

PAPER

Title: Building regional innovation systems in peripheral regions: lessons from the Região Centro, Portugal

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Abstract: Innovation has moved to the foreground in regional policy in the three last decades. Public policies have been shaped by “best practice models” derived from high-tech urban-metropolitan areas and successful territories. Nevertheless, lessons learned from these examples are rarely transferable elsewhere. The regional innovation systems in peripheral regions, and the likelihood of their acting as instruments for territorial competitiveness, have seldom been the subjects of discussion. The main objective of the article is precisely to take Região Centro, in Portugal, as an example to enrich this analysis.

The first part of this article examines the concept of regional innovation systems against the background of modern theories of innovation and regional policies, now that long-term regional competitiveness and sustainability has less to do with cost-efficiency and more to do with the ability of firms and institutions to innovate, or, in broader terms, to upgrade their knowledge base.

The paper will then proceed with an outline of the Portuguese innovation system and an overview of the regional innovative performance, as well as a description of the institutional and economic fabric that supports it, including an analysis of its functionality and dynamic, taking Região Centro as a case study. A particular focus will be put upon the drivers of regional innovation. Finally, the author will focus some specificities that need to be addressed in the redesign of public interventions in order to improve regional competitiveness and sustainability, leaving new insights about possible policy interventions in peripheral regions.

Keywords: : regional innovation systems; innovation policy; S&T policy; peripheral regions; Região Centro; Portugal

JEL codes: O18; O31; R11; R58.

1. Introduction

It is practically unanimous today, in the area of Regional Economy, that innovation is one of the critical dimensions conditioning the dynamic of industrial and territorial competitiveness. It is understood not only in the strict technological sense (product and process engineering) but also in its organisational (management, markets, etc.) and institutional (cooperation networks, etc.) dimensions (McCann and Ortega-Argilés, 2013). Furthermore, rather than being a result from a linear process developed both by the R&D offer (technology-push) and entrepreneurial demand (demand-pull), it is increasingly assumed as an interactive assemblage of dynamics in which dimensions associated to the institutional and territorial contexts are equally important.

Innovation dynamics emerge from interactions between agents operating in the system, where the overall innovation performance largely depends on the quality of these learning interactions and knowledge exchanges among the regional innovation stakeholders - firms, universities, research centres, etc. (OECD, 2011; D'Allura et al., 2012). Innovation is, thus, a process attached to a spatial context, a territory where the socio-institutional environment and economic structure characteristics enable the cooperation of firms and knowledge-creating and-diffusing institutions in innovation activities (Cooke 2008; Asheim et al., 2011b; Camagni, 2014). The regional innovation systems approach is either a useful methodological analytical filter to understand regional competitiveness, either a framework for constructing more adjusted strategies to cope with the challenges of entrepreneurial and territorial competitiveness.

This paper examines the Centro Region innovation system, in Portugal. It comprises three fundamental sections: the first one, addressing the main characteristics of the regional innovation systems approach and its contribution to deepen the understanding of territorial dynamics; the second one, is focused on Centro innovation system, either from a comparative perspective, on an inter-regional, national and EU basis, either pointing out some of its main structural features (RD&I infrastructure, the innovation incentives system, innovation barriers and innovation drivers); and finally, the last section will analyse the implications in terms of territorial innovation policy.

2. What can we learn from the regional innovation systems approach?

Innovation proceeds to a large extent from a combined dynamic involving a multiplicity of actors who, through organizational and institutional architectures of a cooperative

nature, continuously integrate and metabolize information, knowledge and other strategic resources. The innovation is therefore dictated by the good management and efficient use of the strategic flows of information and creation of knowledge, passing some authors (Cooke et al., 2005; Asheim et al., 2011a). to defend, as a priority measure of regional development, the notion of a Regional Innovation System which, in very synthetic terms, comprises a certain productive system and its political-institutional environment. The concept of a regional innovation system increasingly takes of an instrumental role, closely associated with innovation policies and the implementation of regional innovation strategies (Doloreux and Parto, 2005; Capello, 2014). The first objective of this model is to reinforce the territorial levels of competitiveness, by betting on innovative patterns of production, interaction and learning.

The dynamics of innovation appear based on resources that consubstantiate specific territorial assets and are not, therefore, a foot-loose process. Not surprisingly, spatially anchored production and innovation systems are increasingly seen as privileged tools for capturing and re-creating knowledge. This paradigm shift entails a new perception of the relationship between industrial dynamics and regional development: long-term competitive sustainability has less to do with traditional factor allocation optimization and cost efficiency, and more with the ability to companies and institutions demonstrate in innovating, that is, in broadening their knowledge bases (Santos, 2000; D'Allura et al., 2012; Crescenzi and Gagliardi, 2018).

Innovation is part of a dynamic that involves a multiplicity of territorial stakeholders, such as companies, universities, research organizations, technology centres, interface bodies, local authorities, financial institutions, which, through organizational costumes and institutions of a cooperative nature, continuously incorporate and process information and strategic resources (Hauser et al., 2007; Uyarra and Flanagan, 2010). Thus, as an instrument of economic and regional development, the need to value the business environment in the areas of technological assistance and the provision of non-routine services capable of adding differentiation and value to production; fundamental, above all, is the emphasis placed in the field of social capital as a basis for building innovative production (Tura and Harmaakorpi, 2005; Gertler, 2010; OECD, 2011; McCann and Ortega-Argilés, 2013; Rune and Jakobsen, 2018).

The possibilities for an innovation system depend essentially on two dimensions: spatial proximity and technological proximity (Asheim et al., 2011a). However, the

transformation of these two forms of proximity into a system of territorialized innovation presupposes that they are institutionally organized. Put another way, the cohesion of a regional innovation system should be ensured by collective action logics and shared common rules. In certain cases, this cohesion is more a matter of the domain of informal institutions, that is, of rules and norms that prevail in the local socio-productive culture and reduce the levels of uncertainty in the reciprocal behaviour of the actors. In other cases, the institutionalization of the territory is based on the creation of formal entities that involve reorganizations in the *modus faciendi* and the operationalization of a political and administrative framework of action - such is the case of regional innovation systems. In fact, the promotion of institutional architectures adjusted to the respective productive system constitutes, in this model, the true lever of business and territorial competitiveness, which gives it a marked operational character (Isaksen and Tripl, 2016; Makkonen and Rohde, 2016).

This theoretical, methodological and political heritage built around the regional innovation systems approach provides an interpretative framework for regional dynamics and adopts a network paradigm, seeking to identify and understand the cognitive, productive and technological dimensions that currently affect the territories (Kuştepli et al., 2013; Tomaney, 2014). It should also be noted that the now widely established concept of Smart Specialisation, which has been singled out by the European Commission as a central pillar of the Europe 2020 strategy, is, in our view, rooted on, among others, the regional innovation systems approach. The argument is that regions should identify sectors, technology domains, or key areas of likely competitive advantage, and then focus their regional policies by supporting innovation in these areas (Fiore et al., 2011; Wintjes and Hollanders, 2011).

The regional innovation systems mode has thus enriched the readings of the dynamics of regional development (Figure 1). The existence of specific competences, the capacity for cooperation among actors, institutional solidarity, collective learning processes and the promotion of innovation potential are, after all, key ingredients of the of business and territorial development.

Figure 1 – The regional innovation system approach: main features

	Regional Innovation Systems approach
Emergence	Induced; as organizational entity
Predominant culture	Scientific and entrepreneurial culture
	Industrial and tertiary; diversification of production from the

Productive system	standpoint of intra-industry division of labor; large and SMEs; quasi-vertical integration; open
Non-commercial relations among the firms	High intensity of extra-productive exchanges; diversity of non-market formal relations
External relations	Great openness to international dynamics; insertion on the international circuits of information and knowledge transfer
Networking	networks with pivot enterprises or institutions (university, RD&I agents, ...)
Logics	Of partnership; institutional architecture as a lever of the territorial competitiveness; promotion of the innovation potential
Predominant knowledge formats	Codified; global
Predominant learning processes	<i>By searching, by networking</i>
Predominant innovation modalities	Incremental and radical - <i>first of its kind</i> ; of the product, of the process and organizational
Growth dynamics	Cross-fertilization; highly induced by the entrepreneurial ecosystem; dynamic adjustment between the entrepreneurial and the institutional spheres
Potential risks	Technological and relational lock-in; exit barriers: institutional sclerosis

Source: adapted from Santos (2009)

The nuclear debate about the nature of innovation and its implications at territorial level led to the gradual recognition that innovation is neither a one-way diffusion process, nor a clear-cut factor-impact relationship between the creative innovative entrepreneur and the firm, but a process and/or a system of innovation. The pluralism of interpretations of innovation dynamics converges however on the understanding of the importance of the collective learning processes, networking and governance. More profound and lasting effects of increased competitiveness can only be obtained if innovation becomes systemic in a region, i.e. if it assumes a territorial innovation system configuration (Tomaney, 2014; Carrincazeaux and Gaschet, 2015). The regional innovation systems approach has basically emphasized the importance that the formal and informal mechanisms of production, dissemination and consumption of strategic information and knowledge have for the competitive performance of these systems.

From the point of view of the formulation of innovation policies, this approach is enriching, especially for peripheral regions, because they allow us to inquire about the set of basic conditions (on the quality of actors, externalities, in the processes of knowledge accumulation, networking, political-institutional culture, etc.) that need to be brought together so that a dynamic conducive to the promotion of regional innovation potential can take place in a competitive and sustainable way, beyond the reductive but complementary limits attached to orthodox industrial policies.

3. The Centro Region Innovation System

3.1. The Centro Region *versus* the National and EU contexts

The Centro Region of Portugal is made up of 100 municipalities, covers an extent of 28,199 km² (representing 30.6% of the total area of Portugal, being its second largest region), has an international land border with Spain of 270 km and an Atlantic coastline of 279 km in length and an estimated population, for 2017, of 2.243.934 inhabitants – which corresponds to a demographic decrease of 3.6% since 2011 and points out one of the main structural regional problems, an ageing population coupled with continuous flows of out-migration. With Coimbra being its most important city, with an estimated population in 201 of 134.156 inhabitants, the territory is characterized by a network of well-distributed medium-sized cities, presenting, however, a highly differentiated development pattern between the coastal and inland areas. It is, in general terms, a low demographic and economic density territory, with an urban hierarchy anchored on small to medium-sized cities (more S than M, by European patterns).

Figure 2: The Centro Region and its NUT III sub-regions (Inter-municipal Communities)



Source: CEC 2018

In 2016, the Gross Domestic Product (GDP) generated in the Centro Region was 32.3 billion euros, representing 19.0% of the national GDP, becoming the third region of the country, after Lisbon and the North, in terms of the contribution to the national GDP. The majority of industrial activities that make up the most relevant specialization areas

in the Centro Region have a strong exposure to international markets when compared to the national average. The very strong concentration of exports in a limited number of specialisation sectors of (pulp and paper manufacturing, plastics, mineral products, metal products and machinery and equipment) account for almost half of the Central Region's total exports, representing 20% of total regional GVA. The sector that weighs most in regional exports is the manufacturing of motor vehicles and components for motor vehicles. As mentioned above, the Centro Region has a diversified production structure in which traditional areas of expertise (ceramics, non-metallic minerals, forests and resulting products such as pulp and paper) coexist with more recent economic activities based on technology (metal mechanics, moulds, equipment) and also knowledge-intensive activities (information technology, biotechnology, renewable energy, new materials and health) (CCDRC, 2016). The Centro Region also possesses strong knowledge and innovation generation capabilities relevant to several of these areas of expertise.

Table 1: Centro Region vs Portugal and the EU: a quick portrait

	Centro Region	Portugal	EU
Population	2.243.934	10.320.934	511.522.671
Population density	79.6	112.5	118.3
Ageing Index	188.5	143.9	123.9
Proportion of the pop.aged 30-34 with tertiary education attainment	32.7	31.5	39.9
Early leavers from education and training (%)	10.5	11.0	10.6
PhD's/1.000 inhabitants	2.0	1.8	1.1
Unemployment rate	6.9	9.8	7.2
Average monthly salary (€)	950.5	1.152.3	1.520
GDPpc (€)	15.677	17.934	27.700
Coverage rate of imports by exports	117.7	84.5	112.9
GVA proportion in medium to high-tech manufacturing	11.5	22.6	35.2
Proportion of enterprises employing fewer than 10 employees	96.5	95.7	94.9
European patent application per million inhabitants	98.0	14.1	111.97
Proportion of enterprises with innovation activities (2012-2014)	60.2	58.8	78.0
R&D expenditure (% GDP)	1.2	1.3	2.0
Proportion of the R&D expenditure by execution sector – enterprises	47.6	42.7	55.3
Proportion of the R&D expenditure by source of funds – Enterprises	42.1	42.5	54.3

Source: INE, Pordata, Eurostat; Last year: 2017 or last available year

In 2017, the Region exports of goods amounted to approximately 10.7 billion euros, representing 19.3% of the national total, but showing a decrease compared to 2016 and 2015. Exports of goods continued to surpass imports (117.1%), although in a less significant way than in the previous five years. This export vocation profile is, indeed, one of the main structural features of the industrial regional fabric and a sign of its global competitiveness. One of the economic traits of the regional economy is this manufacturing diversified profile that has been persisting over decades – in fact, even suffering from acute structural adjustments dynamics on some sectors (e.g., the downsizing of the textile and clothing industry), the Centro Region never really deindustrialised and has, on the contrary, along the years, diversified and extended its specialisation pattern to new emergent productive areas (CCDRC, 2018).

According to the RD&I indicators shown on Table 1, both the Centro Region and Portugal, still struggle to extract economic value out of its scientific excellence, and both the regional and the Portuguese business innovation lag behind its European peers in technological outputs of the innovation effort. This comparative perception of the framework at national level is important, as it is also important to realize the Portuguese framework in the context of the European Union – Table 2 shows a comparison, according to a selected group of indicators of the European Innovation Scoreboard.

Table 2: Centro Region Innovation Scoreboard indicators relative to Portugal and the European Union

	Data	Performance relative to	
		PT	EU
Tertiary education	29.6	91	72
Lifelong learning	9.5	99	92
International scientific co-publications	1053	102	102
Most-cited scientific publications	9.2	102	109
R&D expenditures public sector	0.69	100	97
R&D expenditures business sector	0.65	105	68
Public-private co-publications	28.7	90	50
EPO patent applications	0.55	100	34

Trademark applications	4.31	87	85
Design applications	0.67	86	77
Employment MHT manuf./KIS services	7.8	75	52
Exports of MHT manufacturing	38.0	104	70
RII 2017 (same year)	-	104.4	85.0

Source: Regional Innovation Scoreboard 2017

The observation of Table 2 illustrates some structural divergences between the Centro Region (a *Moderate + Innovator*), Portugal (a *Moderate Innovator*) and the European Union. Not surprisingly, it is particularly noticeable that the regional and the national innovation systems share many characteristics, there are very much alike in overall terms, the Regional Innovation Index for the Centro Region being slightly superior to the one for Portugal, both lagging behind the EU index. Despite the efforts pursued in terms of R&D inputs (the public sector as the main source of funding R&D activities, the business sector still assuming a role well below the EU average), both Centro Region and Portugal lack a proportional translation into innovative economic performance. There still is a low capacity for patenting, employment creation in medium and high technology manufacturing and in exports with and medium to high technological content. The Centro is the second Portuguese region with the best innovation performance, but lower than the European Union average in 2017 (85.0%). In the total of 220 European regions it is in 121st position, while in the group of the 85 moderate innovative regions it is in the eighth position. For this relative good performance contributed variables such as innovation spending (except R&D), the proportion of SMEs with intramural innovation, the proportion of SMEs with product/process or marketing innovation/organizational.

3.2. The Centro Region S&T system: inter-regional perspective

In 2016, investment in Research and Development (R&D) in the Centro Region was 447 million euros, which represented 18.7% of national R&D expenditure. Faced with 2015, there was an increase in R&D investment of 7.5%. Its weight in gross domestic product (GDP) also increased in the region to 1.27%, but was below the country average (1.29%). This figure remains well below the 3% target set for 2020. The

proportion of regional investment in R&D executed by the private sector in 2016 stood at 52.6%, even though surpassing the national average of 50.0%.

Table 3: The Centro Regional R&D system in perspective

	R&D investment, 2016 (thousands €)	Proportion of the R&D investment on the GDP, 2016 (%)	Proportion of the R&D investment on the national total, 2016 (%)	Proportion of the business sector R&D investment, 2016 (%)
Portugal	2.388.467	1,29	100	50
Norte	748.158	1,37	31,3	50,4
Centro	447.221	1,27	18,7	52,6
AM Lisboa	1.071.716	1,61	44,9	50,5
Alentejo	65.974	0,54	2,8	49,6
Algarve	29.930	0,36	1,3	16,4

Source: CCDRC 2018

The national and the regional research and innovation systems are mostly driven by the Business Enterprise and Higher Education sectors. Over the last decade these two sectors built on their dominant position in the system as R&D performers, while the Government sector concentrated on its funding role.

It is worth adding that along these characteristics, the national S&T system is geographically very unbalanced, since there is a phenomenon of excessive concentration in the metropolitan areas, with a particular focus on the Lisbon region (Table 4). The Lisbon region is responsible for nearly half of the total public and private expenditure in R&D and about the same proportion of the total human resources dedicated to these activities.

Table 4: S&T indicators by NUTS 2

	Human resources in science and technology (HRST), by NUTS 2 region	Employment in high-tech sectors (high-tech manufacturing and high-tech knowledge-intensive services), by NUTS 2 region	Patent applications to the EPO by priority year, by NUTS 2 region	Total intramural R&D expenditure (GERD), by NUTS 2 region	Researchers, all sectors, by NUTS 2 regions

	(% of economically active population, 2017)	(% of total employment, 2017)	(number of applications per million of inhabitants, 2012)	(% of GDP, 2015)	(% of total employment, 2015)
Norte	31.2	2.5	7.23	1.35	0.79
Centro	30.9	2.0	11.72	1.22	0.72
Lisboa	45.3	4.8	8.63	1.51	1.38
Alentejo	28.8	2.1	7.83	0.53	0.30
Algarve	30.4	n.a.	3.74	0.37	0.34

Source: Eurostat (2018)

Nevertheless, on what concerns the Centro Region, it should also be noticed that the spatial distribution of the S&T and technology transfer organizations, under the influence of either the universities of Coimbra, Aveiro and Beira Interior, either, namely, of the polytechnics of Viseu and Leiria, is a strong facilitation factor for implementing a regional innovation system policy. The localization of the R&D infrastructure (labs, technological centre, S&T parks, incubators ...) shows a noteworthy concentration around those higher education institutions and cities, and should constitute a plus and a lever for the formulation of regional innovation strategies.

3.3. The RD&I infrastructure

The regional innovation ecosystem has been progressively consolidated by the existence of a number of higher education establishments (with around 80.000 students), a large number of research units (some of them recognized for their excellence, also internationally) and a wide range of institutions promoting innovation and technology transfer (including three centres of the National Network of Technology Centres, 16 incubators of companies that constitute a regional network - with Instituto Pedro Nunes being a recognized international reference - and a network of seven science and technology parks, where Biocant, nearby Coimbra, stands out. It also includes three thematic clusters and five competitiveness poles based in the Central Region, as well as a significant set of support structures for productive activities, which are a strong sustenance tool for innovation (a particularly important aspect given the small average size of the nearly 70.000 companies in the Centro Region) (CEC, 2018).

Table 5: The regional institutional infrastructure: an overview

Territorially embedded RIS operators	Regional Clusters in activities with low capacity of generating new S&T opportunities (supplier dominated sectors)	Relevant local clusters of ceramics and construction materials, glass and crystal industry, metallic furniture
	Regional Clusters in activities with capacity of creation of new S&T opportunities	Moulds cluster, evolving to engineering activities; health cluster; energy cluster.
	Non R&D professional and technical institutions supporting training, S&T inputs and other specialised services	Sectoral technological centres located in the Region (glass, ceramics, moulds, agro-food)
	Knowledge Intensive Business Services	ICT cluster based on regional start-ups, linked to Univ. Coimbra and Aveiro; Health cluster – Univ. Coimbra and UBI
	R&D institutions (Universities and other non-profit R&D units)	R&D institutions providing supply of human capital and knowledge in all the scientific domains Critical masses of scientific resources in telecommunications, new materials, information systems and in health activities
	Regional interface/brokerage institutions (science and technologic parks, technology transfer offices, ...)	Biocant, a specific industrial park for bio-firms already in place Emergent regional structures of inter-faces academia-industry Regional network of NTBFs incubators (RIERC)
Regionalized external innovation system operators	External business investments in high-tech or R&D activities	Altice/Nokia/Siemens R&D centres in Aveiro IBM R&D centre in Viseu Altran R&D centre in Fundão Bosch R&D centre in Aveiro – thermotechnology

Source: Adapted from Almeida et al. 2008

There is a large number of R&D institutions, some of them with a good scientific reputation and staffed with highly qualified researchers, nevertheless, the mechanisms of technology transfer to industry are still inadequate, although this situation tends to improve due to policies oriented to the creation of transfer instruments, the pressure on public institutions to self-finance and the increased technological awareness of industry. It is also important to emphasize the significant entrepreneurial orientation of the regional innovation policy that is being implemented, namely in terms of the

institutional innovation support concerned with start-ups promotion. In fact, the Centro Region initiated in 2007 the creation of the RIERC - Network of Business Incubators of the Centro Region - which assumes itself as a regional network, integrated into the innovation ecosystem; besides contributing to the regional (and national) policy formulation, it is ultimately oriented towards the implementation of incubators to help promoting entrepreneurship and innovation, with a strong connection to the regional S&T system.

3.4. Enterprise incentives system

Within the framework of the Incentive Systems available in the NSRF and Portugal 2020, the Centro Region focused heavily on the financing of research and innovation, and made intensive use of the tools to support innovative business initiatives. The sectors most represented in the supported investments are the manufacture of pulp and paper products, physical and natural sciences, the manufacture of chemicals, metal moulds, tourism, motor vehicles (including components and accessories), glass and ceramics, plastic articles and information technology.

Table 6: Enterprise incentives system of the Operational Programme Centro 2020

Investment tipology (%)	Entrepreneurial innovation (SI Innovation)	64.9
	SME qualification and internationalisation (SI SME qualification and internationalisation)	20.4
	Financial instruments	9.7
	RTD (SI I&DT)	5.0
Firm dimension (%)	Small	40.8
	Micro	29.1
	Medium	18.0
	Large	2.4
	n/a	9.7
Sector of activity (%)	Manufacturing industry	67.6
	Service	9.8
	Commerce	5.3
	Other	17.3

Source: Centro 2020 (30 June 2017)

The business incentives system shows, in terms of the preponderance of allocation and commitment, that, of the overall European fund value absorbed by the instrument, 64.9% corresponded to approvals in the area of business innovation and

entrepreneurship, while only 5.0% of the investment is related to R&D projects – medium low-tech/low-tech, are only about 20% of this.

The projects supported by SI Innovation are directed towards the promotion of innovation in the business fabric, either through the perspective of introducing innovation in the market (product innovation) or through innovation to be used by the company (process innovation). They should serve to increase innovative productive investment (incorporating new technologies), strengthen business orientation to international markets, and stimulate skilled entrepreneurship and structuring investment in new areas with growth potential. Basically, however, they are addressing the tangible innovation modalities of product and, mainly, of process, neglecting other critical dimensions, such as organisational or market innovations. This said, it seems this is an effect of a still prevailing business model based on volume and scale whose competitive advantages are more due to labour costs than to quality, differentiation and innovation.

SI Research and Technological Development projects finance research and technological development projects of companies, alone or in association. They aim to improve the ability of companies to produce, absorb and apply knowledge in order to increase the competitiveness of enterprises. There are not many firms on such a mature stage in terms of their innovation strategies, this explains the reduced financial bulk allocated to this end. The projects supported in the SME Qualification and Internationalization of SMEs apply only to SMEs and are aimed at stimulating the competitiveness of SMEs by increasing productivity, flexibility and responsiveness and active presence of SMEs in the worldwide market.

The Centro Region allocates a large share of Structural Funds to innovation objectives, along with the high public co-financing rate granted to EU convergence regions for investments in research projects – spanning from 50% for large companies to 70% to small ones. This context makes it attractive to enterprises to pursue their innovation activities in the Region. It also signifies a solid incentive for extra-regional and multinational enterprises to proceed research and develop innovative outputs in Centro Region, compared to EU ‘Competitiveness’ regions where co-financing rates are lower, such as, for instance, in the Lisbon Metropolitan Region.

3.5. RIS main innovation barriers

3.5.1. Barriers associated to the private sector

Concerning the full exploitation of the Centro Region innovation system, there are several structural constraints that are refraining its dynamics or even impeding the RIS from following an easier upgrading trajectory.

The large majority of SMEs (more S than M...), have structural deficiencies associated to the academic qualifications of their human resources. Most companies do not have qualified human resources that may enable them to fully assimilate strategic cognitive resources and gain competitive advantages. This should put the recruitment of middle and senior staff among the main sources of competitive advantage of companies. Besides, the large majority of the small and medium entrepreneurs possess no more than the basic education level and the installed RD&I infrastructure seems too far away from their needs and expectations. It is no surprise that, on this context, there is a reduced entrepreneurial demand for dynamic competitiveness factors (product engineering, quality management, design) which is also not unconnected with the productive profile of more traditional and low-technology industries, low knowledge-intensive, a situation that embodies a fragile demand-pull.

The existing technology transfer system still needs to be adjusted to the specific needs of small and medium-sized lower tech firms that account for the vast majority of the regional productive universe (Santos 2012). They have a specific kind of demand that needs to become explicit so that the innovation support infrastructures can conform to their requirements: most SMEs usually need know-how which is often below the scientific and technological levels of universities, technological centres or other public or private innovation support institutions. It must also be emphasized that non innovative SMEs, that is the larger part of the productive fabric, are seldom taken as a priority target by those innovation support infrastructures (Natário et al., 2012).

Mostly, entrepreneurial strategies more based on volume and scale than on differentiation and innovation. Innovations mostly follow dominant technological paths, grounded on already existing knowledge and being principally of the incremental modality. Basically, companies are bound by market pressures, to take a competitive position that passes mainly by the systematic and gradual renewal production processes (automation of production lines, etc..) with the aim, in the first instance, to increasing productivity, improving delivery times and reducing the need for labour. Resulting from

fordist strategies, they seek to optimise scale and volume: that is the reason why other key types modalities of innovation are inadequately addressed - little attention is being paid to the intangible dimensions of innovation. This seems a consequence of a predominance of a very restrictive notion of innovation among the vast majority of Portuguese entrepreneurs, as they tend to assimilate modernization strategies, based on the renewal of physical capital goods, to innovation.

So, there is an increased awareness about the need to change the basis for the competitive advantage of the Centro regional fabric. On one hand, a vast majority of the research capabilities still lacks substantive interaction with firms and the intensity of technological start-up's is still low (Santos, 2012; Araújo et al., 2013; Gama et al., 2018). On the other hand, RD&I capabilities oriented towards the incorporation of knowledge in the qualification of endogenous resources are incipient, not well targeted and with no systematic interface with a vast number of SMEs that vertebrate the Centro economy.

The reality of demand-pull factors of innovation is quite modest. Three programming periods of the co-funded EU support, already involving competitiveness and innovation goals, originated few organizational learning results in targeted Objective 1 territories. It seems, thus, that the extremely centralized and hierarchical architecture of the national innovation system, in fact, constitutes a bottleneck in instituting a culture of proximity among entrepreneurial and institutional actors (Figueiredo, 2007).

In an attempt to close the gap between university and industry a number of interface institutions, such as the AdI, an innovation relay centre promoted under the framework of the STRIDE Program, were created in a context of central government initiatives. However, the majority of these innovation catalyst institutions belong to the Portuguese innovation system, seldom adopting a territorial focus – on the contrary, vertically and strategically dependent, they have to fulfil national targets that sometimes inhibit the promotion of horizontal cooperative behaviours among the regional actors and the complete exploitation of regional synergies.

Mostly, knowledge sources are external either to the enterprises either to their territorial contexts. Thus, innovation dynamics is not sufficiently regionally embedded, there is a deficit of territorially rooted innovation networks, a fundamental characteristic of a mature regional innovation system. In general, too, the business partners along the value chain are not located in these territorial spaces and, consequently, the dynamics of

innovation is not regionally rooted (Xavier and Vaz 2013). Moreover, a large share of the regional business community, including the vast number of SMEs that vertebrate the regional economies, remain unaware of the mechanisms of information transfer and knowledge in place, not being part of the local/regional innovation systems, either because they are practically non-existent, either because the national innovation system is too far away from the real needs of this wide range of firms. Technical knowledge is socialized on the basis of informal locally-based networks, in which information circulates and is shared. Innovation dynamics that is not territorially embedded.

So, besides their dimensional handicap, as the vast majority of the Centro regional enterprises are small to medium-sized, the true critical bottleneck is their relative isolation, not to be connected to the information and knowledge flows, to the global world, the so-called *loneliness syndrome* (Santos and Simões, 2011).

3.5.2. Barriers associated to the public sector

Portuguese regions are, as mentioned before, *planning regions*, with no political statutory power. On this territorial and organic context, the risks of crowding-out effects are high - for instance, the strategy of attracting FDI in knowledge-intensive activities and services is led by national agencies, with practically no receptiveness to regional innovation systems.

It must be added that Portuguese RD&I policy, as it is centrally defined and implemented (top-down), is specially targeted to the preparation of the economic fabric to the globalization process although, paradoxically, in overall terms, it is not very market-oriented. Defined and implemented from a national level and perspective, this policy tends to deepen vertical hierarchical connections and even centralism, instead of aiming to fertilise a regionally based innovation dynamics (Vaz et al., 2014). In Portugal, there is no regional innovation policies formulated in a regional basis and there is neither an innovation regional policy, territorially based. The innovation policy, designed and implemented on a national level, has not been, in fact, refraining disparities among the Portuguese regions, due to a logic that is largely conditioned by the volume and qualified entrepreneurial demand that favours particularly the most dynamic regions of Lisbon and Oporto.

Chronically, one of the handicaps which also still typifies this region is related to the fact that their technological patterns is characterized by a S&T system in the public sector (universities, R&D laboratories, ...) that is over-represented relative to the effort

developed by the private sector (Laranja, 2009; Godinho and Mamede, 2016). This implies normally consequences on the direction of research activities that are carried out that in these contexts, guided mainly by internal academic logic, more directed to stages upstream, towards focusing on the fundamental and applied research, moving away from the market needs (Xavier and Vaz, 2013; Santos, 2018). Moreover, although there is a relatively dense array of RD&I public (or associative, nearly semi-public) institutions on the Centro Region they are, not rarely, multi-function organisations whose contribution to, and impact on, the innovation ecosystem is achieved mainly as a by-product of their main functions and responsibilities rather than as the primary task.

3.7. RIS main innovation drivers

Regional innovation main drivers, as Isaksen and Trippl (2016) suggest, are connected to stakeholders and processes centred on exploring the logic and mechanisms that are, or can be, activated as a means to promote innovation and competitiveness – in this case, within the Centro Region - and, within this, across and within firms. Thus, which are the means that can be activated for the construction of new pathways for the promotion of the regional innovation capability?

First of all, there has been a vast investment on RD&I infrastructures that has to be fully exploited, principally by the strategic reorientation of their mission, avoiding academic drifts that result on low fertilisation levels of the regional economy. Universities dominate the R&D and high education activities: two at the coastal area, Coimbra and Aveiro and one at the interior (Beira Interior), accompanied by a network of Polytechnic Schools. The most important R&D labs were created on the orbit of these higher education institutions and, they too, need strategic reconfiguration. This institutional endowment is critical: universities need keeping producing skilled human capital but also an adequate level of applied research, both of which could then be suitably employed to satisfy industrial technological needs. These ingredients are rather a pre-condition than part of the place-based innovation policy. Thus, selectivity is needed in establishing an ambitious place-based innovation strategy that may respond to these challenges. To avoid regional lock-in, it is crucial that the strategy is open to newcomers and new policy experiments (Kramer et al., 2011; Boschma, 2017).

Secondly, it has to be underlined that foreign direct investment has been having a significant positive impact on the overall regional innovation capacity. More recently,

and that has been gaining increased expression in the region, investments also occur on the R&D sphere, with the implementation of competences centres, such as in Aveiro (Altimec, Siemens, Bosch), Viseu (IBM) or Fundão (Altran). These are very relevant investments of multinational companies. The potential of this positive outcome is largely conditioned by the availability of the absorptive competences and the presence of innovation-complementary assets in the Centro Region (Crescenzi and Gagliardi 2018). This seems strategic for the region and should constitute a priority in terms of policy design - the type and quality of FDI inflows, if well accommodated, has the potential to serve as a driver of a knowledge-based development strategy. Innovation is an evolutionary and accumulative process. Only with the necessary capability to identify, assimilate and integrate these useful and strategic external knowledge can the host region, Centro, effectively be impregnated with the codified knowledge embedded in FDI. On this ambit, it should be recognised the need to deepen the understanding and get empirical evidence about the knowledge flows between RD&I foreign direct investments and the absorptive capacity at the firm level, namely in peripheral low density areas.

Last, but not the least, an important structural innovation driver might be associated to the gradual renewal of the firms' top management, as well, as the irreversible tendency to equipping companies with more qualified human resources. The existent network of good quality higher education institutions is a guarantee that the flow will continue. Together with a new generation of start-ups, some born on incubation centres, as university spin-offs, this is a vast structural movement that will make emerge more new S&T-based firms, a change that still has residual economic impact but a high potential on upgrading the regional competitiveness dynamics. It is foreseeable that the gradual emergence of new economic *filières* goes hand in hand with a relevant technological upgrading of the installed activities that are territorially embedded as local productive systems. Centro case highlights that the regional innovation dynamics will profit if it will keep on relying on industrial expertise. Strong industrial vocation in certain emergent sectors and an already well-established productive system, often developed in connection with a few large enterprises, are preconditions for a successful clustering dynamics to develop (Isaksen and Trippl, 2016). Some of these clusters are already evolving towards more diversified patterns of specialisation (automation and robotics, moulds, components for the automobile industry, ICT) and need a swift answer from the

potential associated to the knowledge intensive business services (KIBS) sector - for it is expected they don't simply meet the needs of prevailing levels of demand or, more specifically, their clients, but, instead, may establish codified knowledge bridges and points of innovation between companies and science (Strambach 2008).

4. Redesigning public policies conducive to innovation

Public policies conducive to innovation, at least in peripheral low density areas, such as the Centro Region, face different challenges, theoretical, strategic and methodological. Peripheral regional innovation systems are, habitually, typified by being less innovative, in contrast to more central urban-metropolitan areas; they have less R&D intensity and innovation, a less developed knowledge infrastructure (HEI and RD&I institutions) and a lower innovative performance, as well as suffer from governance and organizational handicaps – overall, Centro Region confirms this assumption.

Can we talk about a Centro regional innovation system? Most of the elements that can constitute the core of an orthodox RIS already exist – but these basic prerequisites are only a point of departure. Nevertheless, it seems institutional thickness has no corresponding nor systemic cooperative networking neither proportional institutional capability. We can argue, therefore, that the Centro Region innovation system is fundamentally still an embryonic entity, or a RIS in transition. The main diverse building blocks of its structure are there, along the knowledge-production, diffusion and absorption interactive process, yet there is no systemic collective learning dynamics. Innovation is an output that still results mainly from individualistic behaviours and *ad-hoc* initiatives.

Nevertheless, S&T incentives have been strongly contributing to the consolidation of the public regional S&T system, with high efficiency levels in scientific outputs but with a limited direct contribution to the economic valuation of results, which reflects the old chronicle Science Push dilemma. Even though, RD&I incentives have been contributing to a substantial increase in firms' R&D activities, including organizational additionality, and made an important contribution to an increasing articulation of the innovation system, although, as mentioned before, this has only attained a relatively weak number of the Centro Region enterprises.

A first generation of public push policies for the S&T subsystem (eg. SAESCTN) coupled with a complementary support according to a demand pull logic to the

technological needs of firms (eg. SI I&DT) was important either as a vehicle for the reinforcement of the RD&I dedicated institutional infrastructure, bringing additional (at least, public) institutional thickness to the RIS, either as an instrument for inducing a preliminary learning behaviour.

Nonetheless, as we have seen, there is a lack of a strategy and of a collective dynamics, as institutional thickness and RD&I investments are not being fully translated into proportional regional innovative capability. Infrastructure is visible but requires efforts to generate spillovers. An increase in regional capability for innovation inevitably should involve new forms of organization and institutional partnership to help improve the structural competitiveness of the companies (Fiore, et al., 2011; Pinto et al., 2012; Rodriguez-Pose, 2013; Santos and Simões, 2014; Benneworth et al., 2017, Fernández-Esquinas et al., 2017).

Laranja (2009) argues that this also should imply a change of focus from allocation of resources for innovation to focusing on innovative learning, aiming for behavioural value-added through pursuing a collaborative and pedagogical, even somehow experimental, oriented perspective - thus reinforcing the mechanisms for horizontal coordination and partnership, as well as interface management, avoiding public intervention supported in sectorial logics or fragmented actions.

In this context, especially for peripheral least favoured regions, one can argue that a step forward is needed, for territorial innovation policy, merely understood as the chronic search for an adequate equilibrium between science-push and demand-pull perspectives, seems not enough (Santos, 2009; Uyarra and Flanagan 2010; Benneworth et al., 2017). Preventing a more profound innovation gap within the productive fabric emphasises the need for a more platform and system-oriented, as well as a more proactive innovation based regional policy in order to construct regional advantages - changing innovation policies from being almost exclusively S&T and firm-oriented to a territorially system approach conducive to innovation.

5. Conclusion

This paper described the regional innovation system put in place by Centro Region and analysed the value added that can be attributed to such a system as far as innovation and economic development promotion are concerned. Its strengths and weaknesses were

critically examined and discussed to produce lessons learned with optimistically more general importance.

The Centro Region has a diversified production structure in which traditional areas of expertise coexist (ceramics, non-metallic minerals, forests and resulting products such as pulp and paper), with more recent economic activities based on technology (metal mechanics, moulds, equipment) as well as knowledge-intensive activities (information technology, biotechnology, renewable energy, new materials and health). On this ambit, Centro regional innovation policy faces a double challenge: on the one hand, of upgrading the competitive profile of the companies associated with the most representative sectors of the industrialization models of those territories and, on the other hand, of contributing to the emergence, and reinforcement, of new vectors of productive specialization, trying linkages to more demanding activities in S&T inputs, providing a sustainable effective accumulation of technical knowledge (Santos, 2018).

Overall, the research and innovation system has achieved the targets set out with regard to improving its outputs in tertiary education and publications, as well as the increase in the human also has strong knowledge and innovation generation capacities relevant to several of these resources allocated to the system. However, it was not able to reach the targets regarding the technological outputs and the technological intensification of the economy, and the level of financial resources invested in the system.

Chronically, one of the handicaps which also typifies these peripheral regions, and Centro seems to be no exception, is related to the fact that their technological patterns are characterized by a S&T system in the public sector (universities, R&D laboratories,...) that is over-represented relative to the effort developed by the private sector. This implies normally consequences on the direction of research activities that are carried out that in these contexts, guided mainly by internal academic logic, more directed to stages upstream, towards focusing on the fundamental and applied research, moving away from the market needs (Koschatzky, 2003; Cooke et al., 2005; Asheim et al., 2011b). These circumstances are coupled with demand-side problems for which supply-side solutions continue to be proposed and prevail. Unless medium to highly R&D-intensive companies reach much greater scale in Centro regional economy, a lack of business receptors will eventually remain to frustrate supply-push policies. Nevertheless, a place-based innovation policy, merely understood as the chronic search

for an adequate equilibrium between science-push and demand-pull perspectives, seems not enough (Lagendijk, 2011; McCann and Ortega-Argilés, 2013).

Despite the wide spectrum of regional RD&I stakeholders, it still has low expression the existence of territorially rooted cooperation networks, promoting innovative projects, which is, as we know, the essential distinguishing feature of the presence of an innovative environment. Similarly, it is not institutionalized what might be called a collective learning process, since although there exists an entrepreneurial culture based on empirical knowledge accumulated over generations, companies and institutional actors ultimately follow individualistic paths that do not enrich cognitively the regional context in which they operate - it is not regionally established what might be called a systemic culture of contact.

Yet, as described, Centro encompasses most of the necessary conditions to succeed in the implementation of its innovative upgrading strategy, regarding namely critical mass, industrial strengths, S&T capabilities, stakeholders' interaction potential, and internationalisation (for both business and scientific communities), among other requirements. The Centro regional innovation system needs to keep on focusing and fine-tuning its strategy towards a more mature and qualified innovation dynamics.

References

- Almeida, A., Figueiredo, A. and Silva, M.R. (2008): *From concept to policy: building regional innovation systems in follower regions (FEP Working Papers Nr. 301)*. Porto: Faculdade de Economia.
- Araújo, L., Silva, S. and Teixeira, A. (2013): "Knowledge spillovers and economic performance of firms located in depressed areas: does geographical proximity matter?", *Proceedings of the 17th APDR Workshop Firm Performance and Growth. A Regional, Institutional and Policy Perspective*, Aveiro: University of Aveiro, 185-208.
- Asheim, B. T., Moodysson, J., & Tödtling, F. (2011a): "Constructing regional advantage: Towards state-of-the-art regional innovation system policies in Europe?", *European Planning Studies*, 19(7), 1133–1139.
- Asheim, B.T., Smith, H.L. and Oughton, C. (2011b): "Regional innovation systems: theory, empirics and policy", *Regional Studies*, 45(7), 875-891.
- Benneworth, P., Pinheiro, R., & Karlsen, J. (2017). "Strategic agency and institutional change: Investigating the role of universities in regional innovation systems (RISs)", *Regional Studies*, 51(2), 235–248.
- Boschma, R. (2017): "Relatedness as driver of regional diversification: A research agenda", *Regional Studies*, 51(3), 351-364.
- Camagni, R. (2014): "The regional policy debate: a territorial, place-based and proximity approach". In: A. Torre e F. Wallet (ed.), *Regional Development and*

- Proximity Relations*. Cheltenham: Edward Elgar, 317-332.
- Capello, R. (2014): “Proximity and regional innovation processes: is there space for more reflections?”, In: Torre, A. e Wallet, F. (ed.), *Regional Development and Proximity Relation*. Cheltenham: Edward Elgar, 163-194.
- Carrincazeaux, C., & Gaschet, F. (2015): “Regional innovation systems and economic performance: between regions and nations”. *European Planning Studies*, 23(2), 262-291.
- CCDRC (2016): *RIS3 do Centro de Portugal 2020. Estratégia de Investigação e Inovação para uma Especialização Inteligente*, Coimbra: CCDRC.
- CCDRC (2018): *Barómetro Centro de Portugal*, Coimbra: CCDRC.
- CEC – Câmara do Comércio e Indústria do Centro (2018): *Breve Abordagem Estatística – Região Centro*, Coimbra: CEC.
- Cooke, P. (2008): “Regional innovation systems: impact of the species”, *International Journal of Technological Learning, Innovation and Development*, 1(3), 393-409.
- Cooke, P., Clifton, N. and Oleaga, M. (2005): “Social capital, firm embeddedness and regional development”, *Regional Studies*, 39, 1065-1078.
- Crescenzi, R. and Gagliardi, L. (2018): “The innovative performance of firms in heterogeneous environments: The interplay between external knowledge and internal absorptive capacities”, *Research Policy*, 47(4), 782-795.
- D’Allura, G. M., Galvagno, M. and Mocciaro, L. D.-A. (2012): “Regional innovation systems: a literature review”, *Business Systems Review*, 1, 139-156.
- Doloreux, D. and Parto, S. (2005): *Regional innovation systems: current discourse and unresolved issues*, *Technology in Society*, vol. 27, 133–153
- Fernández-Esquinas, M., Oostrom, M. and Pinto, H. (2017): “Key issues on innovation, culture and institutions: implications for SMEs and micro firms”, *European Planning Studies*, 25(11), 1897-1907.
- Figueiredo, A. (2007): “Regional innovation systems as policy tools in knowledge oriented cohesion policies – the case of Portugal”. Paper presented at the *Regional Studies Association International Conference – Regions in Focus*, 2-5 April, Lisbon.
- Fiore, A., Grisorio, M. J., & Prota, F. (2011): “Regional innovation systems: Which role for public policies and innovation agencies? Some insights from the experience of an Italian region”, *European Planning Studies*, 19(8), 1399–1422.
- Gama, R, Barros, C. and Fernandes, R. (2018): “Science Policy, R&D and Knowledge in Portugal: an Application of Social Network Analysis”, *Journal of the Knowledge Economy*, 9(2), 329-358.
- Gertler, M. S. (2010): “Rules of the game: the place of institutions in regional economic change”, *Regional Studies*, 44(1), 1-15.
- Godinho, M. M. and Mamede, R. P. (2016): “Southern Europe in crisis: industrial policy lessons from Italy and Portugal”, *Economia e Politica Industriale*, 43(3), 331-336.
- Hauser, C., Tappeiner, G. and Walde, J. (2007): “The learning region: the impact of social capital and weak ties on innovation”, *Regional Studies*, 41, 75-88.

- Isaksen, A. and Trippl, M. (2016): "Path development in different regional innovation systems: a conceptual analysis". In: D. Parrilli, M., Fitjar, R. and Rodriguez-Pose, A. (Eds.): *Innovation drivers and regional innovation strategies*. London: Routledge, 66-84.
- Koschatzky, K. (2003): "The regionalization of innovation policy: new options for regional change?". In: Fuchs, G. and Shapira, P. (eds), *Rethinking Regional Innovation: Path Dependency or Regional Breakthrough?*. London: Kluwer, 291-312.
- Koschatzky, K. (2009): "The uncertainty in regional innovation policy: some rationales and tools for learning in policy making", Working Papers Firms and Region No. R6/2009, Karlsruhe: Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI).
- Kramer, J. P., Marinelli, E., Iammarino, S., & Diez, J. R. (2011): "Intangible assets as drivers of innovation: Empirical evidence on multinational enterprises in German and UK regional systems of innovation", *Technovation*, 31(9), 447–458.
- Kuştepelı, Y., Gülcan, Y., & Akgüngör, S. (2013): "The innovativeness of the Turkish textile industry within similar knowledge bases across different regional innovation systems", *European Urban and Regional Studies*, 20(2), 227–242.
- Legendijk, A. (2011): "Regional innovation theory between theory and practice", In: Asheim, B., Boschma, R. and Cooke, P. (eds), *Handbook of Regional Innovation and Growth*. Cheltenham: Edward Elgar, 597-608.
- Laranja, M. (2009): "The development of technology infrastructure in Portugal and the need to pull innovation using proactive intermediation policies", *Technovation*, 29(1), 23-34.
- Makkonen, T., & Rohde, S. (2016): "Cross-border regional innovation systems: Conceptual backgrounds, empirical evidence and policy implications", *European Planning Studies*, 24(9), 1623–1642.
- McCann, P. and Ortega-Argilés, R. (2013): "Modern regional innovation policy", *Cambridge Journal of Regions, Economy and Society*, 6(2), 187–216.
- Natário, M.M.; Braga, A.; Couto, J., Tiago, M. T. (2012): "Territorial standards for innovation: analysis for the regions of Portugal", *Revista de Estudios Regionales*, 95, 15-38.
- OECD (2011): *Regions and Innovation Policy*. Paris: OECD Publishing.
- Pinto, H., Uyarra, E. and Guerreiro, J. (2012): "Diversidades de sistemas de inovação e implicações nas políticas regionais: comparação das regiões do Algarve e da Andaluzia", *Revista Portuguesa de Estudos Regionais*, 29, 3-14.
- Rodriguez-Pose, A. (2013): "Do institutions matter for regional development?", *Regional Studies*, 47, 1034–1047.
- Rune, N. and Jakobsen, S.-E. (2018): "Policy for Evolution of Regional Innovation Systems: The Role of Social Capital and Regional Particularities", *Science and Public Policy*, 45(2), 257–268.
- Santos, D. (2000): "Innovation and territory: which strategies to promote regional innovation systems in Portugal?", *European Urban and Regional Studies*, 7(2), 147-

156.

Santos, D. (2009): “Teorias de inovação de base territorial”. In: Costa, J. S. and Nijkamp P. (coords), *Compêndio de Economia Regional – Teoria, Temáticas e Políticas*, Cascais, Principia, 319-346.

Santos, D. (2012): *Dinâmicas Territoriais de Inovação no Arco Urbano do Centro Interior. O Caso do Setor Têxtil-Confeções*, V.N. Famalicão, Húmus.

Santos, D. (2018): *Territorial innovation models: Which consequences in terms of policy design for peripheral regions? a Portuguese perspective*, *Advances in Spatial Science, Part F3*, 233-250.

Santos, D. and Simões, M.J. (2011): “A dinâmica socioeconómica da fileira da madeira no Pinhal Interior Sul e o código de ética do ilusionista”, In Baleira, R (Ed.), *Casos de Desenvolvimento Regional*. Cascais: Principia, 685-700.

Santos, D. and Simões, M.J. (2014): “Regional innovation systems in Portugal: a critical evaluation”, *Investigaciones Regionales*, 28: 37-56.

Strambach, S. (2008): “Knowledge Intensive Business Services (KIBS) as drivers of multilevel knowledge dynamics”, *International Journal Services Technology and Management*, 10 (2-4), 52-174.

Tomaney, J. (2014): “Regions and place: Institutions, progress in human geography”, *Progress in Human Geography*, 38, 131–140.

Tura, T. and Harmaakorpi, V. (2005): *Social capital in building regional innovative capability*, *Regional Studies*, 39, 1111-1125.

Uyarra, E. and Flanagan, K. (2010): “From regional systems of innovation to regions as innovation policy spaces”, *Environment and Planning C: Government and Policy*, 28, 681–695.

Xavier, A. and Vaz, T. N. (2013): “Regional innovation dynamics: behavioural patterns and trends”, *Proceedings of the 19th APDR Place-Based Policies and Economic Recovery*, Braga, University of Minho, 552-566.

Wintjes, R. and Hollanders, H. (2011): *Innovation pathways and policy challenges at the regional level: Smart Specialization*, UNU-MERIT Working Paper, n° 27.

Sources of data

Portuguese: INE, PORDATA, CCDRC, CEC

European: Eurostat, European Commission – Regional Innovation Scoreboard