

Policies to Foster the Creation of Research-Based Spin-offs in Portugal

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Policies to Foster the Creation of Research-Based Spin-offs in Portugal¹

Abstract

This paper presents a brief overview of the main government and institutional policies and mechanisms that promote and support (directly or indirectly) the creation of research-based spin-offs, as well as of the institutional changes that have been introduced to facilitate the commercial exploitation of results from academic research. In addition, there is an attempt to conduct a very preliminary assessment of some of the results achieved by these policies, within the limitations of the information available. It is concluded that the conditions for creating a firm that brings to the market knowledge or technology originating from academic research substantially improved in the last decade. Technology-based (and sometimes also scientific) entrepreneurship has been the object of several government policies and incentives and have also attracted the attention of other public and private actors, who launched a variety of programs to fund and otherwise support firm creation. This also coincided with institutional changes that facilitated the entrepreneurial initiatives of academic scientists. Although this appeared to have had positive effects in terms of the number of research-based spin-offs supported, the paper concludes, based on the limited data on results, that there is still work to do to improve the quality and effectiveness of the assistance provided. One step in this direction is a greater concentration and coordination of efforts.

Keywords: research-based spin-offs; firm creation; research commercialization; government policies; entrepreneurship programs; venture capital

JEL:

I23 Higher Education • Research Institutions

L26 Entrepreneurship

M13 New Firms • Startups

O31 Innovation and Invention: Processes and Incentives

O38 Government Policy

G24 Investment Banking • Venture Capital • Brokerage • Ratings and Ratings Agencies

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1. INTRODUCTION

The creation of new firms to exploit knowledge / technologies originating from public research organizations (PROs) has increasingly become one focus of the research and innovation policies in European countries (Wright et al, 2007). The interest on this specific category of firms derives from the fact that they combine the status of new technology-intensive companies - therefore benefiting from the importance attributed to technological entrepreneurship as a driver of innovation and growth and from policies designed to promote the creation and development of this type of firms – with that of instruments for the commercial exploitation of academic research – therefore benefiting from the emergence of a “third mission” for universities and other public research organizations and from policies designed to promote the interface between public research and industry.

Most European countries have introduced a number of regulatory changes that aim at reducing the obstacles to the exploitation of academic research and at encouraging the involvement of scientists in those activities. Simultaneously a number of policies and mechanisms have also been introduced – both at the government and at the institutional level - that directly or indirectly promote and assist the creation and development of research-based spin-offs. In addition, these firms benefit from a variety of policies targeting technological entrepreneurship in general.

This paper presents a brief overview of the policies introduced in Portugal that directly or indirectly promote and support the creation of research-based spin-offs (RBSOs). The analysis is based on secondary data and focuses on three main aspects:

- Policies and legislation changes that promote and facilitate the exploitation of results of public research, both implemented at government level and at organizational (PRO) level: e.g. changes in organization of public research; on IPR legislation; creation and development of infrastructures and mechanisms to promote technology transfer at PRO level; human resource policies favourable to commercialization (researcher status; career regulations and reward systems)
- Policies and mechanisms specifically oriented to the creation and /or to the development of firms exploiting results from research (if these exist) or targeting new technology-based firms in general, but found to have particular relevance for RBSOs.
- Impacts of these policies (whenever information is available)

2. THE UNIVERSITY AND PUBLIC RESEARCH ORGANIZATIONS (PROS)

2.1 The Organization of Research

The public research sector consists of three main types of organizations: higher education institutions, including 14 public universities and one university institute, as well as several private universities and university institutes (with diverse degrees of involvement in research activities); 293 research centres hosted by higher education institutions, particularly public universities (mostly small or medium sized); and 9 State Laboratories and 25 Associated Laboratories². During the 1990s and 2000s, a variety of national and European funding schemes enabled the training of new researchers, their inclusion in international academic networks and the creation of non-profit institutions dedicated to research (Laranja, 2007; Caraça, 2003). Thus, the number of scientists involved in public research activities and the volume of research activity consistently expanded over time (DGEEC, 2012).

Due to science policy options followed after the 1980s, the public universities are a central player in the Portuguese scientific system. A set of legislative acts adopted since the mid-eighties increased university autonomy and created the conditions to develop research. The University Autonomy Law (Law 108/88) awarded public universities important administrative and financial capacities and widened their academic autonomy, reducing the State control to a supervision role. The Statute of the University Professor Career (Decree-Law 448/1979 later updated by the Decree-Law 205/2009) made research an obligatory function of university academic staff, while the Statutes of the Scientific Research Career (Decree-Law 68/88, updated by Decree-Law 124/99) and of Scientific Research Fellows (Decree-Law 123/99, updated by Law 40/2004) regulated the research activity outside the university career (Teixeira et. al, 2007). However, the system is composed of a variety of other organisations, whose activity was regulated in 1999 by the Regime for Scientific Research Organizations (Decree-Law 125/99). This Regime also defined the main principles for the performance of research activities and established a number of rules concerning its conduction in research organizations.

The R&D performed in public universities is essentially based in research centres which were founded by academic staff and are often located at university facilities but have scientific and often administrative and financial autonomy. Several of these R&D units are (or were until recently) non-profit associations, so legally independent from universities, although maintaining strong linkages with them. Their public funding is awarded on a competitive basis as part of a multi-annual program created in 1994. This funding scheme includes a periodic assessment by international experts that

² Foundation for Science and Technology: www.fct.mctes.pt, and Council of Associated Laboratories <http://www.cla.org.pt>. Accessed 31.01.2013.

provides a quality classification, according to which the volume of multi-annual funding to be allocated to the unit is determined.

State Laboratories are public research institutions, established and maintained with the explicit purpose of contributing, through scientific research and technological development, to the formulation and implementation of public policies in specific sectors. Their creation goes back to the 1930s, but due to the slow development of the Portuguese science and technology policy during the dictatorship period, only in the early 1980s a national network of State Laboratories was properly organized (Laranja, 2007). Like university R&D units, a first external evaluation of these PROs was conducted in 1996/1997, which recommended several reforms, such as a greater orientation to public interest missions, the implementation of objective-based management models and the rejuvenation of human resources. As a result, in 2006, the government promoted a wide reform of the State Laboratories, including the network and locations reorganization, the redefinition of their missions and competences and the creation of R&D consortia gathering State Laboratories and other institutions. State Laboratories direct financing is based in two components: funds provided directly by the Ministries responsible by their management (which have decreased steeply in the last two decades) or contracts negotiated with the Foundation for Science and Technology in response to public interest priorities. But the main source is increasingly competitive project funding, in parallel with other PROs.

Finally, the Associated Laboratories are public or private, non-profit research organizations, whose “associated” status was formalized through a 10 years contract with the Foundation for Science and Technology (renewable upon positive evaluation), that commits the institution to pursue specific objectives and activities, according to a previously determined work plan. This type of status started being ascribed in 1999 and is attributed to already existing research organizations, individually or grouped, after submission to a national call. These Laboratories are formally consulted by the government on the definition of programs and instruments of S&T policy.

2.2 The Researcher Status

In Portugal, the research careers are ruled by four career Statutes: University Professor, Polytechnic Professor, Scientific Research and Research Fellows. Contrary to other European countries, the encouragement of an entrepreneurial attitude among research is not directly promoted by any of these laws.

Until recently, the Statutes of the University and Polytechnic Schools Professor Career didn't consider non-academic activities as relevant criteria for recruitment or career development, emphasising exclusively traditional teaching and research outputs (publications) for this purpose. In 2009, both

statutes were revised and included economic and social valorization of knowledge as an activity of university professors. Nevertheless, “exclusive dedication” was maintained as the basic rule of contractual link with the higher education institution which, in principle, does not allow the involvement in a company, although it is possible to opt for a different statute that allows for it (even if with much lower pay)³. Also, those statutes only refer to intellectual property rights of pedagogical materials, still missing rules about the protection of intellectual property rights (IPR) on research results. The Statute of Scientific Research Career is the only one which rules IPRs concerning knowledge valorization activities.

The lack of coordination between science, technology and innovation policies is a possible explanation for the inexistence, until 2009, of references to knowledge valorization activities in the legal framework that rules the university careers. In fact, as the responsibility for these policies is not concentrated in one Ministry, the measures adopted do not obey to a clear and unique strategy (Fontes and Novais, 1998; Laranja, 2007). So, in spite of several spin-off incentive schemes, promoted as part of innovation oriented policies, an equivalent encouragement of researchers is not included in the legal career framework for researchers. The recently launched +E+I Program (Strategic Program for Entrepreneurship and Innovation), which will be described in detail below, even configuring an attempt to coordinate science, technology and innovation policies towards a more entrepreneurial society, still does not address the legislation that rules academic careers in what concerns measures to promote entrepreneurship.

3. POLICIES FOSTERING RESEARCH-BASED SPIN-OFFS (RBSOS)

In Portugal, there are four types of public measures which are relevant to foster university spin-off creation, although some of them are not specifically oriented to them:

- Incentives to university knowledge transfer;
- Promotion of new technology-based firms;
- Promotion of venture capital investments;
- Simplification of the firm relationships with the Public Administration.

The first relevant public interventions in this domain began in the 1980s, but it was especially after 2000, along with a growing focus on the economic usefulness of PROs research activities and an increasing emphasis on the valorization of public R&D results, that specific measures to support academic entrepreneurship became popular.

³ In practice, the involvement in entrepreneurial activities, providing that it does not generate taxable rents (and that the often high teaching loads allow it) is increasingly tolerated and often even encouraged, particularly by some more entrepreneurially-oriented technological universities.

Institutional initiatives from higher education institutions in this area have also been increasing, particularly through their association to science parks and incubators and the promotion of entrepreneurship competitions and/or training programs. Frequently, these institutional initiatives are supported by private institutions (such as banks, trade associations or firms).

3.1 Incentives to university knowledge transfer

Since the 1980s, the Portuguese governments have been promoting the knowledge transfer from universities to the economic sphere. Although these public measures were not directly oriented to the promotion of university spin-offs, they resulted in a favourable environment to their creation and development. They included: (i) support to knowledge transfer infrastructures; (ii) support to university patenting; and (iii) support to Technology Transfer Offices (TTOs).

Support to knowledge transfer infrastructures

Given the structural weaknesses of Portuguese S&T and innovation system, the investments in science and technology infrastructures and the implementation of mechanisms to promote technology transfer became a policy priority since the 1980s (Caraça, 2003). Creation of knowledge transfer support infrastructures, such as applied research centres, technology parks and business incubators, were promoted by several programs, supported by EC funds:

- **CIÊNCIA** (Creation of National Infrastructures for Science, Research and Development) (1988/1992), encouraged the creation of the first Portuguese S&T parks;
- **PEDIP I & II** (Specific Program towards the Development of the Portuguese Industry) (1988/1992; 1994/1999) led to the establishment of technological centres and technology transfer centres, business incubators and an expansion of the venture capital market;
- **STRIDE** (Science and Technology for Regional Development in Europe) (1991/1994), promoted the creation of the Agência de Inovação (Innovation Agency) - a private agency with public funding oriented to promote the valorization of public research results, technology transfer, university-industry collaborations and innovation - which assumed the management of several programs supporting knowledge transfer and commercialization;
- **POE** (Economy Operational Program) and **PRIME** (Incentive Program to Economy Modernization) (1999/2004) supported the creation of several S&T parks and technology-based incubators.
- **QREN** (National Strategic Framework) (2007-2013) supports qualified entrepreneurship, including research-based spin-offs.

Incentives to university patenting: GAPIs, internal regulations and IPR Code revisions

Before 2000, Portuguese universities did not rule industrial property rights (IPR) protection and management. The Statute of the University Professor Career does not refer to IPR protection (except of pedagogic materials) and, only in 1999, the then updated Statute of Scientific Research Career (applying to researchers not in the university career) finally ruled in this matter. It imposed the division of IPR between the inventor(s) and the host institution, requiring the sharing, in equal parts, of R&D commercialization benefits. It should nevertheless be noticed that this lack of university involvement in patent activities did not result from any legal impediment. In fact, in the absence of specific regulations, the universities could apply the general law (Industrial Property Code), which establishes that the employer owns the inventions of the employees, whenever the performance of activities presumably leading to such inventions are part of the employee contract, unless the employer gives up such right. But due to the lack of internal rules and, particularly, of university interest in commercialization activities, a tradition of IPR protection by the academic community did not exist and the few researchers aware of its relevance submitted patent applications individually.

In 2001, the Portuguese Patent Office (INPI) launched a network of “GAPI offices” (Unit for Industrial Property Protection), in partnership with several public and private non-profit organizations. In the case of GAPIs integrated in universities, the main objective was to raise awareness and improve the IPR protection of R&D results, in order to make possible its commercialization. Favourably influenced by GAPIs’ action and by the incentives for IPR protection, universities have set-up internal IPR regulations, which, in general, define the university property of all IPR developed by their human resources, establish the duty to disclose inventions and detail the distribution of benefits as well as administrative procedures (Moutinho et al, 2004). Presently, the majority of public universities have adopted internal IPR regulations.

Finally, a support scheme to IPR protection (SIUPI) was also established and the Industrial Property Code was revised in 2003 and 2009, introducing several simplifications on IPR protection procedures. In particular, the last revision created the “provisional patent application”, a simpler and more accessible way to present a patent application which enables to establish the priority of an invention and is valid for 12 months, allowing, within this timeframe, the conversion into a definitive application. This new mechanism is of particular advantage to PROs as it allows conciliating disclosure interests associated to academic publication with the inventions protection. Also, it allows reducing the initial investment in a patent application, granting the applicant until one year to evaluate the potential of an invention, to decide about the real possibilities of industrial application or to improve the invention.

Support to technology transfer offices: OTIC initiative

The OTIC (Knowledge and Technology Transfer Office) initiative was launched in 2005 by Agência de Inovação to encourage the creation of knowledge and technology transfer units. These offices operate within higher education institutions - universities and polytechnics - and their goal is to develop mediation strategies between academia and companies, by detecting opportunities of economic exploitation of knowledge and technology developed by the former, and by identifying firms' demand that can lead to technological developments pursued in collaboration with higher education institutions. 14 Universities and 8 Polytechnic Institutes created an OTIC.

3.2 Promotion of NTBF creation

Although several programs oriented to support entrepreneurship were launched since early 1990s, only after 2000 were created some schemes with the specific purpose of promoting new technology-based firms (NTBFs), including university spin-offs. As a rule, these programs provide training and financial support for innovative start-ups. The programs that were found to be more effective in fostering the creation of university spin-offs are described in more detail below. In addition, several programs supporting firm development, encouraging R&D activities (including direct grants and tax relief), providing funding for innovation projects, and promoting the hiring of PhD and the qualification of human resources were introduced since the 1990s and were extensively used by the spin-offs, both before and after the launch of more targeted mechanisms.

NEST: New Technology-Based Firms Support (2002-2006)

The NEST program was the first national scheme specifically designed to support the development of business projects, based on R&D results and seeking the creation, development and production of new products, services, processes or production systems. The program aimed to address market failure in the final stage of the technology transfer value chain, promoting access to two types of financing: a) seed and start-up funding, through the involvement of venture capital; b) subsequent funding of innovation projects, through privileged access to other types of public support (e.g. PhD hiring; R&D support and IPR protection).

NEOTEC: New Technological Enterprises (2005-2008)

NEOTEC fostered the creation of technology-based firms with high growth potential, by providing financial support to the different firm creation phases. The goal of the program was to fill a financial gap identified in business initiatives originating from universities and, at the same time, to promote an entrepreneurial culture within the national scientific system, by supporting projects oriented to induce higher education students and PROs researchers to incorporate, into their regular activities, the development and implementation of knowledge valorization methods. The program supported new

ventures projects up to 24 months and a maximum of 100.000€. The total public funds allocated to this program amounted to 8.8 million Euros.

FINICIA: Start-up funding support (2005 onwards)

The objective of the FINICIA initiative is to facilitate access to funding by start-ups and small companies, which traditionally have greater difficulties in the financial markets. Using venture capital and mutual guarantee schemes, FINICIA supports three types of business projects: a) highly innovative business projects: targeting the creation of SMEs, financing up to 85% of the capital; b) emerging small-scale business: targeting micro and start-up firms, using venture capital and micro-credit; c) business initiatives of regional interest: targeting small firms, developing activities of local relevance (in collaboration with municipalities). This funding scheme was based on 14 regional platforms, organized around higher education institutions and also integrating trade associations, venture capital societies, business innovation centres and other entities associated to entrepreneurship promotion.

QREN: support to qualified entrepreneurship

The ongoing European Community Support Framework to Portugal (QREN⁴) includes the support to qualified entrepreneurship, including university spin-off creation. This funding scheme supports the setting up of new businesses as well as projects of new firms (less than 3 years of activity), classified as SMEs, integrating highly qualified human resources and that are active in sectors with strong growth dynamics. The public incentive has a refundable nature and varies between 35% and 75% of the eligible costs.

3.3 Firm formalities simplification

The Portuguese government has been investing in the simplification of the relationships between the Public Administration and the firms, which were extremely burdensome and thus were believed to act as a dis-incentive to entrepreneurial activities. Among the measures adopted, we can highlight three. The Business Formality Centres (CFE) network was established in 1998 to reduce the time spent in the processes of firm creation, amendment and dissolution, by concentrating, in one place, front-offices of the governmental agencies most directly involved in these processes. It currently integrates 10 centres. The ‘On the Spot Firm’ initiative was launched in 2005 and allows entrepreneurs to create a company in less than an hour and at a much lower cost by enabling them to do everything in just one office. Finally, the Enterprise’s Portal (www.portaldaempresa.pt) is an integrated access point to public services provided to enterprises, launched in 2006, which among other services, include the

⁴ Quadro de Referência Estratégico Nacional (National Strategic Framework) (www.qren.pt)

complete creation of an enterprise through the Internet (further extending ‘On the Spot Firm’ services), a help desk to enterprise activities and the Enterprise Electronic Dossier where the different processes of each enterprise with the public administration are assembled and made easily and securely available to the firm or their representatives.

3.4 Venture Capital

In the late 1980s, venture capital began to be understood as an important instrument for economic development. In the context of the PEDIP program two large venture capital societies were created, with public funding: NORPEDID and SULPEDIP (renamed in 1999 as PME Capital and PME Investimentos, respectively), which were designed to promote both industrial modernization and actual venture capital activities. During the 1990s, expansion projects dominated the investments of these societies, while the support to NTBFs represented only 15% of the total amount invested (Laranja, 2007). Taking this fact into account, PEDIP II oriented PME Capital to provide mostly seed and start-up financing and created the Venture Capital Syndication Fund – an investment instrument characterized by the combined intervention of public and private funding. In addition, after 2000, a new legal framework was established, simplifying the procedures and operation of venture capital societies (APCRI, 2008). In addition, in 2003, the government created INOVCapital, a public venture capital society specifically oriented to support innovative ventures, including university spin-offs. More recently the government decided to create a “mega” risk capital company – Portugal Ventures - that merges INOVCapital and other companies with public capital and that will invest in both existing companies and new ventures. The latter include seed and start-up and will encompass the proof of concept and the company start-up. Portugal Ventures has also introduced a program to support entrepreneurship – Ignition – that targets market-oriented scientific and technological projects⁵.

The sector remains largely dominated by societies created by public programs, but venture capital associated to banks or industrial groups has gained importance. A few of these have also started to invest in science-based start-ups with high potential (e.g Espirito Santo Ventures, Beta Capital, Caixa Capital, Critical Ventures). According to the Portuguese Securities Market Commission, the sector in Portugal includes 31 risk capital societies and 70 risk capital funds⁶, but only a small subset can be described as involved in venture capital activities.

In recent years the activity of private “business angels” has also increased. An Association of Business Angels (APBA) was created in 2006 and has been active in the promotion and support of entrepreneurial initiatives of an innovative nature, including those originating from the university.

⁵ Portugal Ventures: www.portugalventures.pt/

⁶ Portuguese Securities Market Commission: www.cmvm.pt accessed in 31.01.2013.

3.5 Institutional initiatives

In parallel with a reinforcement of government policies oriented to the valorization of research, technology transfer and technological entrepreneurship, universities and other higher education institutions began adopting internal knowledge transfer and spin-off support policies. A survey on entrepreneurship promotion at the higher education sector conducted in 2005 (Redford, 2005), concluded that 33% of the Portuguese universities and polytechnics inquired integrate knowledge transfer offices, 28.6% are associated to technology parks and 23.8% to incubators. Similarly, nearly 50% of these institutions declared to promote business plans competitions, which typically award the best business idea or projects submitted by higher education students or PROs researchers, providing small amounts of funding (usually around 25.000€). Finally, 14.3% of the institutions inquired had established agreements with financial entities to support spin-off creation.

The association of private entities to these types of university initiatives have become increasingly frequent in recent years, particularly in what concerns entrepreneurship competitions which, as a rule, are sponsored by banks, industry associations or firms. Also, some private organizations have started to organize their own academic entrepreneurship oriented actions. A great variety of business ideas competitions and entrepreneurship programs have thus been launched over time, some of them focusing specific areas (e.g. biotechnology, energy) others with a generic nature, with diverse degrees of success and longevity. We present below four pioneer programs that have originated several spin-offs, although others are currently active.

An interesting case is that of COTEC Portugal (Portuguese Association for Innovation)⁷, which, in 2004, launched **COHiTEC**, a national program whose main goal is stimulating the creation of high-growth ventures based on knowledge generated in Portuguese universities. The Program is based on a methodology of valuation of technology, including entrepreneurship training and financial support for business creation and is developed in cooperation with North Carolina State University and two Portuguese business schools. More recently, the program was reorganized and two separated (but complementary) programs were defined: COHiTEC, that is a training program for researchers and management students and it is the entry point for **ACT** (Technology Commercialization Accelerator) that supports promoters of technology-based projects in turning knowledge into social and economic value, by providing a series of services to help them bringing their idea to the market. Since its launch, this program has identified and supported the development of about 12 entrepreneurial ideas each year. Although only four firms were officially created under the program, several others have been created independently.

⁷ Associação Empresarial para a Inovação: www.cotecportugal.pt

A similar program has been promoted between 2001 and 2008 by the Portugal's Biotechnology Industry Organization (P-BIO), focusing exclusively in this sector – **BioEmpreendedor**⁸. This program was pioneer, not only in associating an Idea Contest with entrepreneurial training and contacts with financial institutions, but also in introducing the requirement of managerial competences in the team. About 15 companies have resulted, directly or indirectly, from this program.

Also of interest is an initiative launched in 2007 in the context of the recently created MIT-Portugal Program – the **Bio-Teams**⁹. This program (whose genesis is the MIT I-Teams project) focuses on (bio)technologies emerging from university research and put together PhD students and senior scientists with the objective of evaluating their market potential. The most interesting aspect of the program is that instead of focusing exclusively in new firm creation, it enables to assess whether the technology is appropriate for a new company (in which case the team is supported to progress in that direction) or whether it should rather be licensed to established companies. Considering the very limited experience of University technology transfer offices in the evaluation of the technologies being generated, this type of programs are important to support correct decision making processes and can also become the embryo for the development of expertise in this domain.

The MIT-Program is also at the origin of the more recent ISCTE-IUL/MIT Portugal “**Building Global Innovator's Venture Competition (BGI)**”¹⁰, launched in 2010 and currently organized in partnership with a venture capital fund (Caixa Capital) and a wide set of public and private organizations, as sponsors or strategic partners. It targets both embryonic and early-stage (from firms less than five years old) projects with what is described as a “clear global proposition”. Besides substantial financial prizes (totalling 1 million euros, awarded to four area-finalists and one grand-finalist), all finalists attend a Catalyst Program that offers training, mentoring by experienced business people and networking opportunities.

Finally, another relevant initiative is **BES Innovation Awards**, promoted by Banco Espírito Santo in association with 10 Portuguese Universities, which aims to reward and publicize research projects with application potential in sectors that are relevant for the future of the Portuguese economy, such as Renewable Energies, Health, and Industrial Processes. The projects are selected for their innovating nature and level of scientific excellence. The prize for each area of activity is worth a total of EUR 60,000, broken into three separate components: a cash prize (25.000€); a financial support to register the patent or other form of intellectual property rights (10.000€) and a viability study of the business carried out by Banco Espírito Santo de Investimento (25.000€)¹¹.

⁸ PBIO: Portugal's Biotechnology Industry Organization: www.apbio.pt

⁹ MIT-Portugal: www.mitportugal.org/programs/bio-engineering-systems.html

¹⁰ ISCTE-IUL/ MIT Portugal Innovation and Entrepreneurship Initiative (IEI): <http://mitportugal-iee.org/>

¹¹ BES Innovation Awards: <http://www.bes.pt/sitebes/cms.aspx?plq=2041D631-DC41-457B-8B8B-8C8D0304AE9A>

3.6 The Strategic Program for Entrepreneurship and Innovation (+E+I)¹²

The Program of the Portuguese XIX Constitutional Government recognizes that although entrepreneurship and innovation are central to achieve economic development and competitiveness, in Portugal there are still structural obstacles which interfere with the construction of an entrepreneurial and innovative society. In fact, despite the progresses occurred in the last years in R&D economic valorization, support to firm creation and innovation, the economic return of R&D is still insufficient while venture capital and other financial schemes have a small impact concerning the support to new and successful businesses.

Considering this scenario and the importance of entrepreneurship and innovation to overtake the economic crisis affecting Portugal, the Resolution of the Council of Ministries n.º 54/2011, published on the 16th December 2011, adopted the Strategic Program for Entrepreneurship and Innovation (+E+I Program), based on the following strategic objectives:

- (a) To build a more entrepreneurial society;
- (b) To extend and strengthen the Portuguese participation in international knowledge, innovation and entrepreneurship networks;
- (c) To improve investment instruments and their results.

To accomplish its objectives, the Strategic Program +E+I identifies four main areas of intervention:

- (a) To extend the competences of Portuguese population, companies and public services;
- (b) To boost innovation;
- (c) To stimulate entrepreneurship;
- (d) To promote innovation funding.

Concerning the first area of action, the government intends to implement it through the promotion of creativity, digital literacy, culture, science, technology and entrepreneurship at all levels of education; the improvement of companies' management skills and ability to innovate and internationalize; boosting citizens' creative and entrepreneurial potential, by encouraging their involvement in the design of solutions, products or services; and encouraging greater collaboration and interconnection between companies and the education system.

As for innovation boosting, the aims are to encourage links between research, creativity and innovation through effective university-industry relations and strengthening the national participation in international networks; stimulating applied research and the reinforcement of innovation and market-oriented science funding.

¹² Program webpage: www.ei.gov.pt/

To stimulate entrepreneurship, the main proposed actions are the creation of incentives for qualified entrepreneurship oriented to internationalization, social entrepreneurship and youth entrepreneurship in the economy; the promotion of social innovation and entrepreneurial skills in all levels of education; and to promote the appreciation of quality, merit and accountability as social paradigms.

Finally, innovation funding promotion shall be implemented by fostering national and foreign venture capital; organising a more articulated public and private funding offer, as well as to promote its appropriateness to entrepreneurship and innovation projects; and promoting the optimal use of funding mechanisms of the Strategic Reference National Framework (QREN).

Table 1 summarizes the measures to be taken in order to accomplish the goals of E+I+ Program.

Table 1 – Synthesis of the +E+I Program

Area of intervention	Measure	Objectives
Enlargement of knowledge and competences	To reinforce the learning experimental component on basic and secondary schools	To improve the experimental teaching of science and reinforce laboratory work. To stimulate creativity, collaborative work and a lower risk aversion.
	INOVA – Learn to be an Entrepreneur (Aprender a Empreender)	To encourage young people to develop initiatives to solve the problems of the communities where they are integrated.
	Scientific Human Resources to Economic Growth	To provide PhDs' with tools and skills allowing a greater and easier transition to non-academic careers; To increase R&D performed by companies, through mobilizing highly skilled human resources.
Boosting innovation	Partnerships towards the future	To improve the articulation between technology transfer units of the institutions of the Scientific and Technological National System, in order to endow them with scale and minimum levels of competence as well as promote links with companies.
	Economic valorization of Scientific Knowledge	To encourage interaction between higher education and R & D institutions and firms.
	Scientific Thematic/Priority Programs	To identify thematic areas of research, oriented towards the needs of firms, and to create concerted programs, involving grants for doctoral studies and projects in these areas, with strong industry participation.
	Support to patent submission and licensing	Support to industrial property rights submission and commercialization.

Policies to Foster the Creation of Research-Based Spin-offs in Portugal

Area of intervention	Measure	Objectives
	Creation and reinforcement of Firm's Innovation and R&D competences	Financial support to the creation and consolidation of firms R&D and Innovation Units.
	Support the participation of national firms in international R&D programs	Financial support to international networking and to the elaboration and submission of proposals to international R&D programs.
	Competitiveness and Innovation Poles	To encourage integration and articulation between economy existing clusters, in order to enhance firm's national and international competitiveness.
	Voucher +; Voucher Innovation; Voucher Internationalization	To support the initial phases of the innovation process through the simplification of funding access and decision process.
	National Council to Entrepreneurship and Innovation	Government advisory structure responsible for reflecting and orienting the establishment of entrepreneurship, innovation and applied R&D policies, as well as for promoting articulation between the different ministries involved in their definition and application.
To stimulate entrepreneurship	Attracting international talent and highly qualified human resources	To encourage international excellence entrepreneurs to begin their business in Portugal.
	+E+I Initiative – Public recognition of civil society initiatives	To provide institutional support to the initiatives undertaken by companies, R & D organizations, universities, public and private entities that fall within the spirit of the Strategic +E+I and contribute to fostering a culture and practice of entrepreneurship and innovation.
	National Award for Talent, Entrepreneurship and Innovation	To award, annually, the major successes in terms of innovation and entrepreneurship and to recognise the talents that more contributed to each area creative development.
	Repository Undertake + Innovate (Bolsa Empreender + Inovar)	To provide the access by start-up projects to the experience of successful companies and entrepreneurs, enhancing knowledge transfer and knowledge and innovation networks.
	Cultural and creative industries internationalization support	To create an internationalization support program to promote the export of Portuguese cultural products.
To promote innovation funding	Restructuring of Public Venture Capital	To reform the public venture capital sector and create only two public entities: a venture capital society, which will invest directly on SME and an investment society, which will manage a funds fund.
	To promote partnerships between national and international investors in innovation funding.	To create incentives to the formation of international networks of investors and create attractive conditions to foreign investment in Portugal.

4. EFFECTS OF POLICIES

The policy measures described in the previous section resulted in a general increase of firm creation, although their impact in entrepreneurial initiative has been negatively affected by the adverse economic climate that has been rising in the last three years. The entrepreneurial activity in Portugal registered a growth from 3.8%, in 2004, to 8.8% in 2007, but then decreased to 4,5% in 2010, which means that, in this last year, about 5 in 100 persons created a firm (GEM, 2012). This data is consistent with the registration of firm creation that presents a 19% decrease between 2007 and 2010.

Although the data on spin-off formation is scarce and dispersed, the information available suggests that the number of university spin-offs in Portugal is still relatively small. Rodrigues et al. (2007) found that the population consisted of around 350 firms in 2005, but a survey on 100 cases verified that most of them were created after 1995 and, in particular, in the 2000s. The study shows that 69% of the firms studied received some type of support, although most of them didn't consider it very relevant. Subsequently, a more precise assessment conducted in the context of a doctoral thesis (Conceição, 2013) identified 327 firms created up to 2007, 77% in the context of an incubator, of which 267 were still in operation in 2010 (Conceição, Fontes, Faria, 2013). Another study (Teixeira, 2011), identified 280 spin-offs associated with the universities that are part of the UTEN Network¹³ and surveyed 164. Among the 72 respondents, about 40% were located in science parks, and 68% had benefited from incubation facilities. However, only 13% mentioned support from TTOs. The main benefits firms perceived to have obtained from these support mechanisms – besides the access to knowledge and qualified human resources – concerned the access to business networks and the mentoring and business advisory services. On the other hand, they identified financial obstacles (cash flow, capital investment, R&D investment obstacles) and the incipient venture capital market as the most important obstacles for business development.

4.1 University S&T Parks and Business Incubators

Ratinho et al. (2007) identified 12 S&T Parks and 13 Business Incubators operating in Portugal in 2007, but according to the Portuguese Association of Science and Technology Parks (TecParques), the number of S&T Parks is currently 13¹⁴. These two types of entities have very similar features as both result from collaborations between local or regional authorities, universities and private organizations, are located in or around major cities and well developed urban areas and support firm

¹³ The University Technology Enterprise Network - Portugal (UTEN Portugal) is composed of 14 Portuguese universities and several R&D organizations and technology parks and was launched as part of the UT Austin|Portugal Program (<http://utenportugal.org/>).

¹⁴ These are: Azores Parque (Ponta Delgada), Algarve STP (Faro), Biocant Park (Coimbra), Lispolis (Lisboa), Madan Parque (Setúbal), Madeira Tecnopolo (Funchal), Parkurbis (Covilhã), Portus Park (Porto), PTM/A (Setúbal), Taguspark (Lisboa), Tecmaia (Porto), Tecnopolo Coimbra (Coimbra) [<http://www.tecparques.pt>]

creation and development. Also, apart from one S&T Park and one Business Incubator which are oriented to Biotechnology firms' support, all incubate companies of any sector of activity. From the 14 public universities, 13 are associated, as stakeholders, to S&T Parks or Business Incubators, some of them being associated to both kinds of institutions. Also, several other PROs, such as State Laboratories and Associated Laboratories, have established strong connections with this kind of support structures.

However, several studies on S&T Parks and Business Incubators demonstrated that their utilization by university spin-offs is very limited. Focusing on seven S&T Parks and four Business Incubators, Ratinho et al (2007) concluded that university spin-offs represent, on average, 7% and 8%, respectively, of their tenant firms, confirming previous research on this (Vedovello, 1999; Vedovello and Godinho, 2003).

4.2 GAPI & OTIC networks

The OTIC initiative supported the establishment and initial development of 22 new knowledge and technology transfer units hosted by universities and other higher education institutes. In addition, GAPI network includes other 22 offices. Although these offices' mission is not the direct support to spin-off creation, both offer substantial support services to the various phases of the spin-off process and can be accessed by academic entrepreneurs: GAPI provides IPR assessment, protection and management, while OTIC offers entrepreneurship training, support the commercial validation of the knowledge or technology to be introduced in the market, facilitate access to funding and promote contacts with business partners.

A recent report on the activity of the activities of Portuguese Technology Transfer Offices (TTOs) (Teixeira, 2011) presented information from a survey of 18 TTOs (most of which were actually created as part of the OTIC initiative). According to this report, TTOs were actively involved in patent applications, whose number had increased in recent years. These TTOs had also been involved in the creation of about 300 academic spin-offs. However, only in two cases the parent organization had taken equity of the companies formed.

4.3 Funding schemes & venture capital investments

The available information on the results of funding schemes and venture capital investments in university spin-offs is very scarce. For FINICIA, no aggregated data is available. The other funding schemes presented in the previous sections supported 314 NTBFs (Table 2), but no data is available that enables to individualize the RBSOs.

Table 2- Number of NTBFs supported by public funding schemes

Funding Scheme	NTBFs supported
NEST	34
NEOTEC	116
QREN (2007-Dez 2012)	164*
TOTAL	314

* Programme Qualified Entrepreneurship (excluding projects in Tourism sector)

Sources: ADI (<http://www.adi.pt>); QREN: <http://www.pofc.qren.pt/projetos/projetos-aprovados-qren>

From the results presented in Table 2, NEOTEC is the only programme which offers more detailed information. The scheme approved 116 projects and, by November 2007, 61 had given rise to new firms. The selected projects were characterized by the high qualifications of the entrepreneurs involved (448 had a university degree, of which 174 a PhD and 114 a Master). Moreover, 26% of entrepreneurial teams integrate people with business experience gained in international firms and the technology of 65% of the projects was protected, or in process of protection, through patents and copyrights.

Venture capital investments in seed and start-up phases, which are the most demanded by university spin-offs, also registered a growth until 2010. After 2010, the investment decreased, probably due to the economic crisis (Table 3).

Table 3 - Venture capital investment in seed and start-up phases (K Euros)

Year	Seed	Start up	Total
2001	7	15.989	15.996
2002	13	10.248	10.261
2003	0	13.503	13.503
2004	9	24.187	24.196
2005	4.332	24.248	28.580
2006	6.000	18.059	24.059
2007	200	27.811	28.011
2008	0	27.840	27.840
2009	88	32.822	32.910
2010	35	51.872	51.907
2011	480	9.480	9.960

Source: APCRI Statistics (<http://www.apcri.pt>)

Finally, in what concerns institutional initiatives, the most visible results are those of entrepreneurship competitions. Considering only the most popular national competitions (Table 4), the data available

points to support being awarded to around 113 NTBFs¹⁵. The highest prize amounted to 50.000€, while the most frequent amount consists of 25.000€. Of these programs only COHITEC explicitly targets academic entrepreneurs, although START, BioEntrepreneur and BGI competitions are largely dominated by this type of entrepreneur.

Table 4 - Number of NTBFs supported by private initiatives (December 2012)

Initiative	NTBFs supported
COHITEC (university spin-offs)	7 ⁽¹⁾
Business Ideas Competition FIVE	41
National Entrepreneurship Competition	5
START Competition	3
BioEntrepreneur Competition	6
ISCTE-IUL / MIT Portugal - BGI	13
BES Innovation Awards	38

⁽¹⁾ Includes only companies formally created in the context of the program

Sources: Programs webpages and documentation.

When analysing the projects approved and the amounts attributed to projects, it is common to identify numerous projects which applied to several funding sources. In fact, despite a proliferation of public or private university spin-off funding, the maximum amounts offered by the majority of these instruments is frequently insufficient to support the spin-off process, leading entrepreneurs to apply to several support schemes in order to obtain the necessary funds to develop their business project. This strategy is also used to profit from the training and tutorial provided to improve business projects that are often very incipient to start with. However, since, with a few exceptions, programs frequently require the public disclosure of the idea and often also of its technology base, this collection of public and private funding sometimes creates additional difficulties – namely in terms of intellectual property protection - instead of facilitating university spin-off development.

Critical voices have already been raised suggesting a greater coordination of efforts, in order to provide more realistic amounts of funding (particularly to firms in fields with higher capital requirements), as well as to offer better quality support (Arantes-Oliveira, 2007). The attempts to organize the entrepreneurship support under one strategic program and the merger of public venture capital funds may represent an effort in this direction, at least in what concerns public support mechanisms.

¹⁵The number of winners does not correspond necessarily to firms created: some winning projects never become firms, while some non-winners ended up profiting from the added value of more qualified programs that offer training, support to business plan development and contacts with capital providers to also create their firms. Finally, entrepreneurs often apply to different schemes and some of them won more than one competition.

5. SECTOR SPECIFIC INCENTIVES: THE CASE OF ENERGY

Besides the programs and mechanisms targeting diverse types of technology-intensive new ventures, firms from some sectors may benefit from incentives specifically targeted to the development of their technologies or industries. Energy is the example of a sector where opportunities for spin-off creation were relatively rare until recently, but where the emergence of new technologies related with renewable energy conversion and energy efficiency generated a more favourable ground for research-based entrepreneurs (Fontes et al, 2012). At the same time, the renewable energy sector was object of extensive government policies, focusing on the development of technological competence and industrial activities, which reinforced its attractiveness for new entrepreneurial activities. A recent overview indicates that, by the end of 2011, around 65 research-based spin-offs had been created in the energy field, the vast majority in the last 3 to 5 years (Fontes et al, 2012). Thus the energy sector is an interesting setting to look at the deployment of policies and mechanisms targeting a specific field.

The “hype” around the energy field led to the launch of a number of institutional initiatives promoting the creation of “green businesses”, some of them specifically targeting highly innovative ideas or university-based ones. Among these can be highlighted an Innovation Ideas contest promoted by the ex-public energy utility (EDP) since 2009, which was more recently complemented with the creation of an incubator specifically targeting new energy start-ups (EDP Starter). Both selected program candidates and incubated companies have access to the EDP Fabrication Laboratory (Fab-Lab) in order to further develop, prototype and test their ideas. The program has already distributed four awards, which combine a monetary prize and EDP support to company creation and project, all but one contemplating research-based spin-offs. In addition, at least five companies have already been created by program finalists. The incubator currently hosts 13 start-ups¹⁶. In addition, some of the generic institutional entrepreneurship programmes have specific streams dedicated to Energy/Environment projects (e.g. BES Innovation Awards; Beta Start; ISCTE-IUL/MIT-Portugal), bestowing one specific award in these areas. It is also worth mentioning the Green Project Awards initiative, co-organized by APA (Portuguese Environment Agency), Quercus (National Association for Nature Conservation) and a consultancy company (GCI). It covers a wide range of fields and types of business, the focus being on projects already implemented. But there is one specific stream on “Research and Development”, mostly directed to ideas originating from research organizations, that has already contemplated university spin-offs.

We can also observe some recent interest of venture capital firms in a few promising energy spin-offs, although the number of companies that were able to secure financing is still very limited. In fact, an

¹⁶ EDP Starter Webpage: <http://www.edpstarter.com/>

analysis of the portfolios of the most important Portuguese VC funds found that by 2012 they had invested in around 10 energy or energy-related spin-offs in different areas (Table 5).

Table 5 – Energy spin-off in VC companies’ portfolios

	Energy area	VC company	Year creation	Spin-off
Fibersensing - Sistemas Avançados de Monitorização, S.A.	Wind	InovCapital*	2004	INESC
Fluidinova Engenharia de Flúidos, S.A.	Efficiency	Change Partners	2005	Univ. Porto (FEUP)
Energus - Investimentos, Sistemas e Gestão SGPS, S.A. (ex-Eneida)	Efficiency	InovCapital*	2006	Univ. Coimbra
Energia Própria, SGPS, S.A.	Efficiency	InovCapital*	2007	Univ. Aveiro
Magpower - Soluções de Energia S.A.	Solar	ES Ventures	2007	Univ. Porto (INESC)
Quattro Energy, S.A	Efficiency	InovCapital* & Beta Capital	2008	Univ. Aveiro
Spheraa, Produção de energia, Lda	Small-hydro	ASK	2008	ISQ
EIDT, SA	Efficiency	Change Partners	2009	UNL (FCT)
Omniflow, SA	Wind	InovCapital*	2010	Univ. Porto (FEUP)
Feedzai - Consultadoria e Inovação Tecnológica, Lda	Wind	EDP Ventures	2012	Univ. Coimbra

* Currently Portugal Ventures

In addition EDP has publicly announced the creation of a corporate venture fund (EDP Ventures) whose goal is described as “to seek out innovative business ideas and talented entrepreneurs, invest in companies that have the potential to become significant, generating financial return”. The fund invests only in the clean-tech industry - including offshore generation (wind and waves), solar, smart grids, energy efficiency, electric mobility and energy storage - targeting companies whose technologies/business models can create value within the EDP group. Information provided mentions the investment on 6 start-ups¹⁵.

With respect to government incentives, several energy start-ups – including some research-based spin-offs - have benefitted from the generalist entrepreneurship programmes mentioned above, in particular from the Qualified Entrepreneurship Program, promoted in the context of QREN, whose launch coincided with the increase in technological and market opportunities in the energy field. In addition, a specific “umbrella” measure was launched, in the context of the preceding Structural Program (PRIME) that provided renewable energy firms with a path to a combination of several support mechanisms available in the program, including support to new firm projects¹⁷. However, data is not available on the firms that benefitted from this type of support.

¹⁷ Despacho 5059/2006 – steer several incentives towards projects that “promote clusterization around activities supporting renewable energy production and use”

6. CONCLUSION

The objective of this paper was to provide an overview of the main policies and mechanisms that have been introduced over time to promote and support the creation and early development of research based spin-offs. In addition, there was an attempt to conduct an assessment of some of the results achieved by these policies, within the limitations of the information available at this level.

One first conclusion is that the conditions for creating a firm which brings to the market knowledge or technology originating from academic research substantially improved in the last decade. In parallel to the introduction of a variety of government policies encouraging and supporting technological (or even scientific) entrepreneurship, it was possible to observe profound changes in the attitudes and behavior of individual scientists and academic organizations regarding the commercial exploitation of research results. More recently it was also noticeable some involvement of other actors (private and public) in technology-intensive entrepreneurial initiatives, namely those conducted by academic scientists which, until recently, tended to be regarded by investors as particularly uncertain. The most visible elements of this involvement are the multiplication of entrepreneurship programs that combine seed funding with a tutorial approach in business areas (particularly important for scientists without business skills or experience) and the increase in venture capital deals.

These changes have significantly altered the infrastructure for technological entrepreneurship (Van de Ven, 1993) creating an environment more favorable for firm creation. It should however be pointed out that most institutional initiatives and policies have been directed towards the process of firm *formation*, while the creation of conditions for the subsequent *development* of this type of firm should equally require the attention of policy makers (Mustar et al, 2008).

There is still limited research on the results of those government and institutional policies. While it was not the goal of this paper to conduct a comprehensive analysis of the impacts of the policies, we have nevertheless attempted to obtain some data on the results of the main programs and mechanisms. This data tends to be as fragmented as the programs themselves and it is not always easy to access, in particular in what concerns older programs that have stopped or have been replaced by new ones. On the other hand, it is often difficult or even impossible to single out the support awarded to research-based spin-offs in the case of generalist programs.

Even taking into account these limitations, it can be argued that the (official) data available points to a number of recipients for the different types of support which is not very high, especially considering that some of them did apply to different programs and that, in some cases, only a proportion of the recipients identified were spin-offs. However, recent attempts to delimit the universe of research-based spin-offs points to higher numbers and to an effective acceleration in the creation process in

recent years (Conceição, Fontes, Faria, 2013). This suggests that a substantial number of research-based spin-offs do not resort to formal incentives, relying on own resources and also, possibly, on the informal support provided the entrepreneurs' personal networks (Sousa et al, 2011). On the other hand, data collected by the authors in specific fields (e.g. biotechnology and energy) shows that a still relevant number of winners from ideas contests never pursue with the actual creation of the new firm. Anecdotal evidence hints that, while this can be explained by technological or market difficulties at the project/product level that prevent the entrepreneurs from reaching the expected outcomes, it can also be a result of failure in obtaining the resources – particularly financial ones – and competences that might sustain their efforts towards building the new business.

This suggests that, despite the presence of a variety of mechanisms and the involvement of diverse types of actors, there is still work to do improve the quality and effectiveness of support to research-based entrepreneurs. Some recent trends may point in that direction. In fact, after a period when there was a proliferation of programmes and mechanisms of very diverse nature and quality, it is possible to observe an attempt to greater coordination and concentration of efforts. This is occurring not only at the level of Government programmes, but also in what concerns programs and systems of institutional initiative, where cooperation and/or combination of resources are increasingly taking place.

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