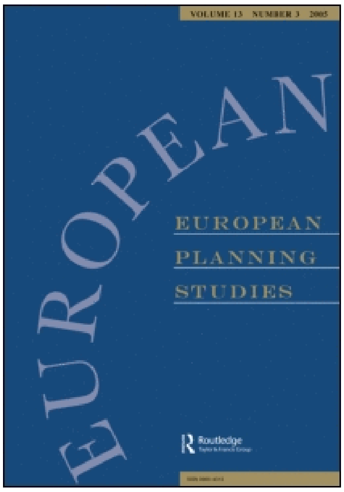

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The Diversity of Innovation in the European Union: Mapping Latent Dimensions and Regional Profiles

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The Diversity of Innovation in the European Union: Mapping Latent Dimensions and Regional Profiles

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ABSTRACT *Regional innovation systems are a relevant approach when analysing territories from either a theoretical or an operational point of view. In the last few years, the development of several different comparisons of innovative profiles of sub-national level demonstrates the interest in this paradigm. The article proposes, through an analysis of 175 regions, a typology of regional innovative profiles to understand the diversity of innovation in the European Union. Multivariate statistics were used to find the dimensions underlying the innovation phenomena and to create homogenous groups of regions that display similar profiles. First, Factorial Analysis was used to reduce regional indicators to their latent dimensions (Technological Innovation, Human Capital, Economic Structure and Labour Market Availability). Second, a hierarchical analysis of clusters was undertaken, resulting in five groupings of regions (Disadvantaged Regions, Average Regions, Central Regions, Large Economic Centres and Innovating Regions). The results of the study are compared with other relevant analyses and some consensual ideas are achieved. Physical proximity still has a relevant impact on innovation processes. The planning and policy-making of innovation must take into account this profile diversity and should originate actions adapted to each specific context. With a political agenda such as Lisbon's, which intends to create a competitive territory, the focus on an indicator such as gross domestic product is extremely inadequate for fundamental decisions related to financing regional policy. More meaningful analysis like the one carried out in the article could be an example to evaluate future regional budgets in terms of European regional policy.*

1. Introduction

Recent advances in regional innovation systems (RIS) literature reflect the high importance that this concept has achieved from an operational point of view. Several

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regions developed their strategies and development programming with the support of RIS. The concept was present in the creation of strategies and plans focusing on innovation, science and technology. Innovation is now transversal to all policy-making and not only a branch of each thematic policy or a particular thematic policy. The Lisbon Agenda and Cohesion Policy 2007–2013 brought the spotlight to innovation, emphasizing its role as a way to solve many of the existing problems in Europe. One important question that emerges is how policy-making should react to these novelties if regions are very diverse in their scientific, technological or productive performances. Some regions face similar problems, so they could be oriented to particular stepping stones in order to achieve Lisbon's objectives. Thus, an important preliminary step is to understand the geography of innovative performance in European regions. Many studies have been conducted recently trying to comprehend this spatial distribution. The goal of this paper is to understand and map the regional diversity in Europe in terms of innovation. The major contribution of the study is the fact that the latent dimensions of an enlarged set of indicators were found and used to cluster the regions. The mapping reflects a very large quantity of information depending more on the structure of the data and less on the choice of the analyst.

The paper is organized in three main sections. The first section tries to make a synthesis of the importance of innovation for regional development introducing and debating the notion of RIS. The second shows the analysis of the 175 European Union regions, detecting the main factors of the variables analysed and clustering the regions into groups with similar innovative profiles. Finally, the main results of this paper are taken into account to enrich policy-making advice resulting from previous studies.

2. Innovation in the Present Context

2.1. *From the Importance to Growth to the Systemic Innovation*

Innovation is seen as the key factor to growth and competitiveness and gained importance within the current political agenda (European Commission, 2004, 2007; OECD, 1990, 2005). Economic theory, including the *growth accounting* (Abramovitz, 1962; Denison, 1967; Solow, 1956, 1957), *new growth theory* (Romer, 1986, 1990; Lucas, 1988) or *technological gap* models (Fagerberg, 1991; Fagerberg *et al.*, 1997), brought explicit verification that innovation and technological change have a critical impact on economic development. Notwithstanding, the concept of innovation remains unclear and has been an area under discussion in different approaches. The concept of innovation is that of adopting the idea of process or innovative activities.

The chain-linked model of Kline and Rosenberg (1986) showed that innovation does not appear in society in a casual way and that if some measures are taken and certain kinds of environments developed, innovation tends to occur more easily. This idea creates the basis of the innovation system approach. The innovation system reflects the understanding of the large number of actors who influence all innovating processes that interact, learn, depend and change their external environment and have specific institutions, rules, norms and types of organization as explained by Amable and Petit (2001, p. 3). The systemic approach facilitates the analysis of the economic, institutional, organizational, social and political factors related to innovation. Ferrão (2002, p. 19) states that the group of relations defined for each one of the actors participating in the system can be territorially defined, which shows that the system is always localized. The National Innovation System (NIS) accepts the national scale as the reference to delimit these relations. Freeman (1995), Lundvall (1992) and Nelson (1993) were the developers of this approach. The increasing significance of smaller territorial contexts, at the regional level in particular, resulting from the need to create efficient decisions, diminishing the gap between citizens and policy-makers, the European principle of subsidiarity and the loss of importance in decision-making of national governments, gave relevance to the regional scale.

2.2. *The Emergence of the Regional in Innovation Systems*

Studies of innovation systems stress the importance of a region and its specific resources that support the innovation between enterprises and territories. Besides facilitating local companies to become more competitive, these specific resources, such as learning capability, corporate attitudes or existing infrastructure, are factors of development (Doloreux & Dione, 2007). Competitive advantages may have a relevant local character, coming from the concentration of highly specialized knowledge and expertise and the existence of institutions, competitors, partnerships and consumers (Porter, 2003). The last edition of the *Oslo Manual* (OECD, 2005) underlines an identical view:

> The notion that regional factors can influence the innovative capacity of firms has led to the increasing interest in analysing innovation at the regional level. Regional differences in levels of innovation activity can be substantial, and identifying the main characteristics and factors to promote innovation activity and the development of specific sectors at regional levels can help in understanding innovation processes and be valuable for the elaboration of policy.
>
> As a parallel to national innovation systems, regional innovation systems may develop. The presence, for example, of local public research institutions, large dynamic firms, industry clusters, venture capital and a strong entrepreneurial environment can influence the innovative performance of regions. These create potential for contacts with suppliers, customers, competitors and public research institutions. Infrastructure also plays an important role.

The concept of RIS emphasizes the role of the region as a territory in the relationships between technology, market, productive capital, culture and representations. The region is not a mere framework for resources allocation but an environment generator of specific resources and generating its own dynamics. The regional is an adequate scale to implement development policies for the promotion of a knowledge-based economy. To exemplify this interest, we can refer to the above-cited multiplication of innovation strategies and planning in the European regions. Several studies allowed identification of similar characteristics of localization in productive systems based on the utilization of technologies to understand more clearly what an RIS is. These studies provide the analytical framework to understand the concept, showing how the spatial concentration of companies and organizations induce innovation as a result of interaction and collective learning (Asheim & Gertler, 2005; Doloreux & Bitard, 2005).

The RIS approach is linked to an understanding of the innovative process embedded in society and territory, stimulated not only by local resources but also by the social and cultural environment in which such processes evolve (Bathelt *et al.*, 2004). According to Doloreux and Dione (2007), the RIS shows the importance of innovative processes, the interaction of actors and their environment and the creation of externalities which affect productive systems. The tacit component of knowledge is easier to transmit in the case of collective share within adequate institutional, economic, social and political frameworks, as referred by Asheim and Isaksen (2002). Physical proximity can have an important role in the strengthening of formal and informal types of cooperation.

The RIS can thus be synthetically defined as the group of actors and organizations (e.g. enterprises, universities and/or research centres) engaged in innovation and collective learning in the region (Doloreux & Bitard, 2005), characterized by the existence of shared territorial, intangible, institutional and relational resources (Guerreiro, 2005).

Territorial resources refer to those that define the territory in terms of natural assets and the profile of the established human community. Intangible resources include the main components of knowledge, not only those transferred by the formal education system but also the dynamics that facilitate learning, informal competencies and traditional knowledge and *savoir-faire*. The network culture is included in this type of resource once it defines a collective posture of openness to cooperation, an important feature to generate density of relations in projects and strategy. Institutional resources are constituted by the enterprises, research centres, laboratories, universities, technology centres and other institutions with administrative responsibilities. The model of governance is a crucial point and restricts the regional conditions to innovative actions. The ability to decide, associated with the existence of a regional strategy and budget, are essential aspects which facilitate the potential offered by the other resources. Finally, the relational resources structure the external relations of the RIS, intensifying internal linkages and including all institutional and corporate relations in the region (Figure 1).

The notion of RIS is often used as a broad expression that covers similar models such as *milieux innovateurs*, technology districts, learning regions or clusters. Literature suggests a problem with the consistency of the concept (Doloreux & Bitard, 2005; Doloreux & Parto, 2005). The delimitation of the territorial analysis framework is one of central issues. Niosi (2005) refers to the importance of defining a region. Regions are often associated with entities of variable geography, from small cities to groups of countries. In this way, the notion of what is the regional can have two different meanings, as suggested by Doloreux and Dionne (2007): one with a more functional character (delimitation by the inter-relations, social capital and specific culture) and the other with a policy-oriented character (a territory defined by administrative governance). This second notion gives a distinctive character to RIS when compared with other territorial models of innovation, with the system defined by a governance structure, often administratively defined (Carrincazeaux & Gaschet, 2006). This vision tries to eliminate the problems that emerge from defining the adequate RIS scale by understanding it as the territory in which enterprises and innovation are supported by decentralized public authorities. In the first case, the borders of the region tend to vary with the evolution of the economy, whereas in the second the frontiers are more stable and limited to a specific physical area. Cooke and Leydesdorff (2006, p. 6) show that a simplified notion of region is to understand it as an administrative division of a country, nested territorially beneath the level of a country and above a municipal or local level. The understanding of the adequate scale to define the unit of analysis of the RIS creates a diversity of approaches. Metropolitan areas, cities or technology districts are used to analyse RIS. Cheshire and Magrini (2000) suggested the

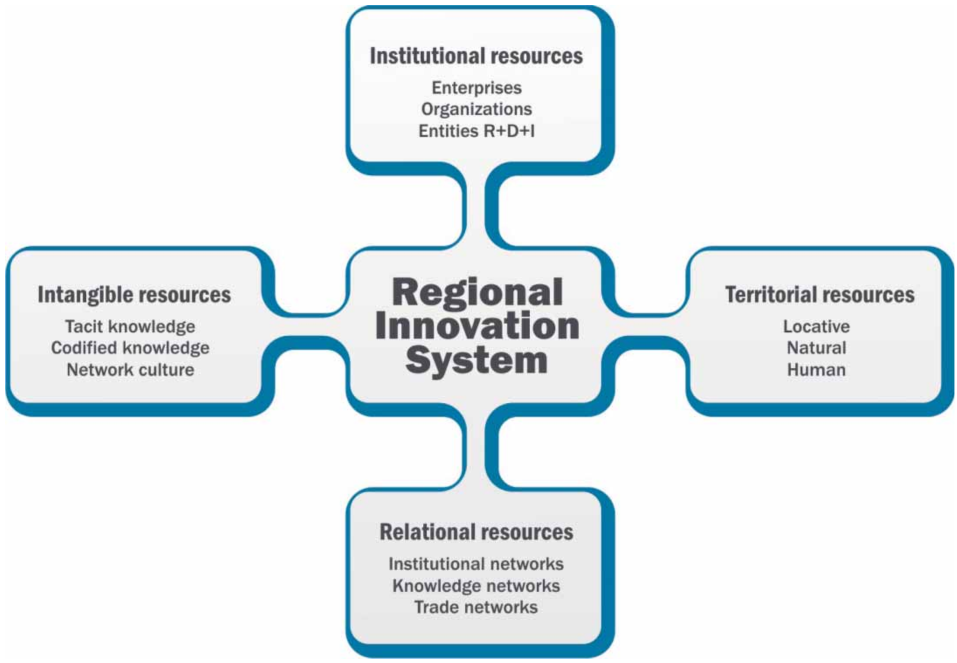

Figure 1. Regional Innovation System
Source: Adapted from Guerreiro (2005).

use of functional urban regions (FURs), based on the fact that urban areas comprehend the functional dynamics of innovative processes. Evangelista *et al.* (2001) suggest that RIS, at a more aggregated level in Europe, can be normally defined by the NUTS II level (*Nomenclature des Unités Territoriales pour des Besoins Statistiques*), which incorporates the majority of administrative regions of France, Spain and Italy, the counties of UK and the *Regierungsbezirken* of Germany (Doloreux & Bitard, 2005). This level is also adequate for Portugal because the spatial delimitation for CCDR, Regional Development Coordination Commissions, is the entity responsible for assuring the implementation and management of regional policies. The use of NUTS II has, to Doloreux and Bitard (2005), a very important limitation—the fact that often this nomenclature is exogenally imposed. This fact creates NUTS with a low degree of homogeneity and not representative of innovative dynamics. Another important limitation is the large discrepancies in the size (in terms of population and economic output) that can create anomalies, e.g. a small region performing very well based on only a very innovative company (Hollanders, 2007).

Sometimes RIS are understood as small-scaled NIS. This notion fails to comprehend the regional specificities of actors, institutions, relationships and attributes. RIS are often criticized since their focus underestimates the external networks and institutions (Uyarra, 2007). Analysing an RIS only as an innovation system with a particular administrative and spatial scale is a limitation, once the new reality appears often *deterritorialized*, with networks containing elements from different contexts. It is fundamental to understand the RIS interactions with the national and global economies. Any RIS is self-sufficient and its success depends on the way its performance is coordinated with the knowledge networks of these levels (Cooke, 1998; Guerreiro, 2005).

As shown by De Bruijn and Lagendijk (2005, p. 1156), the concept of RIS achieved a normative reputation by turning a policy concept, presented as a generally applicable idea to support regional development and stimulate innovation. The popularity of RIS is attributed to the orientation of self-sustained, supply-side measures aimed at increasing regional competitiveness. Innovation has become a horizontal theme for the diversity of measures and programmes from the areas of regional development to industrial support. In this transition from an analytical to a normative concept, the notion of RIS is transformed to a sort of ideal model applicable to all regions, including the less developed. Particularly in Europe, it places a strong emphasis on cohesion, by being an instrument to apply to the strategic planning of lagging regions, as suggested by the authors above. This emphasis on cohesion creates difficulties when harmonizing these goals with those related to competitiveness (De Bruijn and Lagendijk, 2005, p. 1168). In summary, as stated by De Bruijn and Lagendijk (2005, p. 1160), the RIS concept … *is employed and elaborated in a complex multi level actor world driven by a great number of interests and aspirations*. The concept of RIS must provide a common vision and action framework for innovative policies and meet the economic and political realities. It is important to understand that behind each RIS stands a national reality of national education systems, corporate environment and territorial agendas. Nevertheless, as stated by Cooke and Leydesdorff (2006, p. 6), even when a country has no regions, only national states and local administrations, it experiences regional development, including local collaborative partnerships of municipalities pursuing the aims of constructed advantage.

3. European Regions in Analysis

3.1. *Recent Studies on European Regions*

The regional policy in Europe has given important relevance to issues related to innovation.[1] In a circular causation process, this fact increased attention to innovation policy-making in the regional context and gave regional innovation studies an increased recent growth. Currently, even the Innovation Scoreboard, an instrument developed to measure the achievement of Lisbon Agenda goals, has a regional version. The most recent version is presented in Hollanders (2007), but the 2003 version had a major impact on the interest in carrying on the current study by lighting up the huge differences that subsist on regional innovative performances and by using the cluster analysis to define the geography of regional innovation behaviour. The methodology was also influenced by Carrincazeaux and Lung's study (2004), an interesting analysis of French regions, using the conceptual framework of social systems of innovation and production (SSIP) proposed by Amable *et al.* (1997), utilizing variables related to science, technology, industry, qualifications and performance.

More recently, Carrincazeaux and Gaschet (2006) have extended the regions in the study by focusing on European regional diversity in terms of knowledge accumulation and socio-economic performances. Their paper constituted an attempt to propose an exhaustive effort to characterize the diversity of regional knowledge and innovation systems within Europe. The study was performed through data analysis, combining data from three sources (Eurostat, the Cambridge Econometrics database and OST—*Observatoire* *des Sciences et des Techniques*) over a sample of NUTS-II European regions and using multivariate data analysis. Putting together the SSIP and local economic performances allowed defining different regional configurations in order to identify regional trajectories and patterns of articulation between knowledge dynamics and performance. The hypothesis of these authors was that regional growth was not a problem of best practice but of a coherent knowledge combination: institutional differences may lead to similar (or different) science, technology and innovation structures and to diverse (or comparable) performances.

Cheshire and Carbonaro (1996) developed a robust model of differential growth rates of *per capita* income in the major FURs of the European Union. The results underlined the important role of spatial economic processes in differential regional growth and suggested that the pattern of European urbanisation tends to generate systematic divergence. In general, the results are encouraging of the role of European regional policy while the systematic spatial effects of European integration seem to be fading and extending away from near-peripheral urban regions. After this study, Cheshire and Magrini (2000) tried to understand the convergence using cross-section and panel data regressions in the analysis of the determinants of growth to a broad set of 122 FURs over the period 1978–1994. The model recognized growth as a multivariate process and that technological knowledge had an important tacit component that has been neglected in formal theories of endogenous growth. This tacit component, being the *non-written personal heritage* of individuals or groups, is more intense with spatial proximity that increases the interaction between companies and their local environments. The authors stressed the role of research and development (R&D) activities and the influence of other factors such as the existence of universities that shape the local environments and have important policy consequences.

Another interesting approach was that of Crescenzi (2005), where a formal model for the relationship between innovation and growth in European Union regions was developed, based on the theoretical contribution of the innovation systems. The model combined the analytical approach of the regional growth models with the insights of the systemic approach. The cross-sectional analysis, covering all the enlarged European Union (EU 25) regions, showed that regional innovative activities play a significant role in determining differential regional growth patterns. The model stresses how geographical accessibility and human capital accumulation, by shaping the RIS, interacted (in a statistically significant way) with local innovative activities, allowing them to be more (or less) effectively transformed into economic growth. The paper revealed that an increase in innovative effort is not necessarily likely to produce the same effect in all regions. Indeed, the empirical analysis suggested that in order to allow innovative efforts in peripheral regions to be as productive as in core areas, they need to be complemented by huge investments in human capital.

The contribution of De Bruijn and Lagendijk (2005) also explores the framing of the concept of RIS within European economic policies. RIS are analytically and empirically assessed within the policy context of the Lisbon Strategy, with special reference to regional dimensions in the European Research Area. From theoretical and empirical analyses, the authors concluded that RIS is not a one-dimensional concept. Although the authors adhered to RIS arguments as important determinants of economic development, the analyses presented in this article point out that the role of regional innovative capabilities must not be overemphasized, showing that economic development is, in the first instance, dependent on national contexts.

Eckey and Türck (2006) carried out an appealing analysis to summarize recent convergence studies, showing how these studies are concerned with the catching-up of poor economies with wealthier economies over time. The authors stressed that the regional convergence process in Europe has generated extensive interest in recent years due to financial limitations, particularly since important funds aim at diminishing disparities. There have been several studies published recently dealing with this issue, using different empirical approaches. Altogether it can be stated that most models find a slow and limited convergence—global or only referring to some regions creating convergence clubs.

Gössling and Rutten (2007) tried to understand the different regional factors which have a positive impact on regional innovativeness, showing that innovation in a region depends on wealth, the development of gross domestic product (GDP), cultural diversity, the talent of the population and the density of the population. Based on data compiled from Eurostat and national–regional data from all European Union countries, the research used linear regression methods to show that wealth, cultural diversity, talent and density do have a positive influence on innovation. There is indeed a strong, significant negative correlation of GDP growth rate with innovation.

As we can realize from the presented studies, convergence is an important theme in regional studies and currently innovation is at the core of these analyses. The results stress not only the role of intangible assets in innovative processes, but also of the physical proximity as a way to create externalities that facilitate stronger performances and catching-up processes.

3.2. *Focusing European Regions: Approaching the Data*

The following analysis, which considers the regional level as the ideal scale to define the innovation system, seeks to find the latent dimensions of the innovative phenomena and to create homogeneous groups of regions with similar profiles. By means of the analysis of two sets of regional data, in the third Report on Cohesion, European Commission (2004) and the Regional Trendchart on Innovation (Hollanders, 2003), it was decided to analyse all the 175 European regions that were present in both databases. The most recent information at the moment of this analysis was used in the study. These regions refer, in general, to the Eurostat NUTS II level (except the UK and Belgium, NUTS I; Luxembourg and Denmark, national level). The chosen territorial scale is supported by the vision of European Commission and by the regional governance structures in these countries. For example, The ERDF Innovative Actions Program for 2000–2006 suggests a role for eligible regions very close to the analysed regions (European Commission, 2001, p. 18). A restriction of the study is that the focus on NUTS does not permit, in all cases, a high degree of internal cohesion or functional autonomy in the regions, as happens when analysing cases using a pure concept of RIS. A collection of 30 regional indicators, related to territorial critical mass, economic performance, wealth level, labour market, economic structure, age structure, education and training, technologic employment and patent registration, was used. These variables, analysed in Table 1, underline the existent disparities among European regions.

In our analysis, it was important to verify the correlation between variables, to evidence some relationships between them, some that empirical studies accept as evident, e.g. the relationship between technological variables and the GDP level. Several significant correlations were detected between the analysed variables. Using Spearman's ρ and Pearson's R, significant correlations were found between several variables: GDP, patents, R&D,

Table 1. Descriptive statistics

	Minimum	Maximum	Mean	Standard deviation
Inhabitants, 2001	26.00	11,055.00	2,203.75	1,949.43
Population density (hab./km^2) (2001)	3.30	6,015.50	333.04	787.40
GDP growth (average % 1995–2001)	−1.0	9.5	2.64	1.38
GDP *per capita* (2001 UE15 = 100)	52.70	217.30	94.87	26.46
GDP pc mean 1999–2000–2001 UE15 = 100	50.60	217.80	95.00	26.62
GDP pc (2001 EU25 = 100)	57.80	238.50	103.99	29.14
Employment in agriculture (% of total 2002)	.10	36.50	6.16	6.77
Employment in industry (% of total 2002)	7.70	43.30	27.81	7.20
Employment in services (% of total 2002)	25.30	91.50	65.58	9.67
EPO patents for million inhabitants (average 1999–2000–2001)	.00	781.60	130.68	140.38
Employment rate (employed 15–64 years old as % of population of 15–64 years)	41.90	78.40	63.79	7.57
Unemployment rate (2002)	2.00	27.10	8.28	5.38
Long duration unemployment (as % of unemployed) (2002)	.00	76.10	36.16	14.66
Women unemployment rate (2002)	1.80	35.60	9.85	7.06
Young unemployment rate (2002)	3.40	59.50	16.54	10.80
% Population <15 years old (2000)	2.30	23.80	16.55	2.74
% Population 15–64 years old (2000)	61.60	72.10	66.66	1.99
% Population 65+ years old (2000)	8.10	24.70	16.63	2.66
Population 25–64 years old with low education (% of total, 2002)	3.90	86.30	36.25	19.23
Population of 25–64 years with medium education (% of total, 2002)	8.70	70.90	43.44	16.22
Population of 25–64 years with high education (% of total, 2002)	4.80	41.40	20.13	7.45
Tertiary education (2002)	4.84	41.66	20.24	7.23
Life-long learning (2002)	0.13	25.20	7.63	6.33
Employment in medium/high technology industries (2002)	0.10	21.24	6.64	4.10
Employment in medium/high technology services (2002)	0.29	8.78	2.92	1.54
Public R&D in % of GDP (2001)	0.00	2.38	.59	0.41
Private R&D in % of GDP (2001)	0.00	5.27	.94	0.97
% of high technology patents from total (2001)	0.10	341.90	26.41	48.67
Total number of patents (2001)	0.60	824.20	142.44	156.60
GDP *per capita* in euros (2000)	8,112.00	48,920.00	21,209.05	7,294.72

Source: Adapted from Pinto (2006).

education, employment and technology employment, which increased the relevance of a Factorial Analysis.

3.3. *Focusing European Regions: The Diversity of Innovative Profiles*

The Factorial Analysis is a statistical method that tries to reduce the complexity of a set of data by extracting its crucial dimensions (Pestana & Gageiro, 2003). It seeks to explain the existent correlation between variables through statistical techniques that simplify the data by reducing the number of variables, assuming that some are not observable variables that express the relationships between the original variables (known as latent variables or common factors). A choice was made to select the highly positively correlated variables that seemed strongly connected to innovative phenomena and that successfully passed the requirements to use Factorial Analysis. The variables selected to be included in the analysis were: total number of patents, EPO patents for million inhabitants, private R&D in % of GDP, % of high technology patents from total numbers, employment in medium/high technology industries, tertiary education, population of 25–64 years with high education, life-long learning, public R&D in % of GDP, GDP *pc* mean 1999–2000–2001, GDP *per capita* in euros, employment in services, employment in medium/high technology services, employment rate (employed 15–64 years old as % of population of 15–64 years) and population of 25–64 years with average education.

The understanding of the analysis has led us to the four latent dimensions of innovation and to the mapping of regional performances in each factor. The following maps reflect the division of the regions in five groups based on percentile analysis for the regional loadings of each factor.

- *Technological Innovation*. Factor 1 explains 26.03% of total data variance and contains the variables related to patent registration (total number, EPO and high technology), private R&D and employment in high/medium technology industries. In this factor, a strong performance of regions in Germany and Nordic countries can be observed (Figure 2).
- *Human Capital*. Factor 2 explains 21.42% of data variance and includes all variables related to education, training and public R&D. Public expenditure in R&D has a very substantial part in universities. Even when carried out outside the academic sphere it refers in general to basic investigation. In comparison, private R&D is more often market-related research. In this factor, Nordic countries, the UK and metropolitan areas have stronger performances (Figure 3).
- *Economic Structure*. Factor 3, explaining 18.11% of total variance, includes GDP and the employment in services (which reflects the tertiarization of regional economies and is usually very highly correlated with superior levels of production *per capita*). Regions where main capitals are localized have the highest scores in this factor. Tourism-based regions also have relevant performances (Figure 4).
- *Labour market availability*. Factor 4 (11.24%) shows the level of employment and the rate of individuals with an intermediate education level. Regions in the UK and in the centre of Europe are particularly good in this factor (Figure 5).

The creation of regional typologies, relatively similar when taking into account the performances in the four latent dimensions, made pertinent a cluster analysis. Reis (2001, p. 290) defines a cluster analysis as a method that groups cases depending on the existent information in such a way that the cases included in a group are the most alike and always more similar between members of the same group than when compared with cases included in other groups.

In our study, we used a hierarchical cluster analysis.[2] The criterion to define how the cases are associated was the wards, a method that permits the construction of well-balanced clusters in terms of the number of cases included in each. The analysis of the

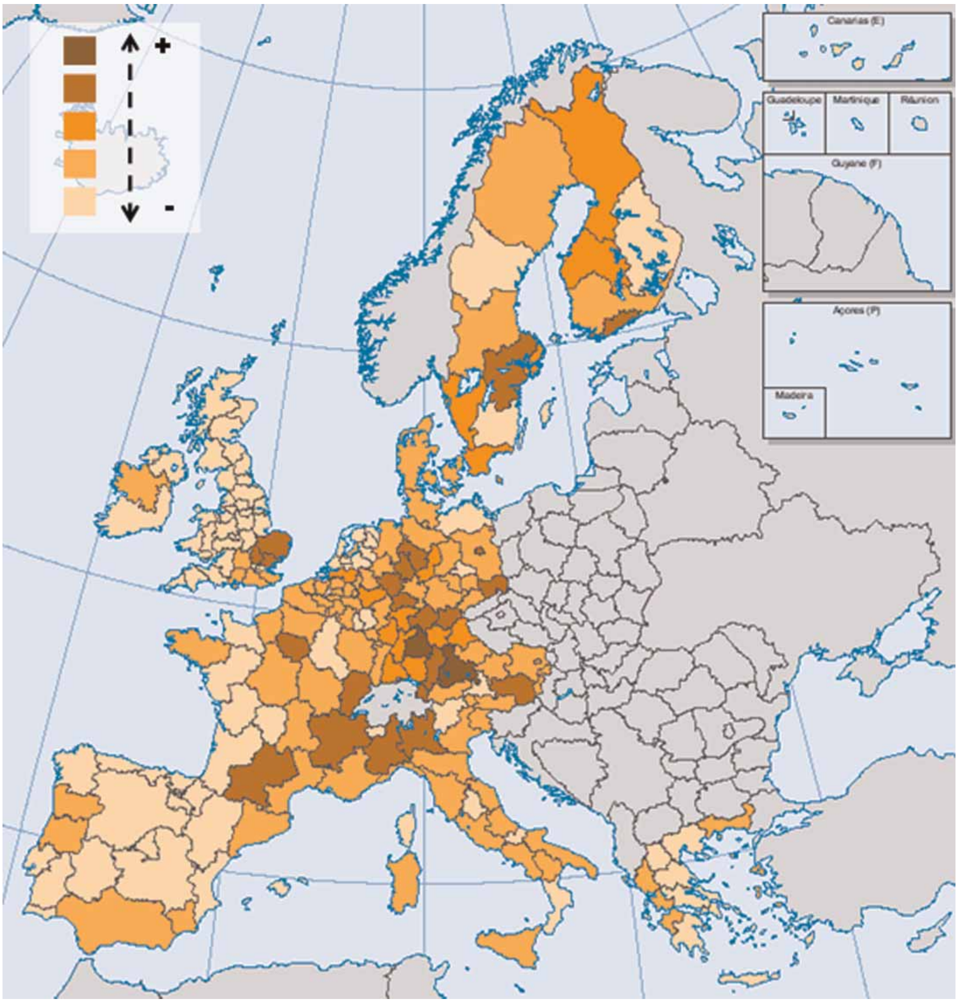

Figure 2. Technological Innovation
Source: Personal elaboration.

dendogram was used to choose the number of clusters. This analysis resulted in the definition of five clusters of European regions. These clusters originated five different regional profiles in relation to the latent dimensions of innovation: Large Economic Centres, Average Regions, Disadvantaged Regions, Innovating Regions and Central Regions (Table 2).

Two from the 175 regions were excluded from the analysis because of problems related to data availability: Departments D'outre Mer (France) and Ceuta y Melilla (Spain).

The analysis of the spatial distribution of clusters is interesting. First, we notice that the cluster *Large Economic Centres* is not spatially delimited because it falls in the major regions in terms of the economic development associated with the national capitals, business centres with high degree of urbanization. Second, if we understand the centre of

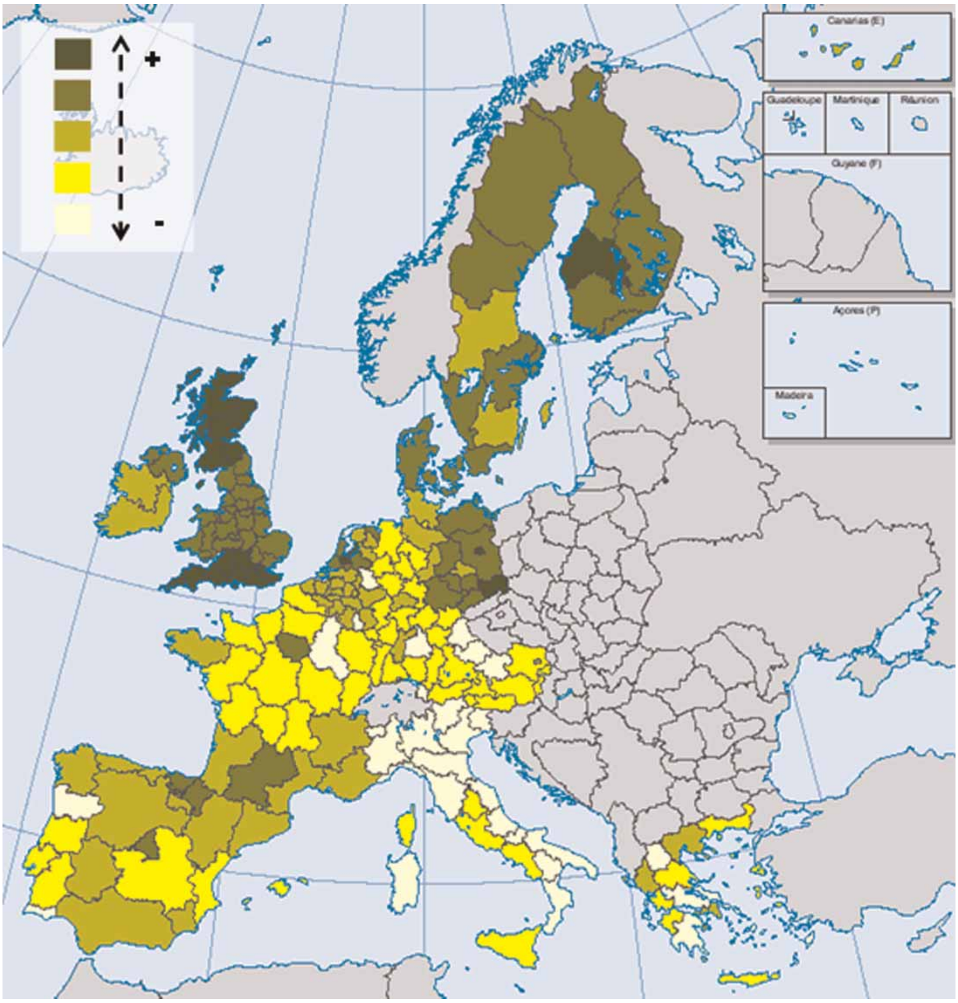

Figure 3. Human Capital
Source: Personal elaboration.

Europe, e.g. near the centre of Germany, where the first level is constituted by *Innovating Regions*, then a second circle is that of *Central Regions* and a third of *Average Regions* and a more peripheral level is that of *Disadvantaged Regions*. The *Disadvantaged Regions* are concentrated in the southern member-states of Europe: Portugal, Greece, Spain, south of France and south of Italy. If we compare the regions from this cluster with the eligible areas under objective 1 for structural funds 2004–2006 or the regions under "Convergence" Objective for 2007–2013, we will notice several similarities.

The analysis of the geographical distribution of the clusters underlines the importance that physical proximity factors have in the innovation process. Nevertheless, as explained by Carrincazeaux *et al.* (2008), geography impacts strongly on institutional or organizational proximity and reinforces our understanding of its relevance (Figure 6).

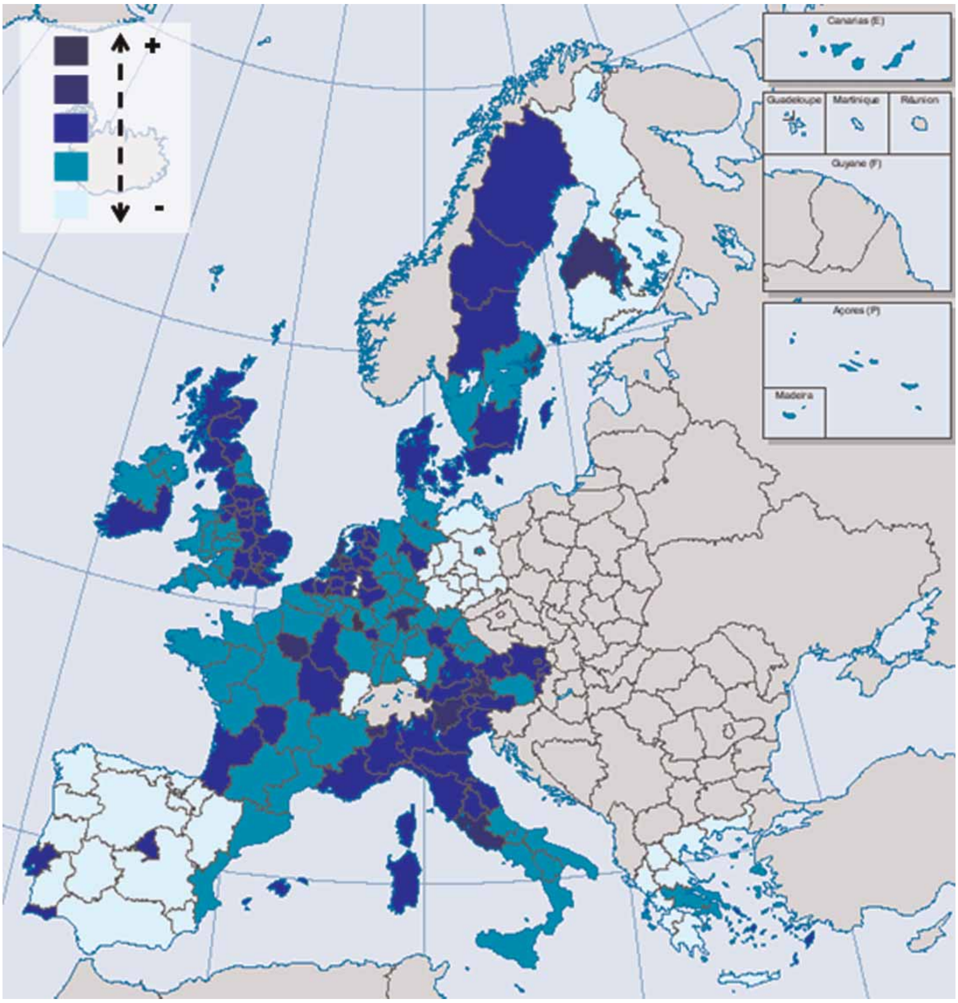

Figure 4. Economic Structure
Source: Personal elaboration.

4. Policy Outcomes from Focusing on European Regions

It is important to compare the consistency of the results achieved with other similar studies. The results obtained are in accordance with the results in other studies,[3] namely, those presented in the previous section of this article. The most interesting features of the study of Carrincazeaux and Gaschet (2006, p. 31) can be found in the results presented, i.e. the strong association of regions within the same countries and belonging to the same EU macro-regions. Another relevant issue, also reported by Eckey and Türck (2006) and De Bruijin and Lagendijk (2005, p. 14), is the association between strong innovative performances and regions with a relevant metropolitan structure. In our analysis, the cluster *Large Economic Centres*, based on the metropolitan areas, was defined by the verified different characteristics when compared with the

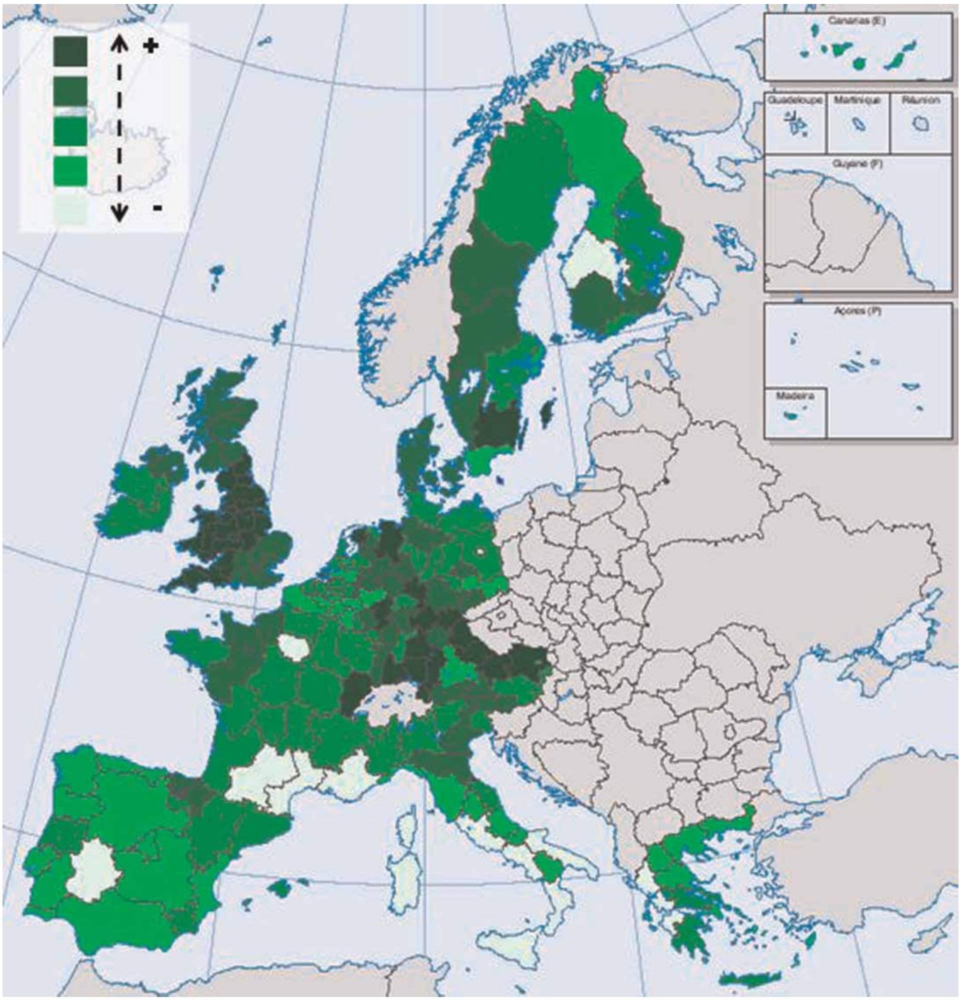

Figure 5. Labour Market Availability
Source: Personal elaboration.

other regional groups. In relation to the study of Regional Trendchart (Hollanders, 2003), a huge coherence between both cluster analyses can be observed (Table 3). Nevertheless, this author found six clusters and our analysis defined only five, but the clusters produced intercept themselves in a considerable number of regions.[4]

The mapping of European regions in terms of innovative performances brings some important issues to the centre of the discussion, which should be considered when defining policy orientations.

One of these issues is the regional innovation paradox. This paradox refers to the apparent contradiction between the comparatively greater need to spend on innovation in lagging regions and their relatively lower capacity to absorb public funds earmarked for the promotion of innovation and to invest in innovation-related activities compared with more advanced regions. Rodriguez-Pose (2001) studied the paradox, trying to understand

Table 2. Latent dimension and cluster's comparative performances

Cluster	Number of regions	Profile	Examples
Large Economic Centres	19	The highest economic development, highest level of *Human Capital*, very intense in technology, but limited in terms of *Labour Market Availability*	The regions of European Union capitals are included, e.g. *Ille* de France, London, Comunidad de Madrid, Hamburg or Brussels
Average Regions	53	Average levels of development, economic performances and labour market issues but high level in *Human Capital* and considerably low in the dimension *Technological Innovation*	Catalonia, La Rioja, Bretagne, Scotland, Wales or Denmark
Disadvantaged Regions	47	These regions have the lowest values in three out of the four dimensions extracted, *Technological Innovation*, *Economic Structure and Labour Market Availability*. The *Human Capital*, despite not being the most negative situation is clearly adverse	Regions from the south of Europe: Portugal, Spain, Greece, south of France and south of Italy
Innovating Regions	13	The most intense cluster in *Technological Innovation*. It presents average levels of *Human Capital* and *Economic Structure* but do very well in terms of *Labour Market Availability*	It is formed by a large group of Germanic regions, as Cologne or Stuttgart (11), one Dutch region and another Swedish
Central Regions	41	The highest labour market performance, high economic level, with a *Technological Innovation* above the average, but with the worst place in the ranking of *Human Capital*	Regions of Central Europe (Germany, France, the Netherlands and Italy)

Source: Personal elaboration.

whether R&D investment in lagging areas is worthwhile. The Schumpeterian strand of the endogenous growth approach highlights the advantages of spatially concentrating the R&D effort in a few regions, to maximize external economies and technological spillovers. In this approach, it is expected that innovation spills over from these technologically advanced territories into less developed neighbouring regions. The neoclassical view, in contrast, considers that decreasing returns makes investment in core regions increasingly less efficient, and investment in peripheries become more effective. As pointed out by Rodriguez-Pose (2001), the regional policy view states that public investment in R&D in lagging regions triggers economic convergence, because it limits congestion in the centre, helps to keep talent and generates spin-offs in lagging areas. Oughton *et al.* (2002) also explored the

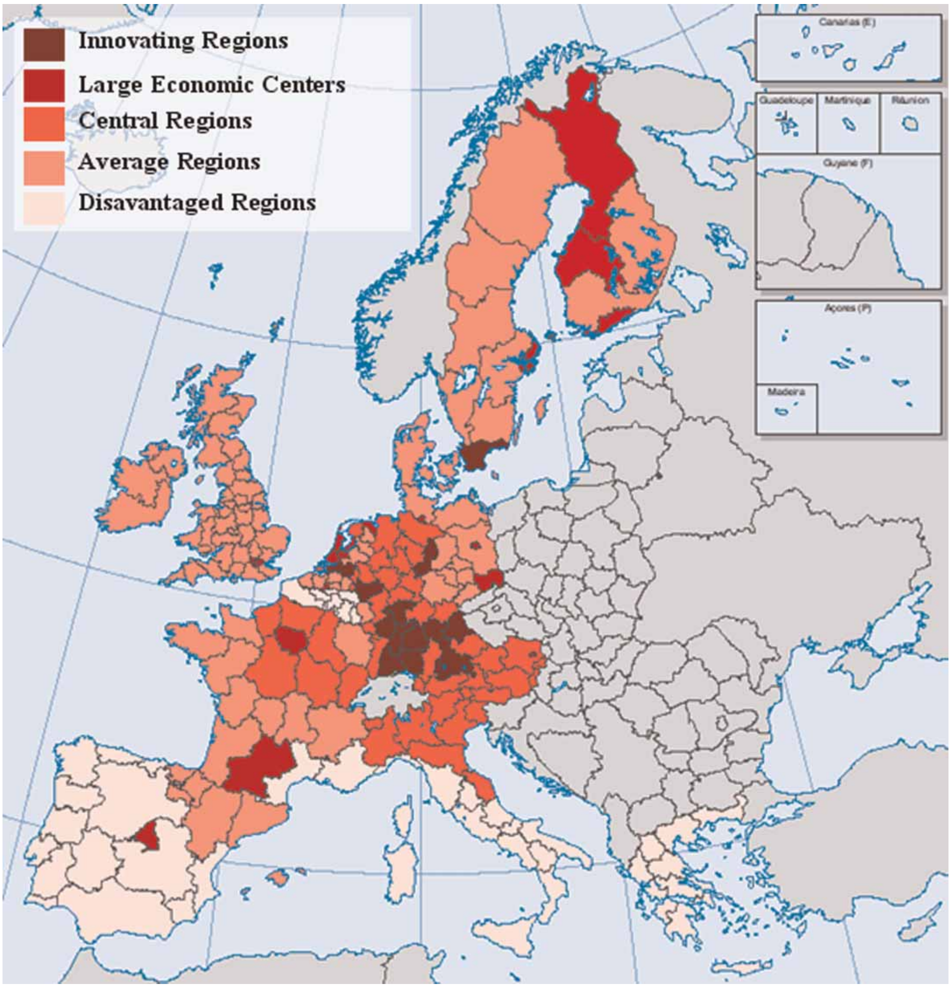

Figure 6. The spatial distribution of the clusters
Source: Pinto and Guerreiro (2007).

regional innovation paradox and its policy implications. Empirical analysis of the nature of the paradox showed that there are strong complementarities between business, education and government spending on R&D and that technology/innovation policy and industrial policies tend to work in opposite directions. The analysis of these authors suggested that the resolution of the paradox requires policies which can increase the innovation capacity of regions by working both on the demand and the supply side of the RIS to increase both private and public sector investment in innovation activity, and also the integration of technology policy and industrial policy by encouraging expenditure on innovation activity within mainstream industrial policy programmes.

Cooke and Leydesdorff (2006) claim that mapping a knowledge-based economy shows how unbalancing effects can subsist. The core cities move away from the peripheries and huge discrepancies tend to grow. The policy imperative to devise mechanisms for

Table 3. Coherence with Trendchart Analysis

	Clusters using *Wards*					
	Great economic centres	Average regions	Disadvantaged regions	Innovative regions	Central regions	Total
Trendchart clustering High Tech 1	2	0	0	1	0	3
High Tech 2	0	0	0	3	0	3
Strong innovation/ high income	6	2	0	8	0	16
Medium-low innovation and high income	6	21	0	0	1	28
Low innovation and average income	4	23	4	1	33	65
Low innovation and Income	0	6	43	0	7	56
Total	18	52	47	13	41	171

Source: Pinto (2006).

non-metropolitan regions participating in the knowledge-based economy is very necessary in order to preserve these territories from turning into social and economic deserts.

Prange (2008) reflected on the variations of innovation policy-making in Europe and found four main factors that support the idea of different instruments: concentration of the research and science system, vertical fragmentation of the political system, degree of Europeanization and endowments of the regions. Different regional conditions, in terms of institutions, organization and resources across Europe make very difficult the efforts to apply the same policies or instruments in different regions by learning from best practices. There is no unique way when devising regional innovation policies (Prange, 2008, p. 50). Regional strategies must not be the replication of successful regions because of the existence of different profiles, path-dependences and particular lock-in processes exist.

An other interesting discussion is the relevance of GDP *per capita* as a main indicator for the allocation of resources in the regional policy in Europe. Even if we understand GDP as an *index* composed of several hundred *indicators* weighted by market prices, this index does not take into account the important features of our reality that influence the participation in a knowledge-based economy, such as the existence and performance of innovation systems and intangible assets that are continuously underestimated when constructing indicators that influence decision-making. Looking at Europe as an ambitious Agenda such as Lisbon's, a deeper analysis should be performed when deciding the possibility of regions to accede, or not, to the financial envelopes that are reserved for regional development, competitiveness and cohesion.

5. Final Considerations

Innovation is, in current times, a focus of European regional policy. Its importance to economic growth is unquestionable. RIS are an attractive concept from the theoretical point of view because they are adequate to explain the dynamics of innovation based on actors which interact and are localized. From an operational point of view, it is interesting to actuate in the territory. Nonetheless, the transition of the RIS concept to concrete action should not be understood as a simple solution with a unique way based on best-practice models. In the European Union regional level, inequalities are easily observed, with all kinds of indicators from GDP to educational levels or unemployment. Regarding innovation, these disparities are not so easily reflected on simple indicators because this phenomenon is characterized by multiple factors that affect each territory differently.

In this context, our study tried to extract the main dimensions of the innovative process. Using the Eurostat data, 175 regions of EU15 were analysed. The descriptive statistics revealed huge regional disparities and the correlation analysis resulted in the evidence of significant relationships between innovation, education and economic development. By using 15 highly correlated variables in a Factorial Analysis, we extracted the four key factors of regional innovation: *Technological Innovation*, *Human Capital*, *Economic Structure and Labour Market Availability.* With these results, the analysed regions were clustered, originating five groups of homogeneous regions: *Large Economic Centres*, *Average Regions*, *Innovating Regions*, *Central Regions* and *Disadvantage Regions*. The results were consistent with other similar studies.

In further studies, it should be interesting to expand this methodology for all EU27 regions on a regular basis, extending the set of variables and using time-series data to understand the evolutionary dynamics of the innovation systems. The relevance of comparing regional performances with alternative methodologies is increased by the European regional policy that subsists on using the GDP *pc* as the main indicator to understand the level of development of regions. With a political agenda such as Lisbon's, which intends to create a competitive territory, this indicator is extremely inadequate for fundamental decisions related to financing regional policy.

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Notes

1. According to Innovating Regions in Europe Network (IRE Network, 2005) 33 regional innovation strategies (RIS, 1994–2001), 70 regional innovation and technology transfer strategies (1994–2001), 16 regional innovation strategies in countries recently associate (RIS-NAC, 2001–2004) and 33 projects of regional innovation strategies in new member-states and associated countries (2005), have been developed with the support of the EU. On the other hand, 145 regions have developed Regional Programs in the scope of the European Regional Development Fund (ERDF) Innovative Actions, many of them as a continuation of the implementation of their regional innovation strategy.
2. The hierarchical methods refer to the development of a hierarchy and the formation of groups in a sequential order that can be graphically represented. From a pre-determined set of cases we define a number of

groups (clusters) which are disjunctive (no common elements) and each sub-group is hierarchically defined, i.e. included in other group until successively we reach the complete set of cases (that includes all sub-groups).

3. In the 2006 APDR Congress (Portuguese Association of Regional Development) were presented two papers with similar approaches: *Inovação e Desenvolvimento Regional: uma análise empírica ao comportamento das regiões portuguesas no contexto europeu* of João Lourenço Marques, Gonçalo de Sousa Santinha and Eduardo Anselmo Castro; *Clusters de Regiões na União Europeia* of Cristina del Campo, Carlos M. F. Monteiro and João O. Soares.
4. The *High Tech* 1 cluster has three regions, two of the UK and another from Finland, two belonging to *Great Economic Centres* and the other to *Innovating Regions*. The *High Tech* 2 cluster includes two regions from Germany and two from Holland, the three being *Innovating Regions*. The *Strong Innovation/high Income* cluster includes eight *Innovating Regions*, six *Great Economic Centres* and two *Average Regions*. The *Medium-low innovation and high-income* cluster groups 21 *Average Regions*, 6 *Great Economic Centres* and 1 *Central Region*. The *Low innovation and average income* cluster aggregates 33 *Central Regions*, 4 *Disadvantaged Regions* and 1 *Innovating Region*. The cluster *Low innovation and Income* includes 43 *Disadvantaged Regions*, 7 *Central Regions* and 6 *Average Regions*.

References

Abramovitz, M. (1962) Economic growth in the United States: A review article, *American Economic Review*, 52(4), pp. 762–782.

Amable, B. & Petit, P. (2002) The Diversity of Social Systems of Innovation and Production in the 1990s, paper available online at http://www.cepremap.cnrs.fr/couv_orange/co0115.pdf (accessed 17 August 2005).

Amable, B., Barre, R. & Boyer, R. (1997) *Les Systèmes d'Innovation à l'Ére de la Globalisation*, p. 401(Paris: Economica).

Asheim, B. & Gertler, M. (2004) The geography of innovation: Regional innovation systems, J. Fagerberg, D. Mowery & R. Nelson (Eds), *The Oxford Handbook of Innovation* (Oxford: Oxford University Press).

Asheim, B. & Isaksen, A. (2002) Regional innovation systems: The integration of local "sticky" and global "ubiquitous" knowledge, *Journal of Technology Transfer*, 27(1), pp. 77–86.

Bathelt, H., Malmberg, A. & Maskell, P. (2004) Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation, *Progress, Human Geography*, 28(1), pp. 31–56.

Carrincazeaux, C. & Gaschet, F. (2006) Knowledge and the diversity of innovation systems: A comparative analysis of European regions, Cahiers du GRES, 29, Université Montesquieu-Bordeaux IV.

Carrincazeaux, C. & Lung, Y. (2004) Configurations régionales des dynamiques d'innovation et performances des régions françaises, Cahiers du Gres, no. 2004–24.

Carrincazeaux, C., Lung, Y. & Vicente, J. (2008) The Scientific Trajectory of the French School of Proximity: Interaction- and institution-based approaches to regional innovation systems, *European Planning Studies*, 16(5), pp. 617–628.

Cheshire, P. C. & Carbonaro, G. (1996) Urban economic growth in Europe: Testing theory and policy prescriptions, *Urban Studies*, 33(7), pp. 1111–1128.

Cheshire, P. C. & Magrini, S. (2000) Endogenous processes in European regional growth: Convergence and policy, *Growth and Change*, 31(4), pp. 455–479.

Cooke, P. & Leydesdorff, L. (2006) Regional development in the knowledge-based economy: The construction of advantages, *Journal of Technology Transfer*, 31(1), pp. 5–15.

Cooke, P. (1998) Origins of the concept, H. J. Braczyc, P. Cooke & M. Heidenreich (Eds), *Regional Innovation Systems—The Role of Governances in a Globalized World,* 1st edn. (London: UCL Press).

Crescenzi, R. (2005) Innovation and regional growth in the enlarged Europe: The role of local innovative capabilities, peripherality and education, *Growth and Change*, 36(4), pp. 471–507.

De Bruijn, P. & Lagendijk, A. (2005) Regional innovation systems in the Lisbon Strategy, *European Planning Studies*, 13(8), pp. 1153–1172.

Denison, F. (1967) *Why Growth Rates Differ: Post-war Experience in Nine Western Countries* (Washington, D.C.: The Brooking Institution).

Doloreux, D. & Bitard, P. (2005) Les systèmes régionaux d'innovation: Discussion critique, *Géographie Économie Société*, 7(1), pp. 21–36.

Doloreux, D. & Dionne, S. (2007) Evolution d'Un Système d'Innovation en Région Rurale: le Cas de LaPocatière dans une Perspective Historique (1987–2005) (Rimouski: Université du Québec).

Doloreux, D. & Parto, S. (2005) Regional innovation systems: Current discourse and unresolved issues, *Technology in Society*, 27(2), pp. 133–153.

Eckey, H. F. & Türck, M. (2006) *Convergence of EU Regions. A Literature Report*, Working Paper 80/06, Institut für Volkswirtschaftslhere, Kassel, Universität.

European Commission (2004) *A New Partnership for Cohesion—Third Report on Economic and Social Cohesion* (Luxembourg: Office for Official Publications of the European Communities).

European Commission (2001) *As Regiões na Nova Economia—orientações relativas às Acções Inovadoras do FEDER para o Período 2000–2006* (Brussels: COM Communication).

European Commission (2007) *Growing Regions, Growing Europe—Fourth Report on Economic and Social Cohesion* (Luxembourg: Office for Official Publications of the European Communities).

Evangelista, R., Iammarino, S., Mastrostefano, V. & Silvani, A. (2001) Measuring the regional dimension of innovation—Lessons from the Italian Innovation Survey*1, *Technovation*, 21(11), pp. 733–745.

Fagerberg, J. (1991) *Innovation, catching-up and growth, in Technology and Productivity: The Challenge for Economic Policy (1991)*, pp. 37–48 (Paris: OECD).

Fagerberg, J., Verspagen, B. & Carriels, M. (1997) Technology, growth and unemployment across European regions, *Regional Studies*, 31(5), pp. 447–466.

Ferrão, J. (2002) Inovar para desenvolver: o conceito de gestão de trajectórias territoriais de inovação, *Interacções—Revista Internacional de Desenvolvimento local*, 3(4), pp. 17–26.

Freeman, C. (1995) The National System of Innovation in historical perspective, *Cambridge Journal*, 19(1), pp. 5–24.

Guerreiro, J. (2005) As funções da universidade no âmbito dos Sistemas de Inovação, in: Vários, *Estudos II*, pp. 131–148 (Faro: Faculdade de Economia da Universidade do Algarve).

Gössling, T. & Rutten, R. (2007) Innovation in regions, *European Planning Studies*, 15(2), pp. 253–270.

Hollanders, H. (2003) *2003 European Innovation Scoreboard: Technical Paper No. 3 Regional Innovation Performances* (Brussels: European Commission DG Enterprise).

Hollanders, H. (2007) *2006 European Regional Innovation Scoreboard (2006 RIS)* (Maastricht: Maastricht Economic Research Institute of Innovation and Technology).

IRE Network (2005) *Innovating Regions in Europe—Strategies making a difference,* brochure (Luxembourg: IRE).

Kline, S. J. & Rosenberg, N. (1986) An overview of innovation, R. Landau & N. Rosenberg (Eds), *The Positive Sum Strategy: Harnessing Technology for Economic Growth* (Washington, D.C.: The National Academy Press).

Lucas, R. (1988) On the mechanics of economic development, *Journal of Monetary Economics*, 22(1), pp. 3–42.

Lundvall, B.-A. (Ed.) (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning,* 1st edn. (London: Pinter Publishers).

Nelson, R. (Ed.) (1993) *National Systems of Innovation: A Comparative Analysis* (Oxford: Oxford University Press).

Niosi, J. (2005) *Canada's Regional Innovation System: The Science-based Industries* (Montreal: McGill-Queen's University Press).

OECD. (1990) *Manual da Inovação—Síntese e adaptação* (Paris: OECD Publications).

OECD. (2005) *Oslo Manual—Guidelines for Collecting and Interpreting Innovation data,* 3rd edn. (Paris: OECD Publications).

Oughton, C., Landabaso, M. & Morgan, K. (2002) The regional innovation paradox: Innovation policy and industrial policy, *Journal of Technology Transfer*, 27(1), pp. 97–110.

Pestana, M. H. & Gageiro, J. N. (2003) *Análise de Dados para Ciências Sociais—A complementaridade do SPSS* (Lisbon: Edições Sílabo).

Pinto, H. (2006) A Performance do Algarve na Inovação—Uma Comparação Inter-regional, Dissertação de Mestrado, not published, Faro: Universidade do Algarve.

Pinto, H. & Guerreiro, J. (2007) As Dimensões Latentes da Inovação: O Caso das Regiões Europeias, *Estudos Regionais*, 13, pp. 83–101.

Porter, M. (2003) The economic performance of regions, *Regional Studies: The Journal of the Regional Studies Association*, 37(6–7), pp. 545–546.

Prange, H. (2008) Explaining varieties of regional innovation policies in Europe, *European Urban and Regional Studies*, 15(1), pp. 9–52.

Reis, E. (2001) *Estatística Multivariada Aplicada,* 2nd edn. (Lisbon: Edições Sílabo).

Rodriguez-Pose, A. (2001) Is R&D in lagging areas of Europe worthwile? Theory and empirical evidence, *Papers in Regional Science*, 80(3), pp. 275–295.

Romer, P. (1986) Increasing returns and long run growth, *Journal of Political Economy*, 94(51), pp. 1002–1037.

Romer, P. (1990) Endogenous technical change, *Journal of Political Economy*, 98(5), pp. S71–S101.

Solow, R. (1956) A contribution to the theory of economic growth, *The Quarterly Journal of Economics*, 70(1), pp. 65–94.

Solow, R. (1957) Technological change and the aggregate production function, *Review of Economics and Statistics*, 39(3), pp. 312–320.

Uyarra, E. (2007) Regional innovation systems in perspective, conceptual relevance and policy challenges, Conference Proceedings, 1st International Seminar on Regional Innovation Policies, Porto.

Appendix

Factorial Analysis Details

To select the number of factors to retain, the Kaiser criterion was used, choosing the factors whose explained variance is superior to one (eigenvalues $>$1). As a consequence of this we retained four main factors, explaining 76.8% of total variance, a very acceptable value in this kind of analysis. Other methodological steps: the extraction resulted in very high commonalities (the variable's variance that is explained by the common factors). To validate the utilization of factorial analysis, the Kaiser–Meyer–Olkin (KMO $= 0.767$) and the Bartlett's sphericity tests were used. The extracted factors were internally consistent, all four factors scored more than 0.6 in the Cronbach́s α. Each factor was analysed through a map where the regions were divided into five groups based on percentiles. The factor loadings did not result in understandable latent dimensions. To solve this problem we have done a Varimax rotation that minimizes the number of variables with high loadings in each factor.

Table A1. Explained variance and extracted components before and after rotation

	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
Components	Total	% of Variance	% Cumulative	Total	% of Variance	% Cumulative	Total	% of Variance	% Cumulative
1	7.1436	47.6242	47.6242	7.1436	47.6242	47.6242	3.9045	26.0300	26.0300
2	2.1167	14.1113	61.7355	2.1167	14.1113	61.7355	3.2130	21.4199	47.4499
3	1.2398	8.2652	70.0006	1.2398	8.2652	70.0006	2.7164	18.1094	65.5592
4	1.0199	6.7990	76.7997	1.0199	6.7990	76.7997	1.6861	11.2404	76.7997
5	0.8989	5.9924	82.7920						
6	0.8162	5.4414	88.2335						
7	0.5105	3.4033	91.6367						
8	0.3467	2.3115	93.9482						
9	0.2747	1.8313	95.7795						
10	0.2263	1.5084	97.2879						
11	0.1825	1.2164	98.5043						
12	0.1598	1.0655	99.5698						
13	0.0382	0.2548	99.8245						
14	0.0145	0.0968	99.9213						
15	0.0118	0.0787	100.0000						

Table A2. Component matrix after rotation (six iterations)

	Component			
	Technological innovation	Human capital	Economic structure	Labour market availability
Total number of patents (2001)	0.8907			
EPO patents for million inhabitants (average 1999–2000–2001)	0.8647			
Private R&D in % of GDP (2001)	0.8012			
% of high-technology patents from total (2001)	0.7501			
Employment in medium/high technology industries (2002)	0.6298			
Tertiary education (2002)		0.8623		
Population of 25–64 years with high education (% of total, 2002)		0.8616		
Life-long learning (2002)		0.6618		
Public R&D in % of GDP (2001)		0.5868		
GDP pc mean 1999–2000–2001 UE15 = 100			0.8718	
GDP *per capita* in € (2000)			0.8074	
Employment in services (% of total 2002)			0.7033	
Employment in medium/high technology services (2002)			0.5893	
Employment rate				0.6368
Population 25–64 years old with medium education (% of total, 2002)				0.5365

Table A3. Latent dimensions and created clusters

	Technological innovation	Human capital	Economic structure	Labour market availability
1				
Mean	0.200	1.224	1.473	−0.716
Minimum	−1.651	−1.587	−1.683	−1.874
Maximum	2.923	2.503	4.144	0.664
N	19.000	19.000	19.000	19.000
2	−0.327	0.717	−0.200	0.471
Mean				
Minimum	−1.304	−0.417	−1.717	−0.475
Maximum	1.607	2.181	1.430	1.684
N	53.000	53.000	53.000	53.000
3				
Mean	−0.457	−0.542	−0.510	−1.044
Minimum	−1.159	−1.818	−2.257	−2.374
Maximum	0.113	0.689	1.430	−0.016
N	47.000	47.000	47.000	47.000
4				
Mean	2.488	−0.291	−0.078	0.317
Minimum	1.605	−1.224	−1.091	−0.920
Maximum	4.868	1.088	1.229	1.387
N	13.000	13.000	13.000	13.000
5				
Mean	0.065	−0.780	0.184	0.820
Minimum	−1.014	−1.851	−0.885	−0.162
Maximum	1.159	0.132	1.655	2.168
N	41.000	41.000	41.000	41.000
Total				
Mean	0.000	0.000	0.000	0.000
Minimum	−1.651	−1.851	−2.257	−2.374
Maximum	4.868	2.503	4.144	2.168
N	173.000	173.000	173.000	173.000