solved in order to increase performance. According to this organization, there are subsystems and actors, but "linkages between them and cooperative mechanisms are missing to a great extent" ("mainly between the public research system

and private R&D and innovation") (OECD 2006: 64). Besides, although the numbers have been increasing, the general picture of the expenditures on R&D are still relatively low, totalizing 0.78% of the GDP in 2003 (OECD 2006: 64). The OECD report has numbers from 2003, but more recent data from 2005 show the same trend, when expenditure with R&D totalized 0.85% of the GDP, whereas the average for the 25 European Union members was 1.85% (Delicado 2007: 2)

Other concern by OECD is related to the modest interest of the private sector in employing highly qualified human resources. In 2003 the number of researchers with a PhD working in industry was only 189. This is also connected to the fact that the funding for R&D was in the same year 60% public while the then EU-15 average was around 35%. (OECD 2006: 64)

The number of research units has increased from 270 in 1996 to 473 in 2003 and the number of PhDs in the units has increased from 3575 in 1996 to 8324 in 2003 (OECD 2006: 68). However many units are "too small for effective research work" and the "co-operative/competitive mechanisms are also unclear" (OECD 2006: 68). The report recommends the funding agencies to give priority to larger research units and centres and to encourage cooperation through competitive funding instruments (OECD 2006: 68).

Another issue highlighted by OECD is that the number of PhDs is increasing but problems with careers and mobility, as well as post-graduate education constitute great challenges. It is stated in the report that the vast majority (over 10.000) of PhDs have remained in the universities. These have been employed in academic research, taking place in research units. About 90% are associated with public universities. 1500 are employed as teachers in the Polytechnics, "over 10% of the whole teaching staff" (OECD 2006: 68). The OECD report makes the concern I try to study in this dissertation very clear:

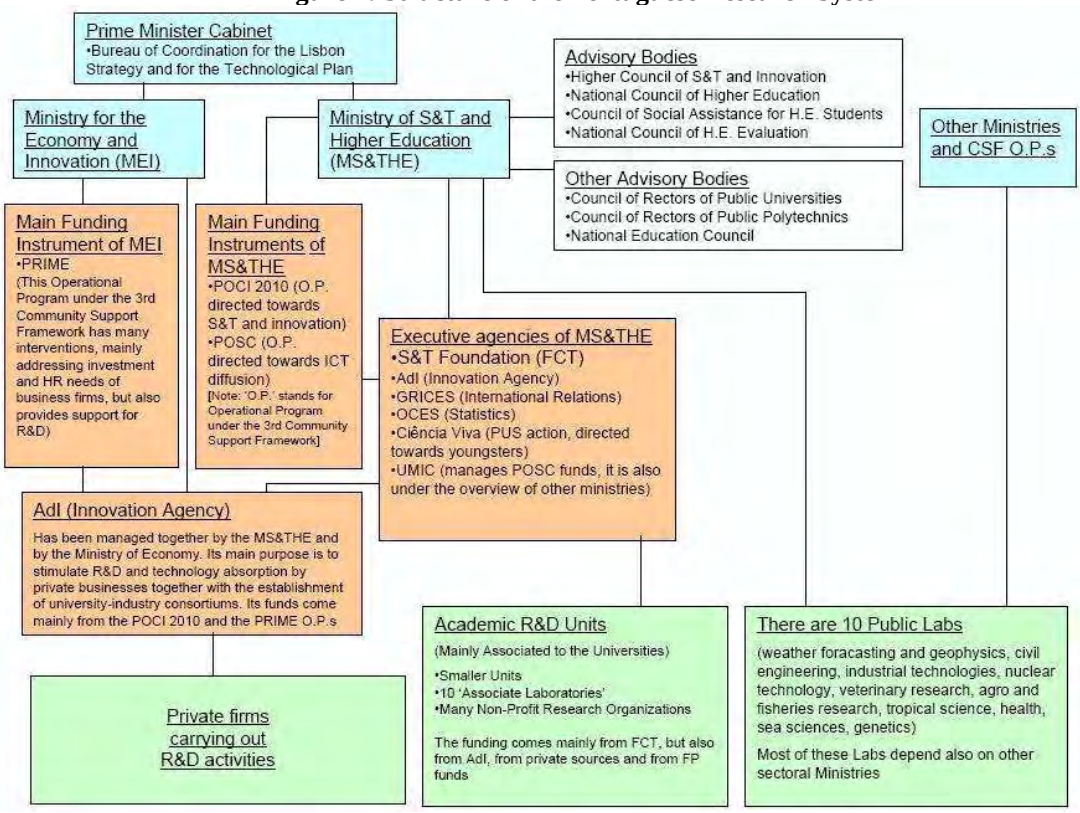
> If the system expands at the current rate – and the official target is even higher – it is clear that the existing structures will not be able to utilise the growing supply of highly qualified manpower. The expansion of highly qualified manpower and of research personnel is clearly desirable but it is equally clear that the present structures and rules will need to be changed if optimal economic and social benefits from the increased supply are to be reaped (OECD 2006: 68).

This concern is in fact the first evidence that there may be a problem related to the employability of the doctorate researchers in Portugal and that this may be related to the

sustainability of the system. This is in fact the ground for the further exploration of this issue hereby.

2.1 - The structure of the Research System

Figure 1: Structure of the Portuguese Research System



Source: ERAWATCH, 2008

This diagram from ERAWATCH shows the general structure of the Portuguese research system. The first level, in light blue, corresponds to the political level, comprising the Prime Minister Cabinet, the Ministry of Science, Technology and Higher Education, the Ministry of Economy and Innovation (these two Ministries are highlighted because according to ERAWATCH they are the main Ministries in terms of support for R&D activities) and the other Ministries (since research is transversal to different social areas). The second level, in orange colour, corresponds to the "operational level, and has the main operational programmes financing the research system together with the major executive agencies". The third level, in light green colour, "displays the agencies that actually perform R&D activities, namely the academic R&D units and the public laboratories". The

white coloured boxes correspond to the bodies that give advice to the Ministry of Science, Technology and Higher Education.

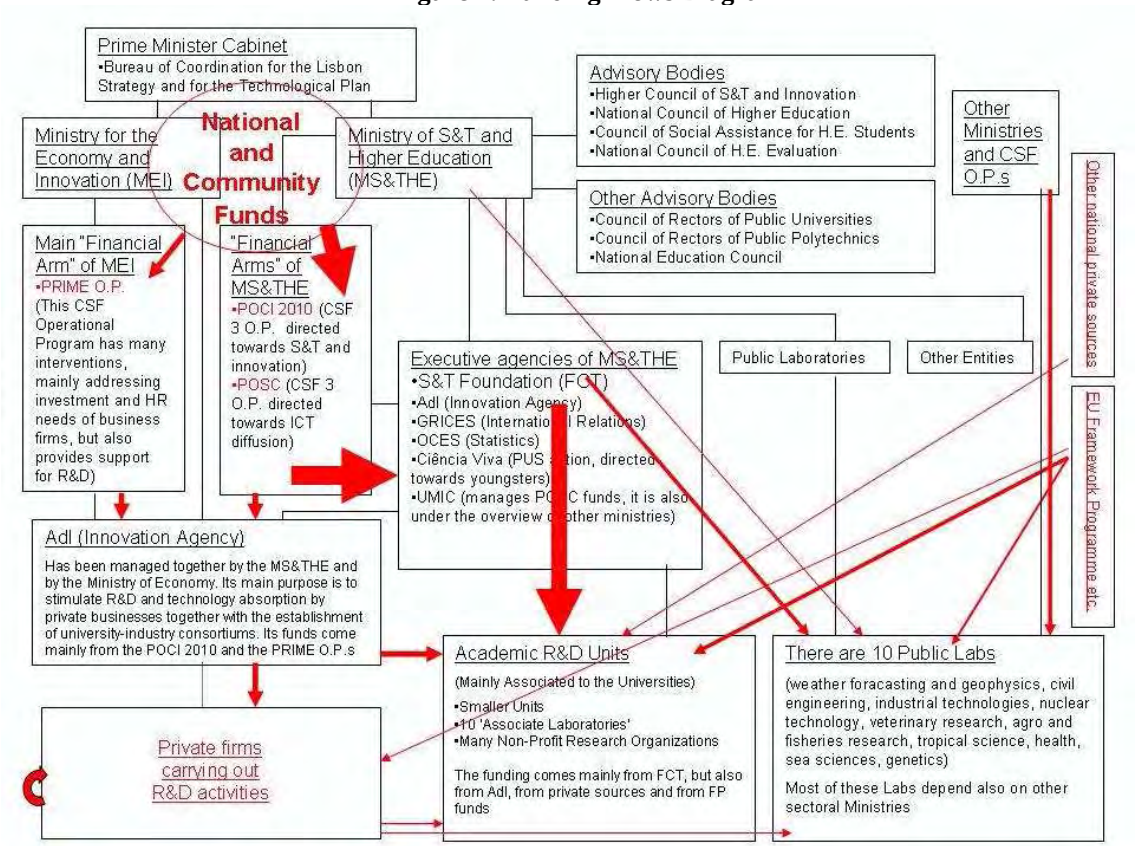
2.2- The Funding of the Research System

According to ERAWATCH, "the Portuguese research and development (R&D) situation is characterised by a significant dualism: while academic science has been progressing rapidly over recent decades, the private sector has been lagging behind" (ERAWATCH, 2008). ERAWATCH also confirms what has already been said about the role of the state:

> Public funding has been the main source of the development of the R&D sector. In 1982 R&D expenditure was 0,30% of GDP. In 1990, after Portugal joined the European Community, this percentage had grown to 0,51%. One decade later, in 2001, the R&D/GDP ratio had evolved to 0,85%. In 2001 the proportion of public funding was 61% while the proportion of the private business sector in the total financing of R&D was 32%. This evolution was in part due to the important contribution of European Structural Funds. Meanwhile in 2005 the R&D/GDP ratio declined to 0,81%, in part due to a retraction in public funding to 56,0% (the private share raised to 36,5%).
>
> The continuous importance of public funding reveals the role of the public sector in the performance of R&D system in Portugal. This system has been marked by a high degree of centralization, through fund allocation and political coordination. The formal structures for hearing the main stakeholders have only been active occasionally, and the informal channels for participation are few and not very active (ERAWATCH, 2008).

Indeed, the funding of the research system is mainly public. Besides, the contribution of the European Structural Funds for Portugal to have the public funds necessary for the development and maintenance of the research system is remarkable. ERAWATCH confirms that "a significant part of the public funds available in Portugal stem from the structural funds", and we can see it also in the following diagram by the ERAWATCH research inventory. It shows the financial flows, represented by red arrows, whose thickness depends on the "intensity of resources flowing between the different agencies" (ERAWATCH research inventory). This comes in line with the information in the previous chapter of 26% of the national budget for R&D having origin in EU funds. We can see in the diagram that there are efforts being undertaken by the Innovation Agency in order to stimulate the R&D activities in private firms.

Figure 2: Funding Flows Diagram



Source: ERAWATCH, 2008

Final Comments

By describing the historical perspective and current design of the Portuguese research system, this chapter demonstrated the importance of the state as a central actor in the research system. Indeed, the historical perspective confirms the idea of a traditionally interventionist state. The way the system is organized, the current policies and the funding structure show the importance of the guidelines of the European Research Area and the efforts of the country to respond to the aims of the Lisbon Strategy.

In what concerns the evolution in the training of human resources, we can see that this has been a priority in recent years, as well as a significant increase after Portugal joined the European Union.

In the next chapter I will make a more detailed analysis of the numbers of new scholarships for PhDs and the employment created in order to understand if there are differences between fields and how big the gap between the employability and employment is.

3rd Chapter: Employability and Employment of the doctorate researchers in Portugal

Introduction

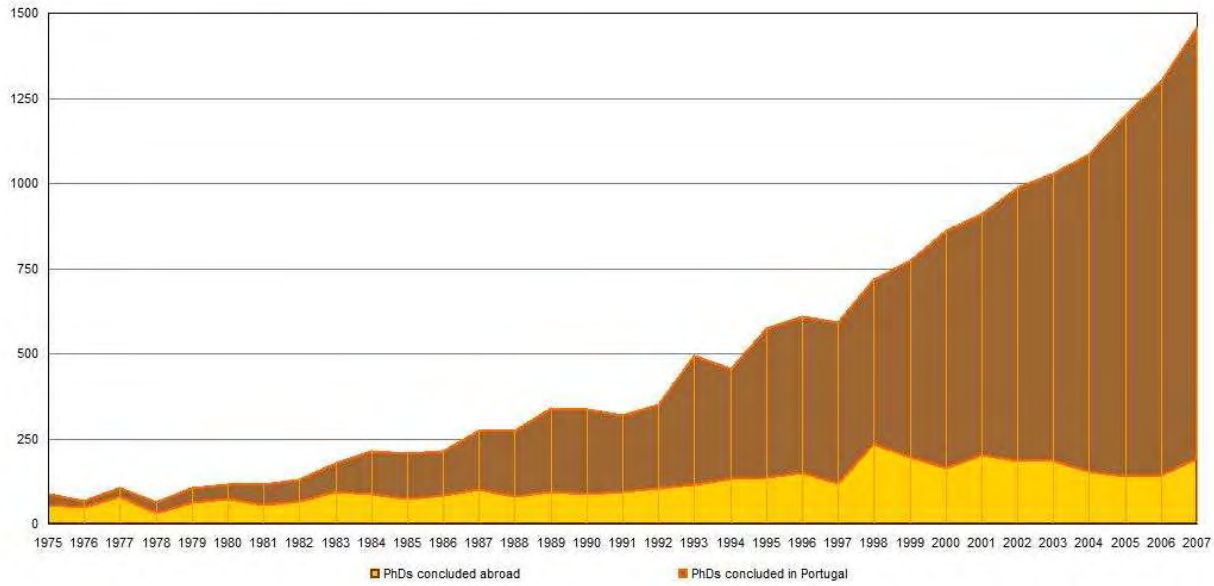
This chapter intends to analyse data related to the employability and employment of doctorate researchers in Portugal. This will be done by analysing the numbers of PhD scholarships and employment for PhDs in different scientific fields (natural sciences, engineering and technology, medical and health sciences, agricultural sciences, social sciences and humanities) and sectors: state, higher education institutions, enterprises and private non-profit institutions. The first two sectors comprise the public sector, which are under state responsibility. The main aim is to find if there are substantial differences between the different areas so that on Chapter 4 I can make a data based interpretation of the issues. Another important goal is to understand if the number of PhD scholarships for each field is consistent with the employment that has been created and with the sustainability of the system. It will also be the ground for a discussion about the intervention of the state in these matters.

This chapter presents some limitations related to the data available. According to the Foundation for Science and Technology (FCT) the statistical information about the programme for employing doctorates is being presently gathered. Therefore, I am using information until 2007 for the scholarships attributed for PhDs, but data on the employment of doctorates was released by the Observatory of Science and Higher Education and reports to 2002. The information about the doctorate researchers in different sectors and the total number of researchers is from the year 2005. It is possible therefore that some conclusions resent this limitation imposed by the data availability, however my assumption is that they allow to trace at least particular trends.

1- Employability

As explained in the previous chapter, the Portuguese government has released a Programme named “Engagement to Science”, which has the target of employing 1000 doctorate researchers between 2007 and 2009. However, the number of new PhD scholarships is much superior to the number of vacancies opened in this programme. Figure 3 shows that the Government is almost reaching its target of having 1500 new PhDs concluded every year:

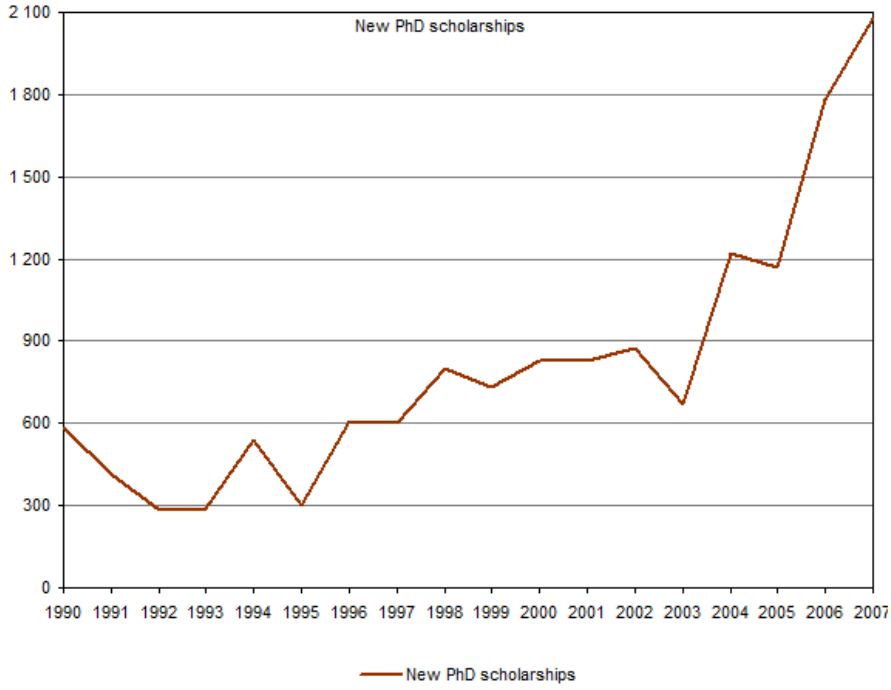
Figure 3: Doctoral degrees concluded or recognized by Portuguese Universities 1990 to 2997, number of PhDs



Source: OCT/OCES/GPEARI Statistics, FCT, 2008

Additionally, in the year 2007 the number of new PhD scholarships reached the amount of 2078, as shown in Figure 4. Indeed in the last years numbers grew substantially. And taking into account that a PhD takes at least 3 or 4 years for completion, the consequences of this increase in the PhD numbers will only be more evident later on, especially for those that were initiated in 2007. There is apparently a gap between the employment being created and the employability of the new PhDs. However, this situation must be more carefully analyzed and one should be aware that not all the PhDs will work as researchers after the degree completion.

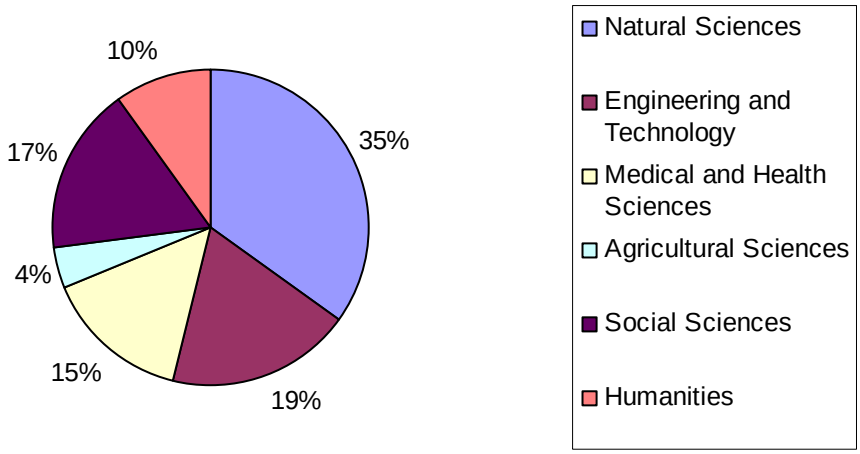
Figure 4: PhD Scholarships provided by FCT annually 1990 to 2007, number of scholarships provided



Source: OCT/OCES/GPEARI Statistics, FCT, 2008

The next graph (Figure 5) shows the funding of FCT PhD scholarships in different scientific fields in the year 2005. These were the most recent statistics available in the FCT website. One can see that the natural sciences were the category that was provided with more scholarships for PhD (35%), while agricultural sciences were the area that has received less PhD scholarships (only 4% of the whole PhDs). The engineering and technology comprise 19% of the scholarships, while the social sciences represented 17% of the scholarships. Medical and health sciences comprised 15% of the PhD scholarships while the humanities were only provided with 10%.

Figure 5: Funding of the PhD scholarships according to scientific field in 2005

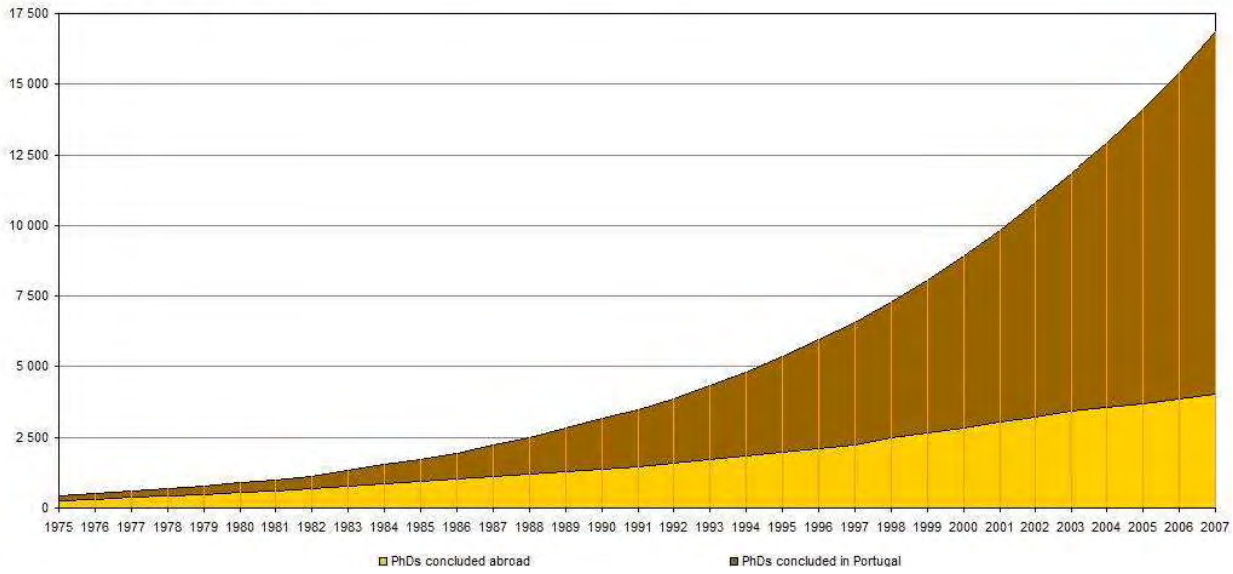


Source: FCT (http://alfa.fct.mctes.pt/images/stat/B16.gif)

2 - Employment

The following graph shows the evolution in the total number of PhDs in the country since 1975:

Figure 6: Stock of PhDs concluded in Portugal and abroad and recognized by Portuguese Universities since 1975
1975 to 2007, total number of PhD holders



Source: OCT/OCES/ GPEARI Statistics, Ministry of Science, Technology and Higher Education, 2008

One may conclude that there was a stock of almost 17,000 PhDs in 2007. The number in 2005 was 14,111, having the number of PhDs increased by about 20%. It is important to make this reference because much of the information used bellow on the doctorate researchers refers to the year 2005 although the situation may be already a bit different in 2009.

With regard to the employment for doctorate researchers, the Observatory for Science and Higher Education has published in 2006 a study about the professional situation of former PhD scholarship holders (scholarships provided by FCT). This study was made through 5 surveys; the first took place in 1997, the second in 1998/99, the third in the year 2000, the fourth in 2001 and the last one in 2002. The response rates were good, varying between 82% and 91% among the five surveys. The surveys comprise all those who have finished their PhDs between 1990 and 2001. Although the data are not very recent (this is the most recent study available) it provides an idea of what the situation is in terms of employment for doctorates.

According to the Observatory for Science and Higher Education, 50% of the doctorates that had previously held a FCT scholarship had professional activity before they obtained the PhD scholarship and 85% had professional activity after concluding the PhD scholarship.

The following table shows the professional activity of the doctorates who held a PhD scholarship between 1990 and 2002:

Table 1
Situation regarding the professional activity of the former FCT PhD scholarship holders between 1990 and 2002

Profession	TOTAL	
	Nº	%
Higher education professors	1481	55
Researchers	383	14
Post-Doc scholarship holders	330	12
Higher technical activities and consultancy	289	11
High school or elementary school teachers	105	4
Direction, management and advisory activities	80	3
Others	7	0.3
Does not know / Does not answer	2	0.1
TOTAL	2677	100

Source: OCES, 2006

It is interesting to highlight that 55% of the doctorates mentioned in this study were employed as professors in higher education institutions. Indeed it is also said in the OECD

Report about Tertiary Education in Portugal that "the vast majority (over 10000) of PhDs have remained in the universities" (OECD, 2006: 68), being over 90% of them "associated with public universities" (OECD, 2006: 68). According to the same report, "about 1500 [PhDs] are employed as teachers in the polytechnics, which is just over 10% of the whole teaching staff" (OECD, 2006: 68). This shows the strong influence of the state and more specifically the higher education institutions as the main employer. It also shows the significant allocation of the doctorates for teaching activities, rather than the research ones. Even though, according to the table 1, the following more popular occupation for the doctorates is to do research fulltime, which was the occupation of 14% of the doctorates who previously held a PhD scholarship by FCT. As can be seen in the statistics, the next occupation for doctorates was to hold a Post-Doc scholarship, amounting to 12%.

The following table shows the distribution by scientific field and professional activity in the period 1999-2002:

Table 2
Scientific field of the PhD and professional situation of the former FCT PhD scholarship holders between 1990 and 2002

Scientific field / Situation of Professional activity	Pursuing professional activity	Not pursuing any professional activity	Post-Doc scholarship holders	TOTAL
Exact Sciences	428	78	93	599
Natural Sciences	398	100	96	594
Agrarian and Veterinary Sciences	141	20	10	171
Health Sciences	240	68	64	372
Engineering and Technology	673	85	49	807
Social and Human Sciences	467	94	18	579
TOTAL	2347	445	330	3122

Source: OCES, 2006

The majority of the doctorates who previously held a PhD scholarship from FCT were developing a professional activity (2347 individuals in a universe of 3122 corresponds to about 75%) while about 14% (445 out of the 3122) did not pursue any professional activity and about 11% were post-doc scholarship holders.

In terms of the distribution of the number of former PhD scholarship holders by scientific fields, the "Engineering and Technology" was the area that comprised the

majority of the subjects, followed by the “Exact Sciences” and the “Natural Sciences”. The situation is not very different from the one we have already found when analysing the funding of PhD scholarships by scientific field in 2005, taking into account that the graph with 2005 data did not make the distinction between “Exact Sciences” and “Natural Sciences”. To some extent it is possible to establish a parallel between the scientific fields in which more PhD scholarships are awarded and the scientific fields in which more doctorates that previously held a PhD scholarship are employed.

As this information is very relevant for the purposes of this thesis and to make it more legible, based on the table I will look at the percentage of doctorates (ex – scholarship holders) in each field that develops professional activity, does not develop any professional activity or holds a Post-doc scholarship:

Table 3
Percentage of FCT former PhD scholarship holders regarding their situation professional activity, throughout the different scientific fields

Situation of Professional Activity / Scientific field	Pursuing professional activity	Not pursuing any professional activity	Post-Doc scholarship holders	TOTAL
Exact Sciences	71.5%	13%	15.5%	100%
Natural Sciences	67%	16.8%	16.2%	100%
Agrarian and Veterinary Sciences	82.5%	11.7%	5.8%	100%
Health Sciences	64.5%	18.3%	17.2%	100%
Engineering and Technology	83.4%	10,.5%	6.1%	100%
Social and Human Sciences	80.7%	16.2%	3.1%	100%

Source: OCES, 2006 (adapted)

One can observe that the percentage of individuals who do not develop any professional activity is higher in the field of health sciences, followed by natural sciences and by social and human sciences. Engineering and Technology was the field that had a smaller share of individuals not developing any professional activity. It is also the field of Engineering and Technology that has a bigger percentage of people employed, followed closely by the agrarian and veterinary sciences and the social and human sciences. With regard to Post-doc scholarships, the percentage of doctorates that were holding a Post-doc scholarship was bigger in the health sciences and followed by the natural sciences and

exact sciences. The fields that seemed to have a smaller share of people holding a Post-doc scholarship were the social and human sciences and the agrarian and veterinary sciences.

The following table shows the professional situation of the doctorates before and after the scholarship:

Table 4
Professional situation of the former FCT PhD scholarship holders – before and after the scholarship, 2000 - 2002

Profession	Before the PhD Scholarship	After the PhD Scholarship
Higher education professors	19%	51%
Researchers	9%	16%
Direction, management and advisory activities	1%	3%
High school or elementary school teachers	4%	2%

Source: OCES, 2006

One can conclude that after the scholarship there were more doctorates employed in all the different professions with the exception of the high school and elementary school teachers. The researchers increased from 9% before the scholarship to 16% after the scholarship. However, the most significant increase was in the number of higher education professors, which increased from 19% to 51%.

With regard to the professional activity of the doctorates that were unemployed before the scholarship, the situation can be observed in the following table:

Table 5
Professional activity of the FCT former PhD scholarship holders who were unemployed before the scholarship, 2000 - 2002

Profession	TOTAL	
	Nº	%
Higher education professors	157	28
Post-Doc scholarship holders	91	16
Researchers	81	15
Higher technical activities and consultancy	53	10
High school or elementary school teachers	9	2
Direction, management and advisory activities	5	1
Others	2	-[1]

[1] The number is smaller than half of the unit used

Total of the employed	398	72
Still unemployed	157	28

Source: OCES, 2006

It is relevant to highlight that 72% of the doctorates were employed or holding a Post-Doc scholarship afterwards. The majority is employed as higher education professors (28%), followed by those who hold a Post-Doc scholarship (16%) and by the researchers (15%).

2.1 - Doctorate researchers by sector in 2005

It is important for our purposes to analyze the distribution of the doctorate researchers throughout the different sectors. I will use data from the "Enquiry to the national Scientific and Technological Potential" of 2005:

Table 6
Number and percentage of doctorate researchers thorough the different sectors, 2005

Sector	Number of doctorate researchers	Percentage of doctorate researchers
National total	7089,1	100%
Enterprises	99,0	1.4%
state	816,3	11.5%
Higher Education	5062,6	71.4%
Private non-profit institutions	1111,1	15.7%

Source: GPEARI, 2007 (adapted)

It is interesting to see that the great majority of the doctorate researchers are employed in the public sector (82.9%), most of them in higher education institutions (71.4%). I kept the designation of "state" as it was in the original source, but it should be understood as the subsector of the Public Laboratories, inside the Public sector. Doctorate researchers employed in the Public Laboratories are only 11.5% of the national total. This is related to what was said in the second chapter about the changes that occurred in the importance of the Public Laboratories. It is also relevant to point out that only 1.4% of the doctorate researchers work in enterprises, which was also explained before about the companies not perceiving the advantages in investing on highly qualified personnel. The

total number of PhD researchers in 2005 was 7,089 while in the same year the stock of PhDs in the country was 14,111 as we've seen before. We can conclude that in 2005 about half of the PhD population was working as researchers.

In the following table we can see the number of doctorate researchers among all the researchers and the differences in numbers according to the academic degree and the sector:

Table 7
Number of researchers according to the academic degree and through the different sectors, 2005

Sector	Total of researchers	Master researchers	PhD researchers	*Licenciatura* researchers	*Bacharelato* researchers
National total	21126,3	4200,8	7089,1	9254,7	581,7
Enterprises	4013,3	240,7	99,0	3402,7	271,3
state	3337,6	578,5	816,3	1771,8	170,9
Higher Education	10,956,4	2831,8	5062,6	1978,1	83,8
Private non-profit institutions	2818,7	549,8	1111,1	1102,1	55,7

Source: GPEARI, 2007

The total number of doctorate researchers in 2005 represented 33.6% of the whole fulltime researchers. This number would only be overcome by the *Licenciatura* researchers, which represent 43.8% of the total. Next are the researchers holding a Master degree, totalizing 19.9% of the whole number, and the academic degree with the least researchers was the *Bacharelato* with only 2.8% of the researchers.

From all the academic degrees, the *Licenciatura* was the one that totalized more researchers in enterprises than in higher education institutions.

3 – Governing, governance and the employment and employability at the system level

As argued, the state is the main creator of employment and employability. The state stimulates the employability of the doctorate researchers, in the sense that by providing scholarships, it increases the doctorates' individual potential to be employed (as explained in the first chapter). The state also stimulates employment, by creating programmes to employ doctorates and giving incentives both to public and private institutions to do so. It

is therefore important to understand how employability and employment are dealt with at the system level, so that on the next chapter we can better discuss this according to the current design of the Portuguese research system, current policies and finally the contribution of current political steering of employability for the sustainability of the research system.

In this section I will explain the "governing" and "governance" measures regarding employability and employment at the system level. According to Magalhães, "while the meaning of 'governing' is associated with tracing objectives and social, economic and political goals, the meaning of 'governance' is associated to political instruments and their development, management and assessment (Magalhães, 2008). I will therefore explain the "governing" dimension, through the description of the main goals of R&D policies, and "governance", through the measures that are being developed to respond to these goals.

Europe has launched the "Lisbon Strategy", whose aim would be that by 2010 Europe would be "the most competitive and dynamic knowledge economy in the world". This strategy is based on three pillars:

> An economic pillar preparing the ground for the transition to a competitive, dynamic, knowledge-based economy. Emphasis is placed on the need to adapt constantly to changes in the information society and to boost research and development.
>
> A social pillar designed to modernise the European social model by investing in human resources and combating social exclusion. The Member states are expected to invest in education and training, and to conduct an active policy for employment, making it easier to move to a knowledge economy.
>
> An environmental pillar, which was added at the Göteborg European Council meeting in June 2001, draws attention to the fact that economic growth must be decoupled from the use of natural resources (Europa website).

The first two pillars directly frame employment and employability, since the knowledge based economy and the investment in human resources, education and training imply the development of sustainable research systems and the investment both in employability and in employment.

According to the Europa website, "the policies in question fall almost exclusively within the sphere of competence of the Member states" and therefore "an open method of

coordination (OMC) entailing the development of national action plans has been introduced" (Europa website). It is in this context that Portugal launched the "Technological Plan", as "an action agenda for all the Portuguese society, which aims at mobilizing enterprises, families and institutions for surpassing the modernization challenges the country has been facing during the last years" (Portugal - Technological Plan Website). Moreover, "the measures aggregated in the Technological Plan constitute the pillar for Growth and Competitiveness of the Portuguese National Reform Plan, designated National Action Programme for Growth and Jobs 2005-2008" (Portugal - Technological Plan Website). According to the Technological Plan website, this plan is based on the following axes:

> Knowledge - To qualify the Portuguese for the knowledge society, fostering structural measures which aim at enhancing the average qualification level of the population, implementing a broad and diversified lifelong learning system and mobilizing the Portuguese for the Information Society.
>
> Technology - To overcome the scientific and technological gap, reinforcing public and private scientific and technological competences and recognizing the role played by enterprises in the process of creation of qualified jobs and Research & Development (R&D) related activities.
>
> Innovation – To boost Innovation, helping the productive chain to get adapted to the challenges of Globalization by means of the diffusion and development of new procedures, organizational systems, services and goods (Portugal - Technological Plan Website).

All these axes can be related to the employment and employability of doctorate researchers. The first axe explains why the state has assumed the objective of increasing the number of PhD scholarships, and therefore the employability. The aim is to increase the qualification level of the population and prepare it to the so-called knowledge society. The second axe, the technology axe, is related to the state's efforts to create both employability (reinforcing public and private scientific and technological competences) and employment (the recognition of the role of the enterprises on creating qualified jobs and developing R&D activities). The third axe, the innovation axe, is related to the country's capacity to adapt to the challenges of globalization, which can somehow relate to the capacity of the research system to innovate and adapt.

The Technological Plan has five transversal focal points of action: 1) A strengthened scientific and technological base; 2) a better organized competitive base; 3) a modern public administration; 4) a favourable environment for business; and 5) a qualified population. The Commitment with Science, which encompasses the programme for the

employment of doctorates and also has as an objective the increase in the number of doctorates, is one of the measures of the first focal point of action of the Technological Plan, as well as for instance the Reform of state Laboratories and the International Evaluation (Technological Plan).

The Portuguese Government has defined the quick scientific and technological development of the country as a national priority (Portugal, 2006). According to the document of the "Commitment with Science for the Future of Portugal", the targets are defined by the indicators that measure internationally the degree of the scientific and technological development of the countries (Portugal, 2006). These targets are:

- reaching 5,5 fulltime researchers by every 1000 active population (there were 3,5 in 2003 in Portugal and 5,5 in the EU25);

- increasing the number of new PhDs per year from 1000 to 1500, increasing also the fraction of PhDs in science and engineering;

- increasing by 50% the scientific production that is internationally quoted, from 400 to 600 scientific publications by million inhabitants and year;

- tripling the number of registered patents in the European Patent Office and in the United states Patent Office (they were, respectively, 4,1 and 1,3 by million inhabitants) (Portugal, 2006).

These policy documents reflect the motivations for state intervention in the employability and employment of PhD holder researchers, as they are regarded as key targets for the scientific and technological development, based on international standards. Moreover, it explains why the state also gives financial incentives to the private sector to employ doctorate researchers, since the second axe of the Technological Plan, the technology axe, aims at reinforcing not only the public but also the private scientific and technological competences. By doing this it recognizes the role of the enterprises in the creation of R&D related activities and its importance for the development and modernization of the country.

In what concerns the employment for doctorate fulltime researchers, the Government launched a programme for employing doctorates, within the "Commitment with Science", as was mentioned in the third chapter, which aims at employing 1000 doctorates for the national scientific and technological system between 2007 and 2009. This programme is geared not only for public but also for private institutions, reflecting the

governmental political goals of increasing the engagement of enterprises in R&D activities. Thus, both in the regulations of 2007 and in the regulations of 2008 these are the target institutions:

- higher education institutions in partnership with R&D institutions which are accredited by FCT
- Associated Laboratories
- state Laboratories
- Enterprises pursuing recognized R&D activities
- Other public and private institutions with R&D activities recognized by FCT

The criteria for the choice of the institutions are: 1) installed scientific capacity and especially relevant scientific production in the last three years; 2) working plan and scientific employment plan, as well as partnerships and support networks; and 3) available conditions to accommodate the projects and conditions for development and co-financing, as well as the contribution they hope to provide to the strengthening of quality critical masses and international co-operation networks (FCT, 2007; FCT, 2008).

The employing institutions are responsible for the selection of the candidates, within the dates previously established by FCT, and have to respect the following conditions: 1) the doctorates to be employed must have at least 3 years of relevant experience and scientific production after the conclusion of the PhD (FCT may consider the application of doctorates with less then 3 years of post-doctoral experience only in exceptional cases); and 2) all the openings are simultaneous and must be mandatorily published in the FCT mobility internet portal, which is referenced in the international scientific press (FCT, 2007; FCT, 2008)..

In what concerns employability, there are different sources for PhD grants, like for instance the Calouste Gulbenkian Foundation or *Fundação Oriente* grants. However scholarships from FCT are nowadays the most significant ones, as seen in the second chapter, and they are funded by the state, which is a relevant point for the argument being developed hereby, i.e., the importance of the role of the state in the employability of doctorate researchers. There are two different types of PhD grants by FCT: the regular Doctoral degree grants and the Doctoral degree grants in enterprises.

Doctoral degree grants are, in principle, one year length, renewable for up to a total of four years, and cannot be awarded for periods of less than three consecutive months

(FCT website). Review and evaluation of applications takes into account the intrinsic merit of the applicant, the work plan and the host conditions, among other criteria to be defined in the announcement of the respective call for applications. Grant awards are based on the results of the evaluation and are subject to the budgetary limits set out by the FCT (FCT website).

The Doctoral degree grants in enterprises have the same length as the regular ones and the review and evaluation of applications have to meet the same criteria. Indeed this comes in line with the political aims of the Technological Plan and the "Commitment to Science", since, as previously underlined, the state recognizes the need to stimulate the private sector to engage in R&D activities, regarded as crucial for the modernization of the country. According to FCT this action aims at promoting the advanced training in entrepreneurial environment, using cooperation between enterprises and universities on projects of interest to the company and whose development allows students to obtain the doctorate degree, awarded by the university. Thus, the objective is to attract quality doctorate students who want to work in companies in the development of projects of entrepreneurial interest which are considered by the university as appropriate for obtaining the doctorate degree. This initiative associates the Innovation Agency (that contributes on the promotion of exploratory contacts in the entrepreneurial environment) and FCT (that promotes the evaluation and the management of the grants).

Final Comments

The main conclusions to be taken in this chapter are that the doctorate fulltime researchers are mainly employed in the public sector, especially in the higher education institutions. The doctorates are mainly employed as higher education professors (at least this was the situation of the former PhD scholarship holders in the year 2002) and the following more common activity is the fulltime research. Also the Post-Doc Scholarship represents a significant occupation of doctorate researchers. In what concerns the differences between scientific fields, the PhD holders in Engineering and Technology are the ones who least face unemployment and it is interesting to see that there can be made a parallel, to a certain extent, between the fields in which more PhD scholarships are awarded and the fields in which more doctorates are employed (natural sciences, exact

sciences, engineering and technology). This suggests that there is consistency in the attribution of scholarships according to the fields where more employment can be and is created. And, as was analyzed in the policies, the fields of science and engineering are given a special attention concerning the number of new PhD places being created because these fields are believed to help modernize the country.

It is important to highlight the fact that only 1.4% of the doctorate researchers are employed in the enterprises sector. It is also interesting to verify the governments' efforts to promote both training and employment of doctorate researchers in the private sector, contributing with funding to that. The Technological Plan recognizes the important role of the enterprises in developing R&D related activities and creating qualified jobs. That is why the "Commitment with Science" encompasses a programme for employment of doctorates both in the public and the private sector and the Innovation Agency provides PhD grants in entrepreneurial environment. These programmes for the stimulation of employment and employability are governance instruments.

However, the funding through which the state intends to stimulate employment and employability both in the private and public sector is partly received by the European Union. This leads us to further elaborate on the sustainability of the system and the role of the state in dealing with the employability of doctorate researchers. Although until now one can not say that there is a serious problem of doctorate unemployment in Portugal, in recent years the number of scholarship has been rising substantially and the number of employment vacancies is not accompanying this growth. A part of the doctorate researchers carries out its work with a Post-Doc grant and sometimes with fellowships that do not have the same social benefits as an employment contract.

In the following chapter this information will be confronted with the current policies and context so that we can understand if the management of employability does contribute or not to the sustainability of the Portuguese research system.

4th Chapter: The sustainability of the Portuguese research system

Introduction

This chapter aims at discussing the data presented in the third chapter, as well as the current policies regarding employability and employment of doctorate researchers, in the perspective of the sustainability of the Portuguese research system. Moreover, the role of the state will be discussed with the objective of knowing if the political actions of the state regarding the employability of the doctorates contribute for the sustainability of the system.

1 – The Sustainability of the Portuguese Research System and the role of the employability of doctorate researchers

As already argued in the first chapter, both ERAWATCH and OECD present concerns regarding the sustainability of the research system. One of the issues that both institutions point out as an area of concern is a possible gap between demand and supply of doctorate researchers. Indeed, and due to the recent policies to increase the number of PhDs, the number of new PhDs concluded every year has been growing very quickly and significantly in the last twenty years. According to the 2005 "Enquiry to the national scientific and technological potential" (*Inquérito ao Potencial Ciêntifico e Tecnológico Nacional*), 7089 doctorates out of the stock of 14111 PhDs in the same year were working as researchers. Although there is a lack of updated and clear figures about the rest of the doctorates, if we take into account the study made by the Observatory of Science and Technology about the professional situation of former PhD scholarship holders and the data provided by OECD, we can see that most doctorates in 2002 were employed as higher education professors and the following two more popular occupations were "Researchers" and "Post-Doc scholarship holders". It seems therefore accurate to state that most of the doctorates have been absorbed by the higher education institutions.

According to ERAWATCH many Portuguese young doctorates have been seeking work abroad. A significant part of the doctorates that held a PhD scholarship between 1990 and 2002 had as an occupation a Post-Doc scholarship (12%), as was mentioned before in the study about the professional situation of the former PhD scholarship holders. This is another issue pointed out by ERAWATCH, since in spite of the fact that it can have

positive impacts in the short term it will “not be able to sustain a long-term development of the research system” (ERAWATCH, 2008) Sustainability may be at risk if doctorates’ employability is on one hand stimulated by the incentives to more qualification, but on the other hand not proportional with the capacity of the country to employ highly qualified manpower. In spite of the fact that the state is making efforts to stimulate employment, the targets of these actions (1.000 employment contracts between 2007 and 2009) are much under the number of new PhDs concluded every year. Whereas going abroad is an option, as well as entrepreneurship by the doctorates (attitudes constitute the individual assets of employability), still a social issue may arise. The country may face unemployment of doctorates and “Brain Drain”. It is important to invest in individuals’ education and the state is trying to pursue to the targets set out by the Lisbon Strategy, but policies should be adapted to the size and specificities of the Portuguese research system.

Another important issue is the sustainability of the Portuguese research system in economic terms. A significant part of the funding for research in Portugal has its origin in funds coming from EU. The increase in the number of scholarships and fellowships has been possible to a great extent due to these funds. ERAWATCH, as a public service for the European research policy, points out at the concerns of what the situation for the national research landscape will be if there are cuts on the funding in the future. This may be a sign for the state to make a better plan regarding the sustainability of the research system. Indeed, the role of the state is crucial and the need for such strong intervention on supply and demand of PhDs shows the incapacity of the system to be self-maintained, that is to say, being sustainable. Even the efforts for the private sector to be more active on employing doctorate researchers are being to a great extent financially supported by the state. This means that the state is trying to enhance the participation of the private sector in R&D with its own funds. Indeed the state is manipulating the normal functioning of the research system, by trying to increase the participation of the private sector, by increasing the scholarships and by funding a programme for the employment of doctorate researchers (whose numbers, as analyzed are much bellow the ones of the scholarships). According to the definition provided of sustainability (see above, first chapter), the situation seems to be one in which the research system is not taking a path that can lead it to the ability of generating funds and being able to maintain its current level of activity even if there are cuts on the funding in the near future. If on the one hand the government projects are the

modernization of the country and the development of research and technology, on the other hand, it assumes a kind of "paternalistic" attitude towards the system and intervenes in employability and employment both in the public and in the private sector. We might talk about a "government failure", since the government interferes in the market, through its "regulatory framework, and the planning and control system" (Jongbloed, 2003:13). It provides a high number of grants with the intent of increasing the potential of the human resources in the research system, but it is not able to increase the employment in the same proportion. Whereas there have not been until now substantial lack of employment for the doctorates, the effects of the current policies for the increase in the PhD numbers are still hard to predict. However data show clear signs of a possible gap between employability and employment in the near future. The state might be this way increasing the number of doctorates without a careful analysis of the consequences in terms of future employability of those researchers.

My argument is not one in which employment should be increased without any planning of the real needs only to meet the needs of the doctorates to be employed. My point is not that there should not be grants for doctorates either. I argue that it is important that the state invests on the qualification of individuals but it has to be done in a sustainable way, namely taking into account the needs of the research system and its dimension. If the system is not able to employ the doctorates (in whom investment was made on training) and generate self-funding, and continues to rely on EU funds (as was highlighted by ERAWATCH), we may argue that the system faces a real problem in terms of sustainability. Therefore it is possible to argue that there is a connection between the way the state deals with the doctorate researchers employability and the sustainability of the system. While in the short term there are positive effects for the research carried out through fellowships, on the long term there may be problems of unemployment of doctorates and "Brain Drain", as will be underlined in the next section.

2 –Employment, Mobility and Brain Drain

In 2004, the Council of the Associated Laboratories (*Conselho dos Laboratórios Associados*) (reference institutions which have been ranked as excellent units by the international evaluation panels) has issued a document about the scientific employment in

Portugal. It expresses concerns related to the employability of PhD holders in Portugal. There are references to the lack of transparency in the processes of public contracts; delays in the payments to the Associated Laboratories; lack of autonomy of the state laboratories that are not employing new researchers; and not enough employment opportunities for the new PhD holders (Associated Laboratories Council 2004). Another important perspective is the one of the Association of Grant-holder Researchers (ABIC) (*Associação dos Bolseiros de Investigação Científica*). This Association also expresses concerns related to the scientific employment. About 23% of the researchers registered at national research centres are grant-holders and 26% of the publications quoted have at least a grant-holder within its authors (Ferreira, 2004). They point out to the low salaries and great professional instability (they claim a lack of basic rights as holidays, social security system, unemployment subsidies) (Ferreira, 2004). The professional opportunities are according to ABIC a pull factor for Brain Drain. They refer to the European Researchers Charter, stating that the objectives drawn in the Lisbon strategy were important but are not being reached and the research careers are becoming less attractive. The way in which the Association regards mobility is also interesting. It says that mobility should be encouraged but should not be imposed. They point out the fact that if the European member states do not improve their scientific employment, the researchers' mobility within Europe will be unidirectional to the countries that have more opportunities in this field, leading to Brain Drain in other countries (Ferreira, 2004).

Another important factor that encourages mobility, especially at the PhD level is the fact that the FCT scholarships are much higher for students that go abroad (regardless of the country) than for the students that stay in Portugal (according to the values on the FCT Website). The value in 2008 for the "PhD scholarship abroad" was 1710€/month while the value of the scholarship for PhD students in Portugal is 980€/month. Mobility is important, especially on the assumption that this is a state investment in high skilled personnel that will return with more expertise. According to Peixoto, during the period 1990-2000, the proportion of scholarships directed to foreign countries reached almost 30% of the whole scholarships, "a figure that has acquired a growing volume during the decade" (Peixoto, 2004: 12). OECD also reports these numbers and acknowledges a "slight increase of the former FCT scholarship holders working abroad" (OECD 2006: 75)

In the period 1996-2000 24.2% of the total PhD scholarships awarded by the Ministry of Science, Technology and Higher Education were directed to foreign countries. Peixoto points out to a number of areas of concern: “the country may lack competitive capacity to attract the best worldwide talents”, difficulty “to assure the return of the more capable of the Portuguese that left the country and remained in their destination” and the difficulty “to retain the best local talents” (Peixoto 2004: 16). This is regarded by Peixoto as a consequence of the “greater abundance of qualifications in the Portuguese labour market”, the “difficulty of pursuing local careers”, the “wider international experience of Portuguese students and scientists” and the “facilitating process over migration” (Peixoto 2004: 16). Peixoto points out the risk that “Portugal may experience in the near future a brain drain directed to the economic and scientific centres of Europe or elsewhere” (Peixoto 2004: 16) but relativises this issue by highlighting the benefits of networking. With regard to the scientific inflows, Peixoto states that the number of foreign researchers working in Portugal is low, based on sources from the Science and Technology Observatory (National Survey on Science and Technology, 1999). According to this data, in full-time equivalent, the foreign researchers “amounted to 4.7% of the total in 1999” (Peixoto, 2004: 9).

Final comments

In fact, the way employability of doctorate researchers is dealt with at the system level has a strong link with the sustainability of the system, since the state is carrying the “burden” of not only promoting the employability (through scholarships) but also employing and stimulating the employment in the private sector. Until now the state has been able to absorb most of the new doctorates, especially in the higher education institutions. However, many of the doctorate researchers work by using fellowships in research projects and do not have the stability of a regular job. ERAWATCH highlighted the possible consequences of a decrease in the European Union funds, which are crucial to fund a great part of the PhD scholarships and also many of the projects in which the doctorates are working through fellowships. The state is making policies according to the Lisbon Strategy and with the aim of increasing the potential of the Portuguese Research system. However without an adequate coordination of employability according to the

capacity of the system and the employment opportunities, Portugal may face serious consequences in the near future like brain drain and the unemployment of many doctorates if the European Union funds are cut.

Conclusions of the Study

Based on the analysis undertaken on the sustainability of the Portuguese research system and the contribution of the employability of researchers, some conclusions can be drawn and some reflections can be made about the challenges for the future, not only at the national level but also at the European level.

This study has some limitations: first of all, although the information about the PhD scholarships is up to date, the available information about employment is not very recent and clear. One of the studies about the occupations of the doctorates (former PhD scholarship holders) that I have used comprise of doctorates between 1990s and 2002. Although currently the situation may be different, at least it allows an inference of the trends and also to reach the conclusion that until recently the system has been able to absorb most of the doctorates in different occupations. Another limitation is the fact that the statistics about the programme for employing doctorates are now being gathered by FCT, and so there are no clear numbers about the distribution of doctorates in this programme throughout the different scientific fields. The only available numbers are the total numbers of vacancies fulfilled and the employing institutions. Finally, the time limitation was also a constraint since this dissertation had to be undertaken within a time frame of five months, which is quite a difficulty considering the needs of a research study.

Nevertheless, this study has enough evidence and findings to support the thesis that the employability of the doctorate researchers is effectively one of the factors that contributes to the sustainability of the research system. On the one hand, there is investment on the doctorates' skills and competences, but on the other hand, the system in the near future will not have the size and capacity to respond to this increase in highly qualified personnel. As has been argued, the significant increase in the number of PhD scholarships may not be entirely absorbed in employment positions, since the programme for the creation of employment does not reach the same level of numbers as the scholarships provided annually. Thus there is a discrepancy between the number of PhD scholarships and the employment being created. Then a problem of employability may arise. Both ERAWATCH and OECD relate this issue to the sustainability of the system itself, since many financial resources are being allocated to the provision of PhD scholarships. If until now the system has been able to absorb most of the doctorate

graduates, especially in higher education institutions and teaching functions, in the near future the consequences of this huge increase are hard to predict since those who have been awarded scholarships from 2006 onwards have not yet entered the labour market.

For all these reasons, the role of the state is the central focus of my argument. It is clear that the state is intervening both in the creation of employability and employment through its governing strategies (the aims of the policies, to modernize the country and to meet the development levels traced by the Lisbon Strategy) and governance instruments (the instruments which the state uses to attain political goals, like the programmes for attribution of scholarships and the programmes for creation of employment).

The private sector in Portugal does not invest greatly in R&D activities and personnel, and also in this field it is the state that is stimulating the participation, through financial incentives. As argued, these intervention and investment by the state both on the public and the private sectors have a reason: to respond to the demands of modernization political goals. However, it is also true that a great part of the funds for this increase in the number of scholarships, fellowships and projects have origin in the EU. If ERAWATCH expresses concerns with the issue of sustainability in the case of a possible decrease in the funds, then this should be a sign that policies should be reviewed. It is possible to infer from the data that many of the doctorates work using fellowships instead of work contracts and also that their social benefits are not as good as would be desired if the European Charter of Researchers would be taken into consideration. A part of the doctorates has as their occupation a Post-Doc scholarship, which is not by definition a work contract. If the funding for the projects in which all these doctorates are working is diminished by eventual decreases in EU funds, it may be the case that the issue of lack of sustainability will be felt more intensely, because the research is highly dependent on those funds. This leads us once again to the role of the state and the type of investment that should be done to increase the sustainability, for instance in structures that are able to generate funds for their own functioning.

The historical overview and current design of the Portuguese research system show that the state has traditionally adopted an interventionist role, as is the case of other semi-periphery countries. This socio-cultural dimension must also be considered, as the state has been assuming an interventionist character throughout history and possibly this is also expected by the Portuguese society. This may help to explain, at least partially, why the

state feels the need to generate policies regarding the employability of researchers and why the private sector is not as active as would be desired at the European level.

At this stage I would like to highlight and reflect upon three main aspects, adding my own conclusions and suggestions with regard to the sustainability of the Portuguese research system: the role of the state, the role of the private sector and the European demands vs. national characteristics and needs.

My personal perspective is that the path for the sustainability, through the contribution of employability in the research system, is one where the state should maintain its role of coordination and intervention. As stated above, this has been traditionally its role and therefore the Portuguese society and the different actors in the system expect it. Besides, the system operates through a model where the state is the coordinator and the main actor. I am not arguing that the state should not provide any scholarships nor maintain programmes for the encouragement of the employment and to encourage the involvement of the private sector. However I believe that the number of scholarships should be more balanced with the needs of the labour market, taking also into consideration the social dimension, the nature of higher education and the benefits of the pursuit of knowledge. A research system in which the employability of the researchers does not have a great gap in relation to the employment that can be created and in which there is not a risk of "Brain Drain" (losing highly qualified personnel in which the state has invested) will be certainly more sustainable than one in which the state invests in individuals' qualification without having the structures to use this potential. In addition, the fact that 26% of the national funds for R&D have origins in European funds is a cause for concern, since it may be dangerous to rely so much on external funds. As already mentioned, if these funds are cut for any reason, the Portuguese research system may experience serious difficulties in maintaining its normal functioning, the projects, as well as the training and employment programmes.

The role of the private sector is also an important issue. The private sector is not yet intensely engaged in R&D activities or employing a significant number of doctorates. The state is providing financial incentives to stimulate the employment and the training in entrepreneurial environment. The state, through the Innovation Agency is active in trying to involve more the private sector in R&D activities and it is expected that positive outcomes will be felt in the near future. If the private sector indeed increases its

involvement in the research system, this will mean that the system will become more dynamic, more funds will be available and derived domestically, more research will be carried out in the context of application, more employment and employability will be created, thereby increasing the sustainability of the system.

Another important aspect to be reflected upon is related to the European level. The targets of the Lisbon Strategy were set out and the countries are making policies and taking measures to try to reach them, although as argued they are not being able to meet such targets so far. However, as diversity is one of the core characteristics of the European Union, maybe more attention should be paid to the differences in size, character and capacity of the different research systems at the European level so that individual countries can make more adequate plans regarding their own situation in terms of research capacity. At the national level there should also be a more critical attitude towards the targets of the Lisbon Strategy and how adequate some of these goals are, taking into account the specificities and size of the Portuguese research system.

In Portugal the case is not yet one in which there is a serious problem of employability of doctorate researchers, however there are signs that indicate that risks may arise in the near future and therefore the sustainability of the system may be affected. Hence policies must be reviewed.

References:

Barr, N. (2003). Higher Education. In Barr, *Economics of the welfare state* (pp. 321-345). Oxford: Oxford University Press.

Beerkens, E. (2008). The emergence and institutionalisation of the European Higher Education and Research Area. *European Journal of Education*, 43, 4, 407-425.

Caraça, J. (1993). *Do saber ao fazer: porquê organizar a ciência*. Lisboa: Gradiva.

Caraça, J. (1998). A Investigação na universidade: Uma perspectiva histórica. In Pedro Conceição, Diamantino Durão, Manuel Heitor e Filipe Santos (orgs.), *Novas Ideias para a Universidade*. Lisbon: Instituto Superior Técnico Press.

Directorate-General for Research (European Commission) (2005). *The European charter for researchers – The code of conduct for the recruitment of researchers*. Brussels: European Commission.

European Commission (2002). *The sixth framework in brief*. Brussels: European Commission.

European Commission (2005). *Working together for growth and jobs – a new start for the Lisbon Strategy*. Communication from President Barroso in agreement with Vice-President Verheugen to the Spring European Council on the 2nd of February of 2005.

European Commission (2007). *Strategic report on the renewed Lisbon strategy for growth and jobs: launching the new cycle (2008-2010) - Keeping up the pace of change.,* Communication from the European Commission to the Spring European Council on the 11th December 2007. Brussels: European Commission.

European Commission (2008). *Better careers and more mobility: a European partnership for researchers.* Communication from the Commission to the Council and the European Parliament on the 23rd May 2008. Brussels: European Commission

European Communities (2004). *Facing the challenge – The Lisbon Strategy for growth and employment*. Report from the High Level Group chaired by Wim Kok. Luxembourg: Office for Official Publication of the European Communities.

Ferreira, J. (2004). *Bolseiros de investigação: problemas e perspectivas*. Associação dos Bolseiros de Investigação Cientifica (ABIC). Lisbon: ABIC.

Gibbons, M., Limoges, C., Schwartzman, S., Nowotny, H, Trow, M. and Scott, P. (1994). *The new production of knowledge: the dynamics of science and research in contemporary societies*. London: Sage

GPEARI – Gabinete de Planeamento, Estratégia, Avaliação e Relações Internacionais (2007) SUMÁRIOS ESTATÍSTICOS I IPCTN.05 *Inquérito ao Potencial Científico e Tecnológico Nacional*. Lisbon: GPEARI

Heitor, M., Horta, H., Conceição, P. (2004). Do ensino técnico ao ensino das ciências de engenharia: uma leitura sobre a evolução do ensino da engenharia em Portugal no século XX. In: Heitor, M., Brito, J. M. B., Rollo, M. F. (eds.). *Momentos de Inovação e Engenharia em Portugal no século XX*. Lisbon: Dom Quixote.

Hillage, J., Polard, E (1998). Employability: Developing a Framework for Policy Analysis. *Research Brief*, 85. Brighton: Institute for Employment Studies

Jongbloed, B. (2003), Marketisation in higher education, Clark's triangle and the essential ingredients of markets. *Higher Education Quarterly*, 57, 2, 110-135

Magalhães, A. (2004). *A identidade do ensino superior: Política, conhecimento e educação numa era de transição*. Lisbon: Fundação para a Ciência e Tecnologia/ Fundação Calouste Gulbenkian

Magalhães, A. (2008). *As Formas Emergentes de Regulação Política e a Governação do Ensino Superior na Europa*, paper presented at the Seminário Internacional de Política y Sociología de la Educación Superior held (15 and 16 de December 2008) at the Universidad Nacional de Tres de Febrero, Buenos Aires, organized by RIAIPE – Rede Ibero-Americana de Investigação em Políticas da Educação.

Magalhães, A., (2001). *Higher Education Dilemmas and the Quest for Identity: Politics, Knowledge and Education in an Era of Transition*. Enschede: University of Twente Press

OCES - Observatório da Ciência e do Ensino Superior (2005). *A Situação Profissional* dos *Ex-Bolseiros de Doutoramento*. Lisbon: Observatório da Ciência e do Ensino Superior

OECD – Organization for Economic Co-Operation and Development (2002). *Frascati Manual – Proposed Standard Practice for Surveys on Research and Experimental Development*. Paris: OECD

OECD - Organization for Economic Co-Operation and Development Examiners (2006). *Reviews of National Policies for Education – Tertiary Education in Portugal – Examiner's Report*, Lisbon: OECD

Olsen, J.P. and Maassen, P. (2007). European debates on the knowledge institution: the modernization of the university at the European level. In P. Maassen and J.P. Olsen (eds.) *University Dynamics and European Integration*, Dordrecht: Springer

Oxford Advanced Learner's Dictionary (1995). Ed. Hornby, A., Crowther, J. Oxford: Oxford University Press

Peixoto, J. (2004). Highly Skilled Migration in Portugal – An Overview, *SOCIUS Working Paper* 3/2004. Lisbon: Centro de Investigação em Sociologia Económica e das Organizações

Ribeiro, F. R. (1998). O Sistema Científico e Tecnológico Nacional: Reforço da Internacionalização e Perspectivas. In Pedro Conceição, Diamantino Durão, Manuel Heitor e Filipe Santos (orgs.), *Novas Ideias para a Universidade*. Lisbon: Instituto Superior Técnico Press.

Ruivo, B. (1991). As Instituições de Investigação e as Políticas Cientificas em Portugal. In José Mariano Gago (ed.), *Ciência em Portugal*, Lisbon: Imprensa Nacional, Casa da Moeda

Van Vught, F. (forthcoming) *Dealing with the challenges in European higher education – A history and analysis of the European Union's higher education and research policies*, paper presented at the AFR Higher Education Conference, Sydney, 13-14 March, 2008

Weert, E, de (1999) Contours of the emergent knowledge society: Theoretical debate and implications for higher education research, *Higher Education*, 38, 49-69

Web:

A Dictionary of Business and Management. Ed. Jonathan Law. Oxford University Press, 2006. Oxford Reference Online. Oxford University Press. Tampere University. Last accessed at 13/02/2009
http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t18.e6268

A Dictionary of Education. Ed. Susan Wallace. Oxford University Press, 2009. Oxford Reference Online. Oxford University Press. Tampere University, last accessed at 13/02/2009
http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t267.e320

Associated Laboratories Council (Conselho dos Laboratórios Associados) (2004) *Emprego Cientifico em Portugal – Posição do Conselho dos Laboratórios Associados sobre o Emprego Cientifico em Portugal*, available at http://www.labs-associados.org/empregocientifico.shtml, last accessed at 20/05/2009

EUROPA Website, available at http://europa.eu/index_en.htm, last accessed at 29/04/2009

ERAWATCH Website, available at http://cordis.europa.eu/erawatch/index.cfm, information updated on the 08/12/2008, last accessed at 13/02/2009

FCT – Fundação para a Ciência e Tecnologia Website, http://alfa.fct.mctes.pt, last accessed at 09/04/2009

FCT – Fundação para a Ciência e Tecnologia (2007). Regulations for the programme of employment of doctorates for the national scientific and technological system (2007

version), available at http://alfa.fct.mctes.pt/apoios/contratacaodoutorados/regulamento2007.phtml, last accessed at 29/04/2009

FCT – Fundação para a Ciência e Tecnologia (2008). Regulations for the programme of employment of doctorates for the national scientific and technological system (2008 version), available at http://alfa.fct.mctes.pt/apoios/contratacaodoutorados/regulamento2008.phtml, last accessed at 29/04/2009

Fifth Framework Website, available at http://cordis.europa.eu/fp5/, last accessed at 13/02/2009

Innovation Agency Website, http://www.adi.pt/, last accessed at 09/04/2009

Intituto Camões: Ciência em Portugal Website, available at http://cvc.instituto-camoes.pt/conhecer/bases-tematicas/ciencia-em-portugal.html, last accessed 13/02/2009

OECD – Organization for Economic Co-Operation and Development (2008). *OECD Factbook 2008: Economic, Environmental and Social Statistics*, available online at http://masetto.sourceoecd.org/vl=6689095/cl=15/nw=1/rpsv/factbook/070101.htm (last accessed at 23/10/2008)

Portugal (2006) *Compromisso com a Ciência para o futuro de Portugal*, available at http://www.umic.pt/images/stories/publicacoes/MCTES_compromisso_com_a_ciencia.pdf last accessed at 29/04/2009

Portugal – Conselho de Ministros (2005) - Resolução do Conselho de Ministros, n. 198/2005, 2nd December 2005, available at http://www.portugal.gov.pt/Portal/Print.aspx?guid=%7B973547F8-59F7-4AC1-BD7D-C423AE553AA4%7D, last accessed at 23/05/2009

Portugal - Technological Plan Website, available at http://www.planotecnologico.pt/, last accessed at 29/04/2009

Seventh Framework Programme Website, available at http://cordis.europa.eu/fp7/, last accessed at 12/02/2009