ESPON

KIT
Knowledge, Innovation, Territory

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This report presents the interim results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

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This basic report exists only in an electronic version.

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1. Introduction

The understandable limited size of the interim report calls for a scientific report as an addendum, in which more in depth results, methodologies and maps can be discussed in length.

In this scientific report, the reader can find very detailed analyses on different issues.

Chapter 2 is about **scientific regions**. For these, the main indicators are presented in the interim report. Here the analysis is enlarged to descriptive statistical methods, to spatial association analysis, and reports the ranking of regions for each indicators. Some indicators are mapped in absolute terms, and for different time spans. Moreover, a theoretical review of the role of human capital and research activities in regional growth.

Chapter 3 deals with **knowledge networking regions**. Also in this case, we present here in a much more in-depth way the variables used to build the knowledge networking regions, associating to each indicator statistical descriptive analyses. This is done for both spatially and non-spatially mediated mechanisms. Interestingly, in this chapter a social network analysis is applied to a sub-set of our variables of interest. While spatial statistics and spatial econometrics give the opportunity to study the geographical distribution of knowledge variables and their spatial interactions (see 'The functional approach to the knowledge economy' within this report), SNA provides a specific methodological framework to investigate non-geographically mediated variables at the regional scale. In particular, the a-spatial branch of the 'Networking Regions' –cross-regional co-patents, spatial mobility of highly skilled individuals, and cross-regional patent citations made - is going to be analysed here. To do so, we take 287 European NUTS2 regions as being nodes, or points or actors, of a whole network of regions. These nodes may or may not be linked through edges, or ties, to one another, make up by either co-patents or inventors' spatial mobility or patent citations.

Chapter 4 of this scientific report presents an in-depth description of the methodology used to estimate the innovation data at NUTS2. All methodological problems encountered are presented, and all **tests of robustness** of the estimates presented. Moreover, all maps of the Eurostat national data are here contained.

Chapter 5 presents in-depth results of the **comparison between India, China and US**. The text is organised into five sections that lay the foundations of research in this area for the final report. In section 5.2 an in-depth analysis of the spatial distribution of patenting activity, by country, region and key technology fields (ICT, biotech and nanotech) is pursued. In section 5.3 a conceptual framework to inform the quantitative analysis of these territorial dynamics is outlined. Section 5.4 provides brief conclusions. Section 5.5 gives a summary of key methodological issues.

Chapter 6 is about the case studies. In particular, interview protocols for both kinds of case studies (best practice in knowledge creation and knowledge spillovers) are presented, as well as the timetable for the implementation of the interviews.

More than a coherent piece of work, this scientific report has be to interpreted as a collection of scientific reports that support the contents of the interim report, enlarging and deepening the analysis.

2. Scientific regions

2.1. Introduction

In the KIT project the knowledge economy is conceptualised following a multi-dimensional approach. By analysing the concept of knowledge economy under diverse perspectives three different but complementary definitions emerge. A sector based approach allows identifying technologically advanced regions, a functional approach leads to the definition of scientific regions while a relational approach brings to the innovative networking regions identification.

Here we focus on the function-based approach with the aims of, first, providing a definition of what is meant by scientific regions and, second, identifying the indicators for measuring such regions. More specifically, the functional approach emphasizes the importance of pervasive and horizontal functions like high education and innovation efforts (Research & Development, patenting). In this line of reasoning the definition of scientific regions is based on two fundamental pillars: human capital and research activities. It is important to remark that these two elements are able to capture both the production of knowledge carried out within the region and the capacity of the local firms to absorb knowledge spilling from the external economies.

The appreciation of the pervasive role of advanced functions in creating and diffusing knowledge is grounded in the economics of knowledge literature. In this strand of the literature, the generation of new knowledge is conceived as the specific outcome of distinct and specific activities like internal learning, formal research and development activities, and the acquisition of external tacit and codified knowledge. In this line of thought, the knowledge external to the firm is a necessary and relevant complement to knowledge internal to the firm in order to generate new knowledge. Firms that have no access to external knowledge and cannot take advantage of essential complementary knowledge inputs may generate new knowledge only to a limited extent, even if internal learning combined with research and development activities provides major contributions. Also the opposite is true. Firms that do not perform any knowledge generating activity but have access to rich knowledge commons are not able to generate new knowledge since they do not have absorption capacity. In this view, the context into which firm innovate plays a key role to make the actual introduction of innovations possible. In particular local institutions like universities and research centres are crucial sources of external knowledge to firms.

The debate on the economics of knowledge has evolved through different steps based on the different characteristics assigned to knowledge through time (see Antonelli, 2008). Following the different phases in the debate, firms and local institutions, in particular universities and research centres are assumed to play evolving roles. Based on the works by Arrow (1962) and Nelson (1959), knowledge has firstly been regarded as a public good. The basic idea behind this assumption is that knowledge is a public good, thus, it may spill over, primarily from universities and research labs, and it is freely available to firms. Subsequently, knowledge has been considered as a quasi-proprietary good (Nelson and Winter, 1982). In this view, the firm is regarded as the privileged locus where knowledge is created and accumulated. Firms can appropriate and protect a fraction of the new knowledge introduced by means of patents. In turn, universities and public research centres are solicited to protect their research output in order to increase dissemination. Finally, the literature has shifted towards the concept of knowledge as a collective process. This approach focuses on external knowledge, generated by interactions among the diverse economic agents (Griliches, 1992; David, 1993; Cooke, 2002). In this line of thought, the firm is regarded as a changing and creative agent, searching for knowledge in the local environment. Interrelation among firms, universities and research centres are now considered vital for the generation, dissemination and absorption of new knowledge. Knowledge can indeed be transferred and disseminated among different actors in the economic system. The spillovers of knowledge generate positive externalities to firms by stimulating innovation activities and productivity.

In each phase, this debate has highlighted one specific aspect of the knowledge generating process: firms fund R&D activities but can appropriate only a fraction of the total benefits. However, the positive side of the coin is that firms can take advantage of the knowledge spilling in the atmosphere from other firms and also from universities and research labs. This has emphasized the importance of investments in research activities and human capital formation not only at the business level but also at the regional and the institutional levels. Thus, research activities and human capital - the two main pillars at the base of the scientific regions definition – have become the object of flourishing strands of the literature at the regional level.

As far as the first pillar of our approach is concerned, the appreciation of the role of knowledge spillovers and knowledge externalities in the area of regional science has emphasized the importance

of advanced functions like research efforts (R&D expenditure, patenting activities) for the regional economic development. Indeed, the innovation process requires exploring activities that denotes a deliberate and active effort to search for new technical and organizational solutions, new products and processes. The main economic actors involved in this process are R&D professional laboratories in private firms, and research institutes and universities in the public domain. In this line of thought, institutional approaches in regional economics have been developed and regions hosting large and well-known scientific institutions have become the object of this new field of enquiry. In this area, concepts like Regional Innovation Systems (RIS) (Cooke et al. 1997, Braczyk et al. 1998) and Triple Helix (TH) (Etzkowitz and Leydesdorff, 1997, 2000) emphasize the active role of territorial actors within regional development dynamics and give relevance to the institutional foundations of regions' competitive advantage in the areas of education and research and development. These institutional approaches argue that differences in economic behaviours and outcomes are primarily related to differences in institutions (Hodgson, 1988, 1998; Whitley, 1992, 2003; Saxenian, 1994; Gertler, 1997).

Many empirical works have analysed regional differences in the distribution of research and innovative activities and have investigated the process of knowledge creation and diffusion within and across regions. These empirical studies are based on innovation input and output indicators like R&D expenditure, patents statistics and innovation counts. A first strand of the literature has focused on pure knowledge spillovers and proved that they are geographically bounded (Audretsch and Feldman, 1996; Baptista and Swann, 1998; Acs et al., 2002). In this line of research, a number of empirical contributions have investigated the role of universities in the process of knowledge spillovers (Jaffe, 1989; Anselin, 1997; Audretsch and Feldman, 1996) and found strong evidence in favour of a significant positive correlation between firms' concentration and university location (Varga, 2000; Audretsch and Lehmann, 2005). A second strand of the literature have attempted to investigate the main general mechanisms of the process of creation and diffusion of inventive knowledge rather than just looking for localized knowledge spillovers. Such studies have been applied to the US case (Varga et al., 2005; Carlino et al., 2007) as well as those of Europe (Bottazzi and Peri, 2003; Greunz, 2003; Moreno et al., 2005; Rodriguez-Pose and Crescenzi, 2008; Tappeiner et al., 2008; Acosta et al., 2009) and OECD countries (Usai, 2010). All in all, these contributions find that technological spillovers, both pure and pecuniary, may exist within and across regions and have shed light on the role of geographical distance in the economics of knowledge transmission. Moreover, this strand of the literature has suggested that knowledge spillovers may be also affected by cognitive, social, organizational, and institutional distance, as suggested by Torre and Rallett (2005) and Boschma (2005). A further set of empirical literature has addressed the issue of distinguish between Marshallian externalities and Jacobian externalities and has focused on the regional differences in the patterns of specialisation and diversification of innovation. While Feldman and Audretsch (1999) find that there is no evidence of specialization externalities, whilst diversity externalities are at work in the case of US metropolitan areas, these results have been somewhat disputed by several analyses based on European data (for example, Paci and Usai, 1999, 2000; Massard and Riou, 2002; Greunz, 2003; and Moreno et al., 2006), suggesting a notable difference in the functioning of the local innovation systems in the United States and Europe.

As far as the second pillar is concerned, since Solow's (1957) contribution the literature has emphasized the positive role of human capital on productivity level and growth. Two main approaches have been applied. The first approach was developed by Mankiw et al. (1992) that extended the Solow growth model by explicitly introducing human capital as an ordinary input in the production function. An alternative approach was introduced by the endogenous growth models (Lucas, 1988; Romer, 1989) that directly related human capital to the adoption of technology and underlined the positive interaction between knowledge, capabilities and innovative ability. On a parallel ground, the seminal paper by Cohen and Levinthal (1990) on the firm's absorptive capacity gave rise to a strand of the literature aimed at understanding key characteristics of firms, regions and countries that make it easier to understand and absorb external knowledge in an economically efficient manner. In this line of reasoning, human capital is not just a precondition for enhancing the growth capabilities of regions or countries, but rather provides the stock of accumulated knowledge that allow a region to identify and utilize proper knowledge from outside.

A recent and wide body of empirical literature have been developed in order to verify these theoretical predictions at the regional level of analysis. For example, Rauch (1993) find that at the regional level a higher availability of well educated labour forces represents an advantage for the localization of innovative firms thus promoting local productivity. Bronzini and Piselli (2009) assess the role of the technological knowledge, as measured by the stock of R&D capital, the human capital, and the stock of public infrastructure, in enhancing the levels of Total Factor Productivity (TFP) of Italian regions over

the period 1980-2001. They shows that there exists a long-run equilibrium between productivity level and the three kinds of capital; among them, human capital turns out to have the strongest impact on productivity. Dettori et al. (2010) investigate the determinants of the TFP levels by analyzing the role played by intangible factors like human capital, social capital and technological capital for a sample of 199 European regions over the period 1985-2006. They provide robust evidence on the role played by intangible capital in enhancing economic growth and social cohesion. Abreu et al. (2008), in their paper using UK firm-level data, investigate the impact of absorptive capacity at the firm-level on the regional variations in innovation performance. They find that innovation requires the appropriate human capital.

In this line of reasoning with these strands of both the theoretical and empirical literature we propose a workable definition of scientific regions which is based on the two main pillars of the knowledge economy: human capital endowments and research activities. The rationale behind this choice is clearly shown by the literature: these two elements are able to capture either the creation of new knowledge within the region and also the capacity of the local firms to absorb knowledge spilling from the internal and external economies. More specifically, in our approach scientific regions can be defined as those regions characterised by above the average values for both human capital and research activities. It is well known that both variables represent a complex and multifaceted process composed by input and output elements and consequently they cannot be proxied by a single indicator.

The level of **human capital** stock in a region is represented by means of both input and output indicators. As input indicator in the process of human capital formation we use the percentage of population employed in the education sector assumed as a proxy of the regional effort to create and promote new knowledge and human capital activities. As output indicator, we use the share of population that has attained at least a university degree. Furthermore, we include the extent of the involvement of each region in the activities of the 5th Framework Programmes as a proxy for the quality of the human capital and research activities conducted in the region and the diffusion of knowledge through cooperation.

The level of **research activities** is also measured by means of both input and output indicators. As an input variable, we employ R&D expenditures and the percentage of employees in R&D in order to analyse the regional distribution of research activities. Scientific regions are those ones characterised by high quantity and quality of inventive activities that is the output of the knowledge production function. To measure the inventive activities we rely upon patent counts including two complementary measures: the total number patents released in the region in all economic sectors and the number of patents for the subsample of high-tech sectors. These output indicators are expected to measure the value resulting from technological knowledge generated by firms and can be used as a proxy for research and development effectiveness.

In Section 3 we will identify scientific regions under the two main perspectives described so far: research activities and human capital. We thus aim at selecting regions above the EU average in terms of specialisation on both dimensions. This will allow us at developing a synthetic indicator that provide, first, a unique classification of European regions according to the functional approach and, second, the rankings of regions according to their scientific innovative performance.

Once we identify the scientific regions, we will analyse the typologies of scientific regions by looking at how they are characterised in term of sectoral specialisation (High tech, Medium high tech; Medium low tech; Low tech) and also according to other institutional and territorial features (Urban, rural, central, peripheral, etc; EU15, New EU entrants, EFTA; convergence, transition, competitive; etc).

Finally, we will conclude by discussing the results of our descriptive analysis.

2.2 The knowledge indicators

2.2.1 Introduction

The aim of this Section is to provide a full and more in depth description of all the knowledge indicators used in this report which can be grouped in the four categories:

- Human capital;

- 5° Framework Program;

- Research and Development;

- Patenting activity.

The list of the indicators and the sources of data is reported in Table 1, while the summary statistics are presented in Table 2.

A list of the 31 ESPON considered countries together with the number of NUTS2 regions in each country is reported in Table 3; in total we will consider 287 regions.

In the following four sections, for each variable we present the following elaborations:

- Table with average values for macro areas in Europe;

- Maps (absolute, per capita values);

- Table with the list of top and bottom ten regions;

- Table with a regional index of concentration (coefficient of variation);

- Table and maps with spatial association measures (Moran and Lisa).

Table 1 Variables information

Knowledge variables		Weights	Measurement unit	Description	Sources	Years available
Human Capital	*Percentage of population with ISCED 5-6	1/3	Percentage	Percentage of population aged 15 and over by highest level of education attained	CRENoS elaborations on Eurostat data	2005-2007
	*Percentage of population employed in the education sector	1/3	Percentage	Percentage of population employed in the NACE education sector		2005-2007
5th Framework Programme	Number of participations		Units	Number of active projects in each region *j*	CRENoS elaboration on CORDIS data	1998-2002
	Funding		Millions of Euro	Funding received by the participants *i* summed up by region *j*.		1998-2002
	*Funding per 1000 population	1/3	Thousands of Euro per 1000 POP	Funding over POP divided by 1000		1998-2002
Research and Development	Expenditure		Millions of Euro	Millions of Euro spent per RD activities	CRENoS elaboration on Eurostat, ISTAT and Institut National de la Statistique et des Études Économiques data	2006-2007
	*Expenditure per 1000 population	1/4	Millions of Euro per 1000 POP	Millions of Euro spent per RD activities over POP divided by 1000		2006-2007
	Expenditure as % of GDP		Percentage	Millions of Euro spent per RD activities over GDP		2006-2007
	*Personnel, % of Employment	1/4	Percentage	Head Count Employment in RD over Employment		2006-2007
Patent activity	Number of patents		Units	Number of Patents released at NUTS2 level	CRENoS elaboration on OECD REGPAT database	1995-2006
	*Number of patents per million population	1/4	Patents per 1000 POP	Number of Patents released at NUTS2 over POP divided by 1000		1995-2006
	Number of high-tech patents		Units	Number of patents in high-tech IPC sectors		1995-2006
	*Number of high-tech patents by million population	1/4	Patents high-tech per capita	Number of patents per million population in high-tech IPC sectors		1995-2006
	Yearly rate of change		Yearly Rate	Yearly rate of change in the number of patents		1995-2006
Other variables:						
Population		POP	Thousands	Total population at 1st January	Eurostat	1990-2008
Employment		EMP	Thousands	Head count employment aged 15 and over	Eurostat	2006-2007
Gross domestic product		GDP	Current market prices	Gross domestic product at current market prices	Eurostat	2006-2007

***Indicates the variables used to define the scientific regions.

Table 2 Summary Statistics (31 countries, 287 regions)

	Variable	Period	Average	Median	Min	Max	Standard deviation	N. of missing
Human Capital	Percentage of population with ISCED 5-6	Average 2005-2007	12.37	12.32	4.09	33.19	4.59	1
	Percentage of population employed in the education sector	Average 2005-2007	3.24	3.01	1.53	6.20	0.84	5
5th Framework Programme	Number of participations	1998 - 2002	253.61	110.00	0.00	4418.00	410.70	0
	Funding, Millions of €		40.00	16.16	0.00	803.09	70.23	0
	Funding per 1000 POP, Thousands of €		22.27	12.75	0.00	207.83	26.55	0
Research and Development	Expenditure, Absolute value, Millions of €	Average 2006-2007	842.65	386.14	1.69	15121.08	1415.47	7
	Expenditure, Millions of € per 1000 POP		0.44	0.28	0.00	2.63	0.47	7
	Expenditure % GDP		1.45	1.13	0.09	6.77	1.19	7
	Personnel % EMP		1.44	1.27	0.18	5.71	0.94	8
Patent activity	Number of patents (absolute values)	Average 1995-1997	120.69	39.35	0.00	2181.00	242.92	0
		Average 2005-2006	204.17	72.01	0.00	3161.97	385.11	0
	Number of patents (per million population)	Average 1995-1997	61.93	38.71	0.00	428.54	79.11	4
		Average 2005-2006	103.18	61.50	0.00	727.90	128.47	0
	Number of patents in high-tech IPC sectors	Average 1995-1997	14.56	2.17	0.00	393.52	40.17	0
		Average 2005-2006	27.30	5.04	0.00	603.70	64.99	0
	Number of patents in high-tech IPC sectors (per million)	Average 1995-1997	6.98	1.91	0.00	93.08	13.68	4
		Average 2005-2006	13.12	4.17	0.00	181.51	22.77	0

Table 3 Regional disaggregation of data

Code	Country	Number of Regions
AT	Österreich	9
BE	Belgique-België	11
BG	Bulgaria	6
CH	Schweiz/Suisse/Svizzera	7
CY	Kypros / Kibris	1
CZ	Ceska Republika	8
DE	Deutschland	39
DK	Danmark	5
EE	Eesti	1
ES	España	19
FI	Suomi / Finland	5
FR	France	26
GR	Ellada	13
HU	Magyarorszag	7
IE	Ireland	2
IS	Ísland	1
IT	Italia	21
LI	Liechtenstein	1
LT	Lietuva	1
LU	Luxembourg (Grand-Duché)	1
LV	Latvija	1
MT	Malta	1
NL	Nederland	12
NO	Norge	7
PL	Polska	16
PT	Portugal	7
RO	Romania	8
SE	Sverige	8
SI	Slovenija	2
SK	Slovenska Republika	4
UK	United Kingdom	37
	TOTAL	287

2.2.2 Human Capital

We describe human capital by using two different indicators: the percentage of people with at least a tertiary education degree and the percentage of employees in the education NACE sector.

Table 4 shows the average values for different aggregations of regions. We use two different regions' classifications: the first one is "political", classifying a region with respect to the country of membership, and the second classification is based on the eligible areas under the Convergence Objective and the European Competitiveness and Employment Objective (Cohesion Policy 2007–2013)[1].

The ESPON whole sample average indicates that the 12.37% of population has a tertiary education degree; a higher average applies to the EU15 countries (12.88%), while the EU new entrants countries have a much lower percentage of 9.34%. The 4 EFTA countries denote the highest percentage of population with a ISCED 5 or 6 degree, with 16.41%. The aggregations of EU regions, differentiated per convergence, transition and competitive regions denote much different values, 9.21%, 12.66% and 13.61% respectively.

For what concerns the percentage of employees in the education NACE sector, EFTA countries regions show the average highest value (4.27%). Lowest values are shown by convergence regions and New Entrants (respectively 2.84% and 2.87%). Notice that the average value for the whole sample is equal to the same value for EU15 regions sample.

Map 1 shows the distribution of values for Tertiary Education for the whole sample of regions. Highest values are observed for UK regions, Scandinavian regions, Iceland, northern Spanish regions and regions located in the middle of Europe. Lowest values are shown by southern Italian regions and those located in the Balkanise area.

Table 5 shows the results for top and bottom regions for the percentage of population with a tertiary education degree. In the first positions of our ranking we note two UK regions, namely Highlands and Islands (Scotland, with a remarkably 33,19%) and Inner London (England). Following those regions we note other capital regions, such as Oslo (Norway), Brussels (Belgium), Hovedstaden (Denmark), and Comunidad de Madrid (Spain). High values are listed also for Pais Vasco (Spain), Prov. Vlaams-Brabant (Belgium) and Utrecht (Netherlands). On the bottom of our ranking there are 4 Romanian regions (Nord-Vest, Nord-Est, Sud-Est, Sud - Muntenia), 3 Portuguese regions (Região Autónoma da Madeira, Alentejo and Região Autónoma dos Açores), 2 Italian regions (Puglia and Provincia Autonoma Bolzano/Bozen) and finally a Czech Republic region (Severozápad).

Map 2 presents the spatial distribution of Employment in Education. Highest values are shown by regions located in the north and in the centre of Europe.

Table 6 shows the ranking of top and bottom regions for the percentage of employment in high tech sector. It is easy to note that the best performing regions are all Northern European ones, with all Sweden with its 7 regions, 2 UK regions (Highlands and Islands and Berkshire, Bucks and Oxfordshire) and Nord Norge (Norway). The Bottom regions of the ranking come mostly from Romania, where all its 7 regions share a very low percentage of employment in the high technology industry. On the other hand we find also a German region (Schwaben) and 2 Greek ones (Notio Aigaio and Ionia Nisia).

In Table 7 we observe the coefficient of variation for the two variables which measures the dispersion of values around the mean regardless of the unit of measurement. For tertiary education the highest values are listed for the "transition" regions (0.441) and the EU new entrants countries (0.410), while a much lower value is registered for EFTA countries (0.194). The ESPON whole sample and the EU 15 countries register closer values (0.356 and 0.346 respectively).

Focusing on values for the coefficient of variation for the percentage of employment in the high tech industry, we notice that the sample of countries shows higher values of this indicator for the

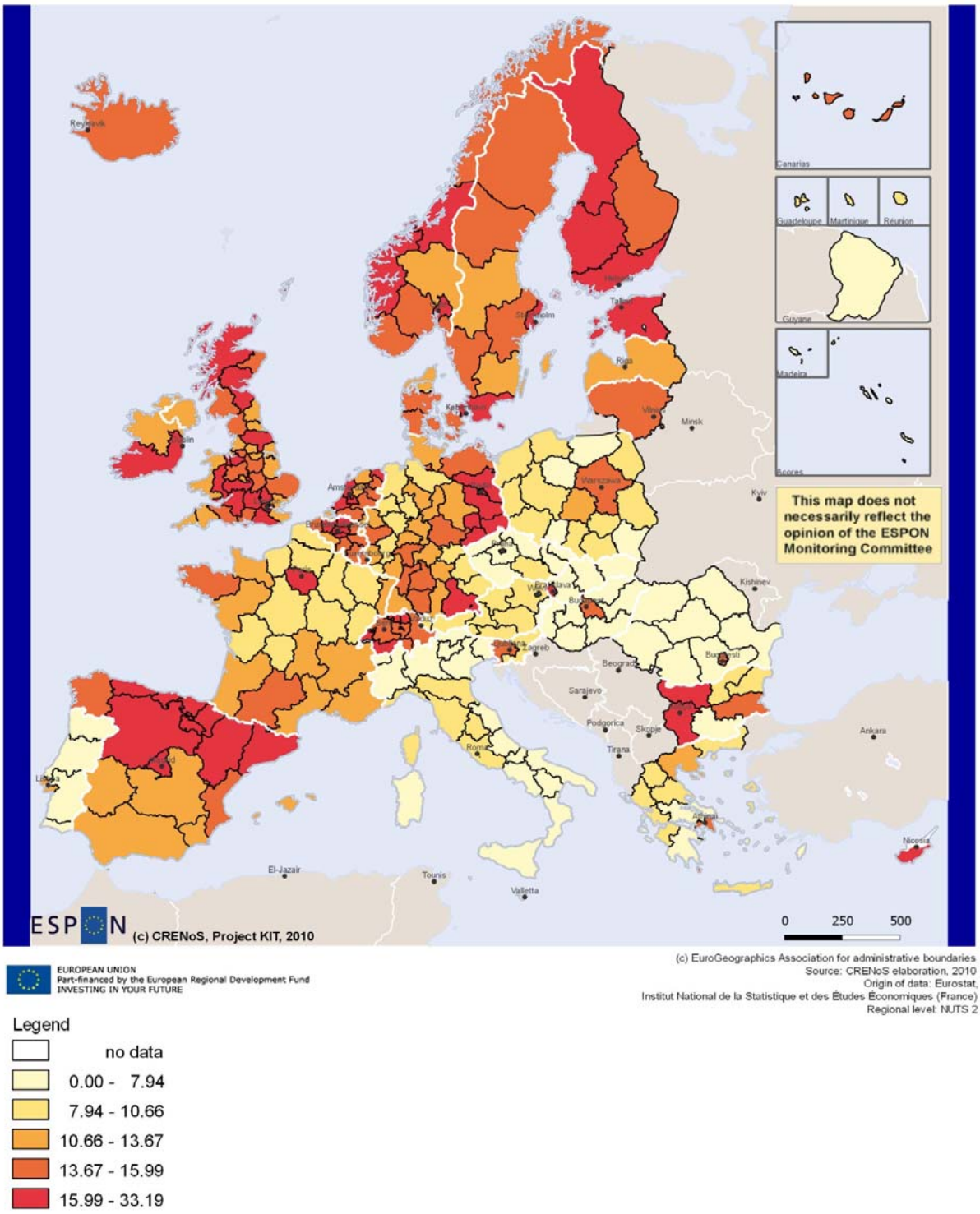
[1] source: http://ec.europa.eu/regional_policy/atlas2007/index_en.htm and http://ec.europa.eu/regional_policy/policy/region/index_it.htm

EU15 countries, while very low values are those listed for the EFTA4 countries. On the other hand, considering the sample of EU regions, competitive and transition regions share the same coefficient of variation (0,26), while lower values are registered for the convergence regions.

Respect the analysis of the spatial association measures, in table 8 we can observe the regional Moran index for tertiary education and employment in the education sector. Values indicate the presence of spatial association with statistical evidence. Maps 3 and 4 present the map for the LISA index. As expected, it shows that regions with high values are strongly concentrated: these regions are located near similar regions and the same happens for low values of the same indicator.

Table 4 Human capital, average values for selected samples, 2005-2007

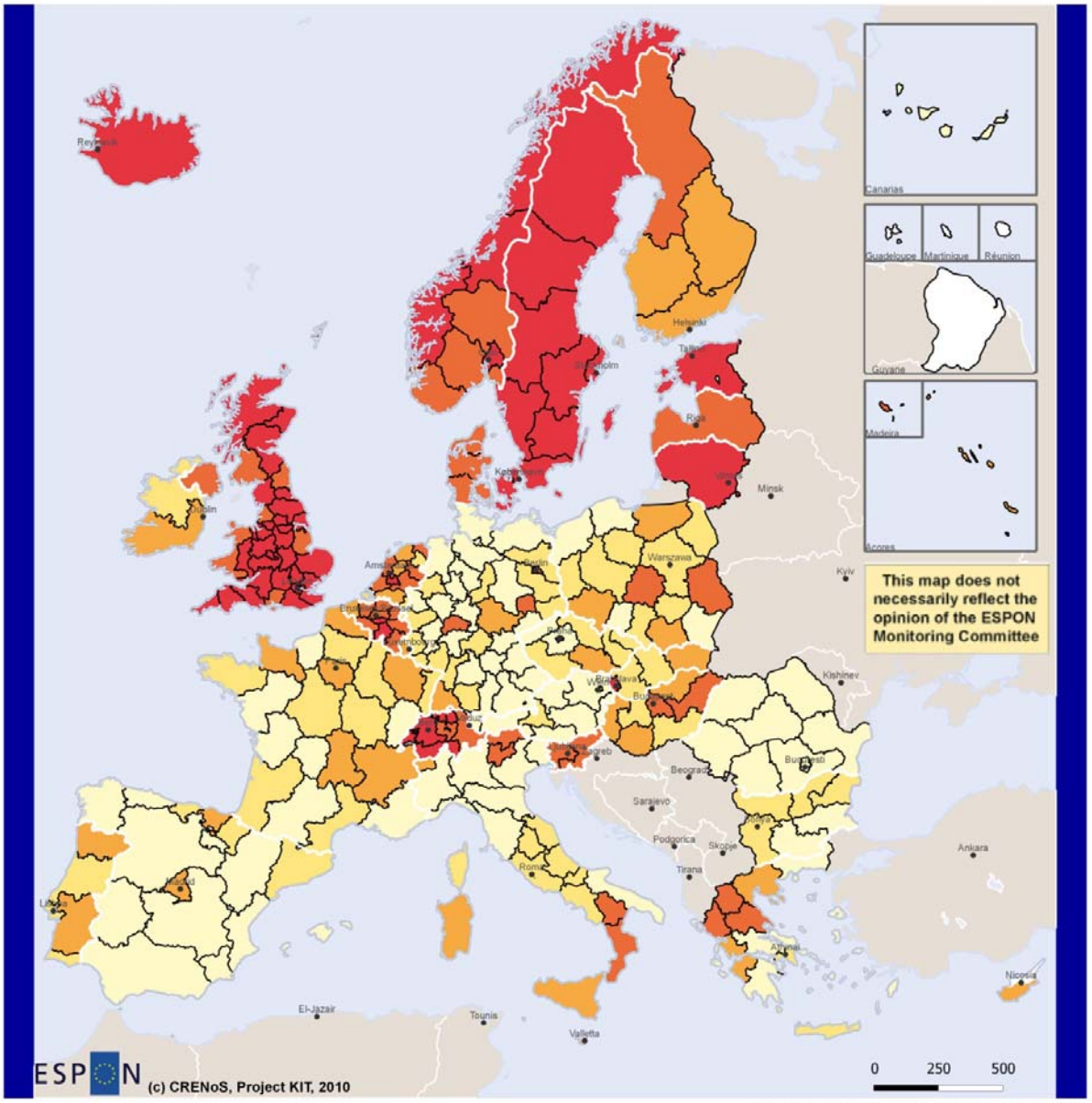
	ESPON whole sample	Countries			EU Regions		
		EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
Tertiary education (% POP)	12.37	12.88	9.34	16.41	9.21	12.66	13.61
Employees in education (% POP)	3.24	3.24	2.87	4.27	2.84	3.10	3.37



Map 1. Tertiary education (% over population), 2005-2007

Table 5. Tertiary education (% over Population) - Top and bottom ten regions, 2005-2007

Position	Region code	Region name	Country	ISCED 5-6 (% population)
		top regions		
1	UKM6	Highlands and Islands	United Kingdom	33.19
2	UKI1	Inner London	United Kingdom	26.06
3	NO01	Oslo og Akershus	Norge	25.86
4	ES21	País Vasco	España	24.66
5	BE31	Prov. Brabant Wallon	Belgique-België	24.45
6	DK01	Hovedstaden	Danmark	22.70
7	BE10	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	Belgique-België	22.43
8	ES30	Comunidad de Madrid	España	21.90
9	BE24	Prov. Vlaams-Brabant	Belgique-België	21.81
10	NL31	Utrecht	Nederland	21.62
		bottom regions		
277	PT30	Região Autónoma da Madeira	Portugal	5.66
278	ITF4	Puglia	Italia	5.63
279	ITD1	Provincia Autonoma Bolzano/Bozen	Italia	5.57
280	PT18	Alentejo	Portugal	5.43
281	RO11	Nord-Vest	Romania	5.42
282	RO21	Nord-Est	Romania	5.04
283	RO22	Sud-Est	Romania	4.87
284	RO31	Sud - Muntenia	Romania	4.52
285	CZ04	Severozápad	Ceska Republika	4.43
286	PT20	Região Autónoma dos Açores	Portugal	4.09



Map 2. Employment in education % POP, average 2005-2007

Table 6. Employment in education (% population), 2005-2007- Top and bottom ten regions, 2005-2007

Position	Region code	Region name	Country	ISCED 5-6 (% population)
		top regions		
1	SE33	Övre Norrland	Sverige	6.2
2	SE11	Stockholm	Sverige	5.5
3	SE32	Mellersta Norrland	Sverige	5.5
4	SE12	Östra Mellansverige	Sverige	5.4
5	UKM6	Highlands and Islands	United Kingdom	5.4
6	UKJ1	Berkshire, Bucks and Oxfordshire	United Kingdom	5.3
7	SE22	Sydsverige	Sverige	5.3
8	SE31	Norra Mellansverige	Sverige	5.2
9	NO07	NordNorge	Norge	5.2
10	SE23	Västsverige	Sverige	5.1
		bottom regions		
273	RO11	NordVest	Romania	2.1
274	RO12	Centru	Romania	2.1
275	DE27	Schwaben	Deutschland	2.0
276	RO21	NordEst	Romania	1.9
277	GR42	Notio Aigaio	Ellada	1.9
278	RO22	SudEst	Romania	1.9
279	GR22	Ionia Nisia	Ellada	1.8
280	RO42	Vest	Romania	1.8
281	RO41	SudVest Oltenia	Romania	1.7
282	RO31	Sud Muntenia	Romania	1.5

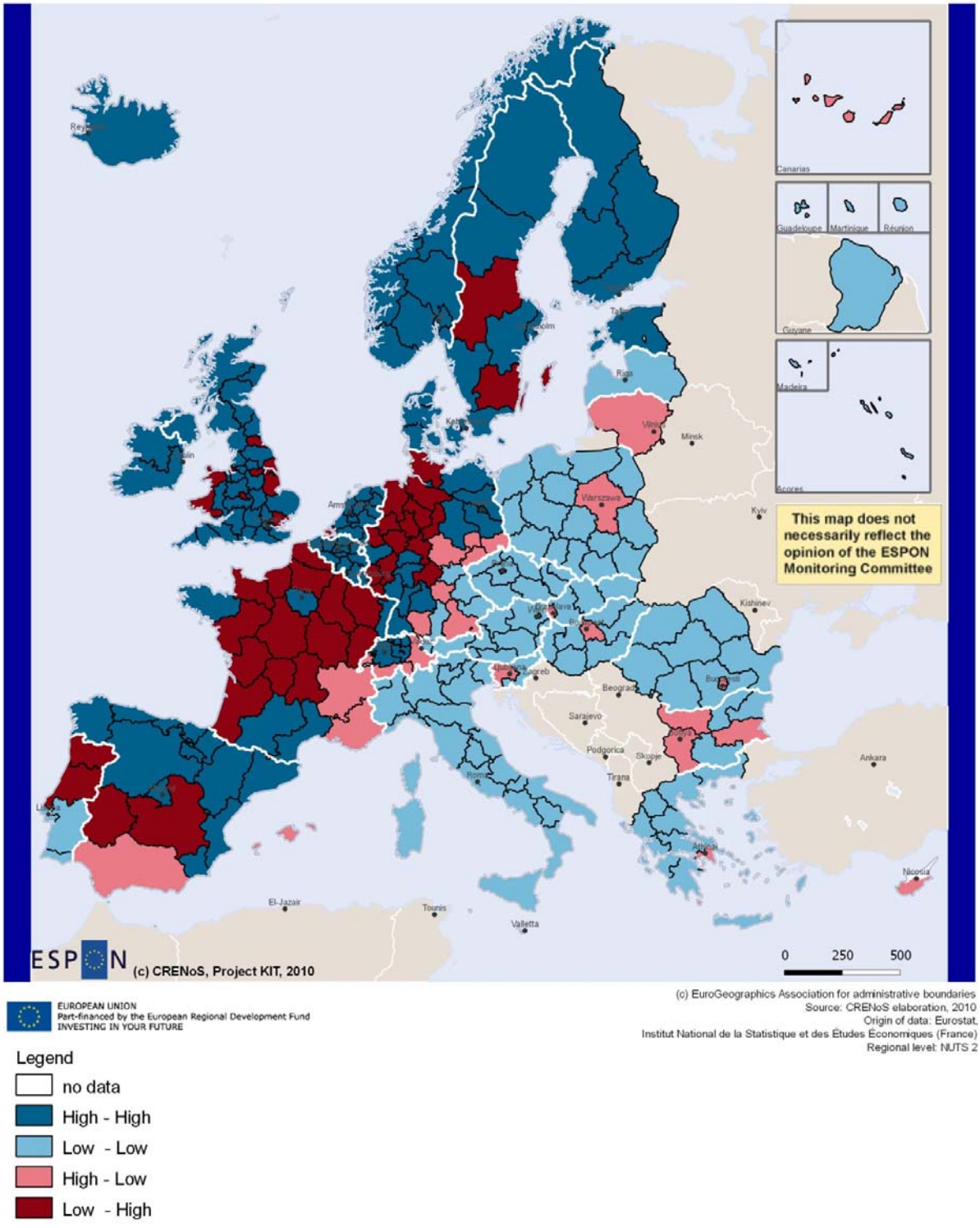
Table 7. Human capital, coefficient of variation 2005-2007

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
Tertiary education (% POP)	0.36	0.35	0.41	0.19	0.39	0.44	0.30
Employment in education (% POP)	0.26	0.26	0.21	0.13	0.19	0.26	0.26

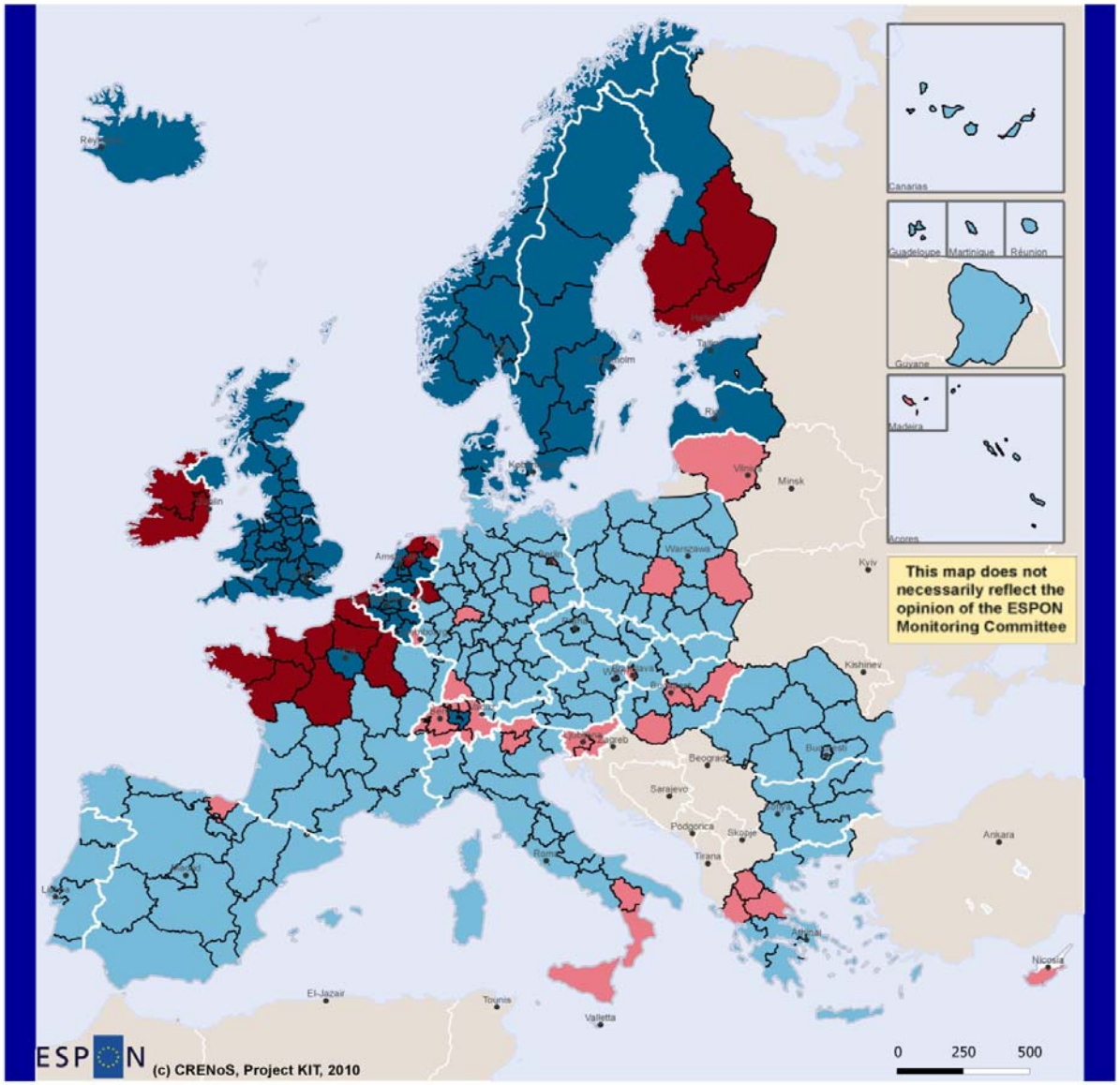
Table 8. Human capital 2005-2007, Moran (standardized distance), whole sample

	I	z	pvalue*
Tertiary education (% POP)	0.129	25.860	0.000

Employment in education (% POP)	0.144	28.725	0.000



Map 3. Spatial association analysis, Tertiary education (% over population), 2005-2007



Map 4. Spatial association analysis, Employment in education, % POP, average 2005-2007

2.2.3 Fifth Framework Programme

Table 9 presents average values for variables measuring regions' participation to the Fifth Framework Programme. For the first two variables, participation and project funding, "competitive" regions show the highest values. On the contrary, for the variable project funding per capita, regions belonging to EFTA countries show the best performances. Regions belonging to "New Entrants" countries and "convergence" regions present the worst performances.

The participation in FP5 is characterized by evident differences between Western and Eastern Europe. Map 5 shows a good level of participation in almost all the regions of the (ex) EU 15, with a substantial concentration of participants in the Mediterranean basin. At the national level, all capital city regions provided a high number of participants to FP5 and, generally, the heterogeneity between regions of the same country is restrained. The pattern is completely different in the Eastern Europe: if capital city regions offer the same performances of the Western ones, huge disparities emerge between capital city regions and the others: if we analyse the distribution of the variable we may point out that 43% of the Eastern European regions resides in the first quintile and 21% in the second.

Table 10 presents the top and bottom of the ranking of regions for this variable. All the regions in the first ten positions are characterized to be territories where country capitals or very important towns are located. On the contrary, most regions in the bottom of the ranking are characterized to be peripheral areas, like Ionia Nisia (Greece), Martinique and Guyane (France), Ciudad Autonoma de Ceuta and Ciudad Autonoma de Melilla (Spain). Due to this fact, we may deduce that being located in the administrative core of a country facilitates the participation to the 5th Framework Program.

While analysing the regional distribution of funds (Map 6), the same type of West-East dichotomy may be observed; on the same fashion Table 11 shows the ranking of region for the funding in the 5th Framework Programme and results don't change: we observe the same regions as in Table 10.

On the other hand, a completely different picture appears analysing the funding per thousand population (Map 7). In this case the West-East dichotomy disappear, replaced by the well known core-periphery relationship. Furthermore, data show sharper regional differences at the national level: for example in France, Spain and Portugal an high concentration of project funding per thousand population may be noted in the capital city regions. Finally, we can underline that whereas southern regions are among those with the highest number of participants, those in the north of Europe register the highest level of funding per population.

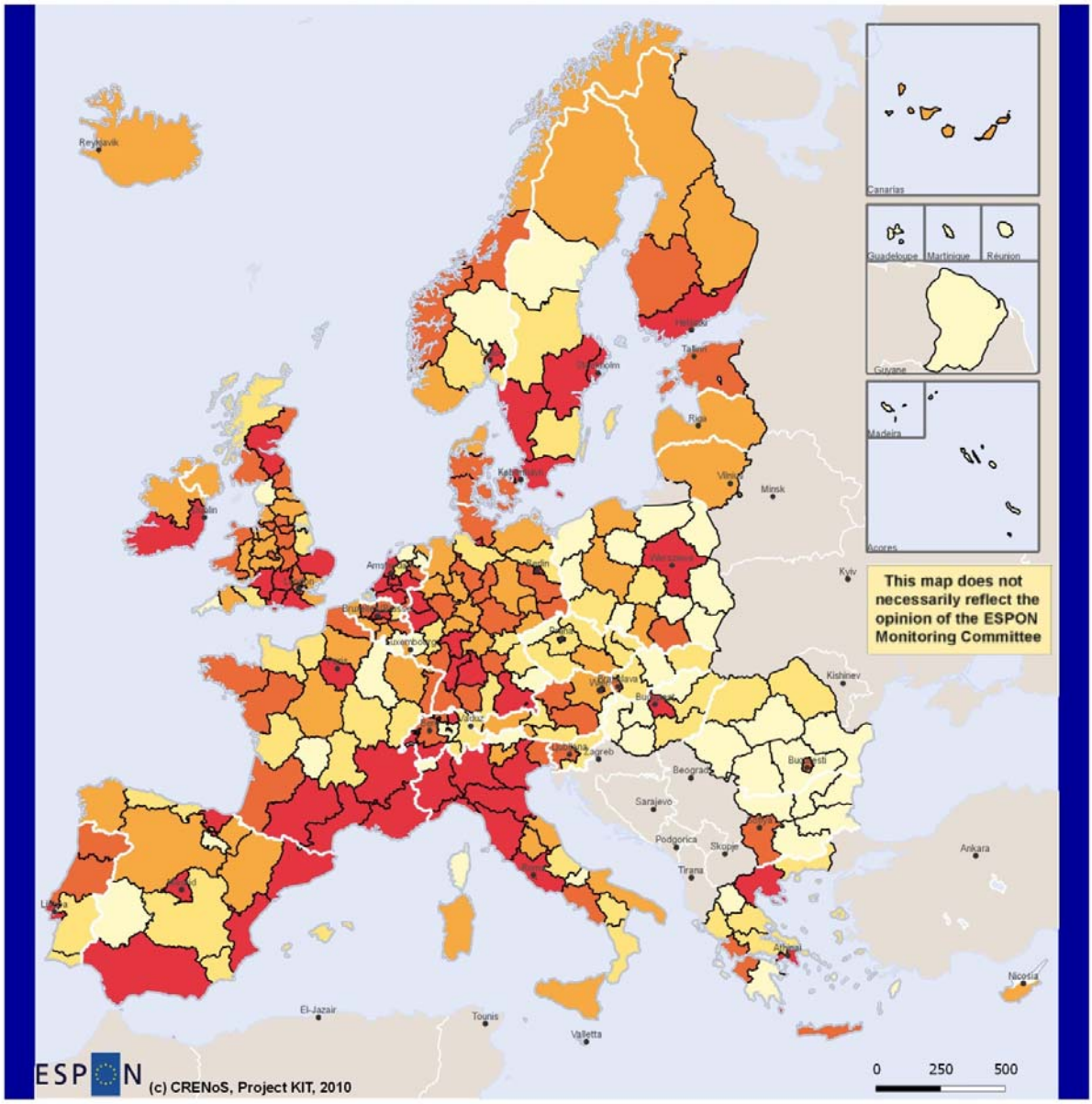
The ranking of regions change when we consider the funding per capita received from the territories (Table 12). Indeed, among the top ten positions we observe 3 Belgian regions, the region of Bruxelles, Province Vlaams Brabant and Province Brabant Wallon, but also Hovedstaden (Denmark), Liechtenstein, Trøndelag and Oslo og Akershus (Norway), Inner London and North Eastern Scotland (United Kingdom) and Stockholm (Sweden). Among the regions in the bottom of the ranking, we find the same regions as in the other rankings: Martinique (France), Yugoiztochen and Severozapaden (Bulgaria), Sud Vest Oltenia and Sud Muntenia (Romania), Lubuskie, Podkarpackie and Swietokrzyskie (Poland), Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla (Spain).

In the case of Table 13, that presents the coefficient of variation for variables related to the Fifth Framework Programme, for the first two variables (participation and project funding), highest values are shown by "transition" regions; for the third variable (project funding per capita) regions belonging to the New Entrants countries show the worst performance. The sample shows always the lowest value for coefficient of variation, and then less dispersion, for regions belonging to EFTA countries.

Respect the analysis of the spatial association measures, in Table 14 we observe regional Moran index values for variables related to V Framework Programme. All values indicate the presence of spatial association with statistical evidence. Map 8 presents the map for the LISA index for funding per 1000 population and, as expected, it shows that regions with similar values of this indicator are strongly concentrated, above all regions presenting low values.

Table 9. 5FP, average values for selected samples

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
Number of participations	253.61	301.23	84.36	206.13	83.52	184.41	360.26
Project funding (Millions of €)	40.00	48.12	11.09	32.05	11.36	26.98	58.20
Project Funding per 1000 POP (Thousands of Euro)	22.27	24.31	7.13	47.89	6.94	15.25	28.99



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(c) EuroGeographics Association for administrative boundaries
Source: CRENoS elaboration, 2010
Origin of data: Cordis, 1998-2002
Regional level: NUTS 2

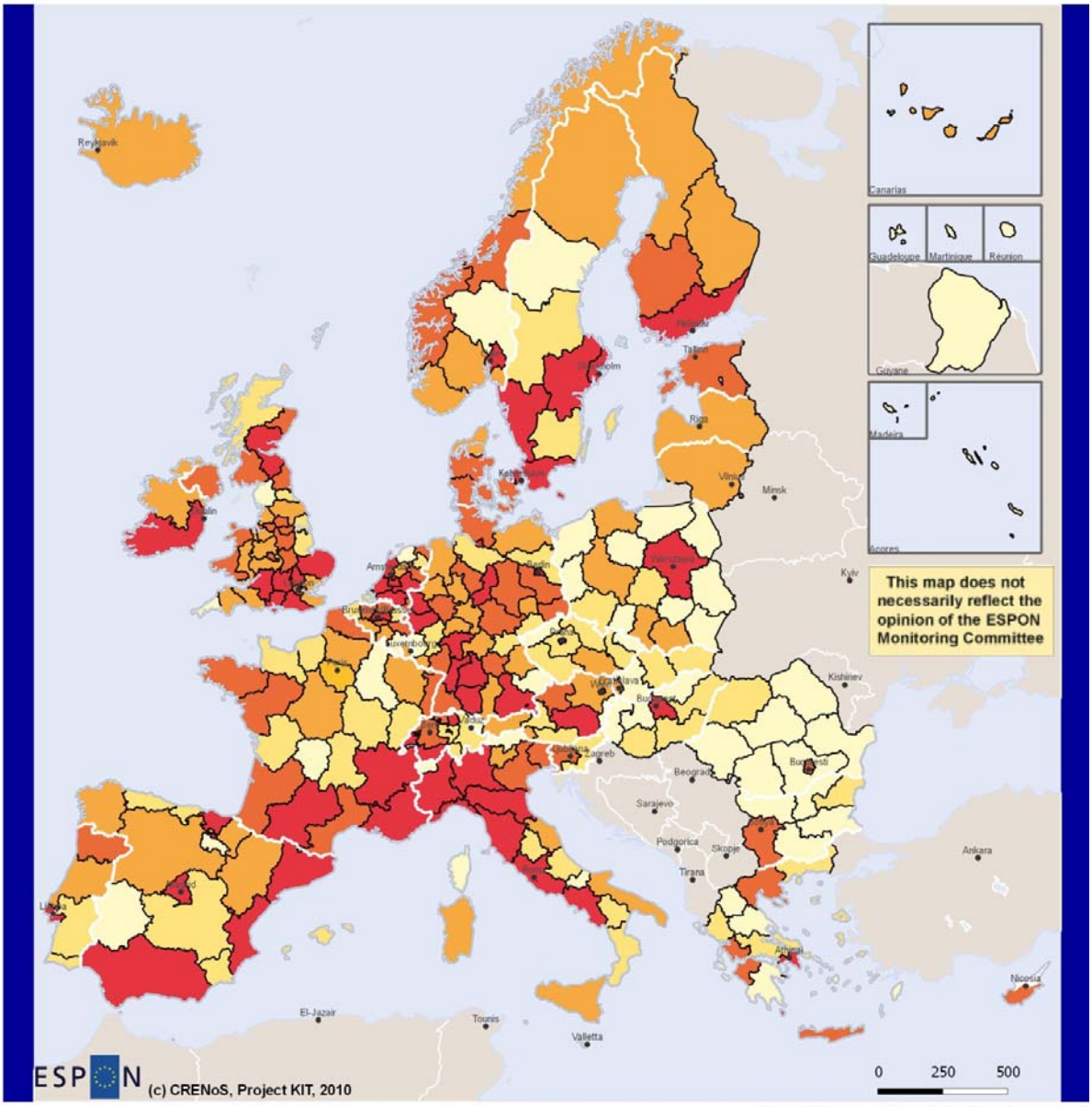
Legend

- no data
- 0 - 25
- 25 - 77
- 77 - 172
- 172 - 364
- 364 - 4418

Map 5. Number of participations in the 5FP, 1998-2002

Table 10. Number of participations in the 5FP, 1998-2002 top and bottom regions

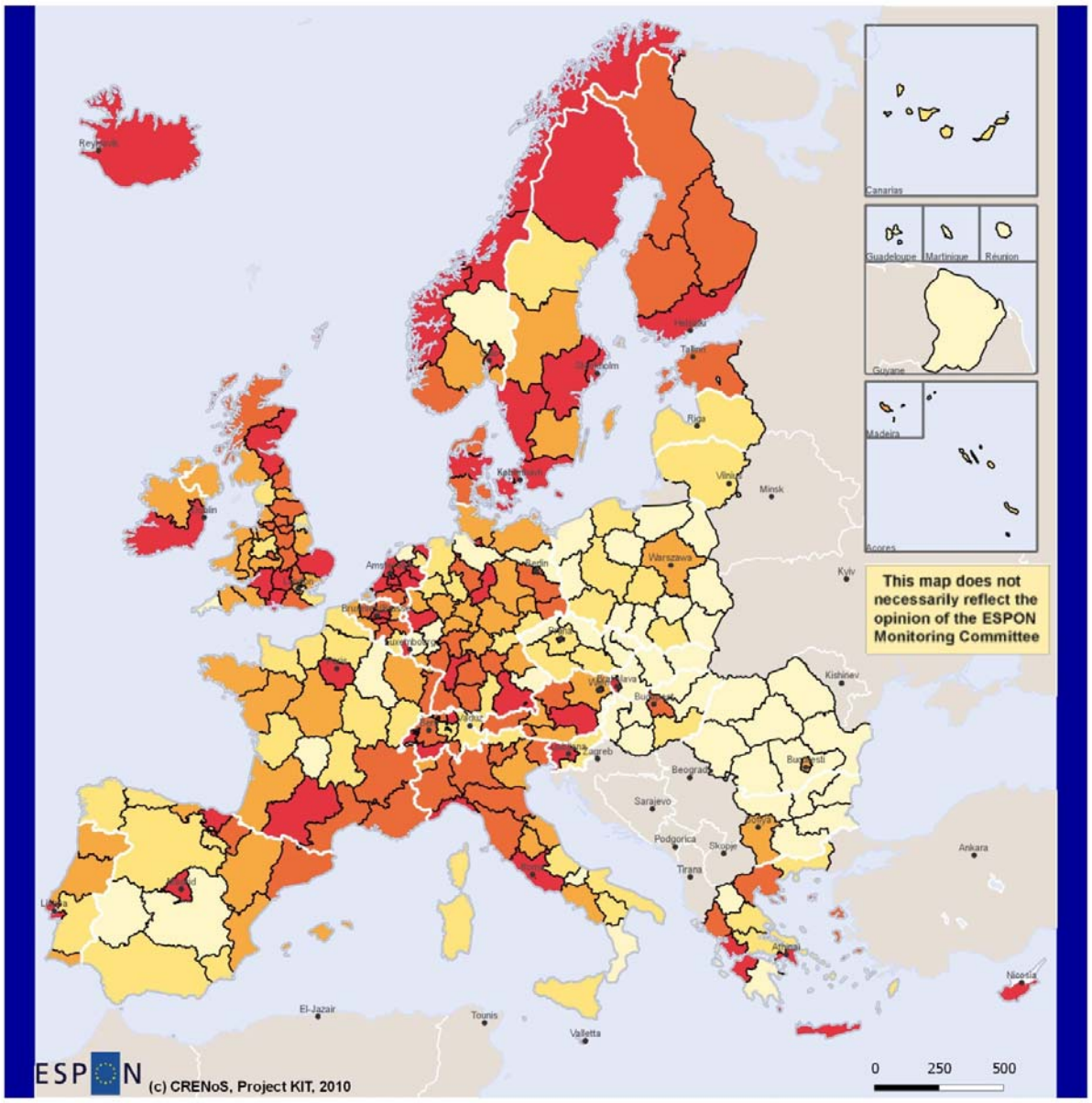
Position	Region code	Region name	Country	Participations
		top regions		
1	FR10	Île de France	France	4418
2	UKI1	Inner London	United Kingdom	1839
3	GR30	Attiki	Ellada	1817
4	ES30	Comunidad de Madrid	España	1655
5	ITC4	Lombardia	Italia	1622
6	DE21	Oberbayern	Deutschland	1395
7	ES51	Cataluña	España	1354
8	ITE4	Lazio	Italia	1342
9	FI18	EteläSuomi	Suomi / Finland	1275
10	NL33	ZuidHolland	Nederland	1240
		bottom regions		
278	GR22	Ionia Nisia	Ellada	3
279	PL43	Lubuskie	Polska	3
280	RO41	Sud Vest Oltenia	Romania	3
281	BG31	Severozapaden	Bulgaria	2
282	FR92	Martinique	France	2
283	PL33	Swietokrzyskie	Polska	2
284	RO31	Sud Muntenia	Romania	2
285	FR93	Guyane	France	1
286	ES63	Ciudad Autónoma de Ceuta	España	0
287	ES64	Ciudad Autónoma de Melilla	España	0



Map 6. Funding in the 5FP, 1998-2002, Millions of Euro

Table 11. Funding in the 5FP, 1998-2002, top and bottom regions, Millions of Euros

Position	Region code	Region name	Country	Project Funding
		top regions		
1	FR10	Île de France	France	803.1
2	GR30	Attiki	Ellada	303.2
3	UKI1	Inner London	United Kingdom	300.1
4	DE21	Oberbayern	Deutschland	280.3
5	ES30	Comunidad de Madrid	España	275.9
6	ITC4	Lombardia	Italia	250.5
7	ITE4	Lazio	Italia	204.4
8	BE10	Région de BruxellesCapitale/ Brussels Hoofdstedelijk Gewest	Belgique-België	199.8
9	FR71	Rhône Alpes	France	196.5
10	DK01	Hovedstaden	Danmark	195.1
		bottom regions		
278	PL32	Podkarpackie	Polska	0.432
279	PL43	Lubuskie	Polska	0.238
280	GR22	Ionia Nisia	Ellada	0.197
281	BG31	Severozapaden	Bulgaria	0.196
282	FR92	Martinique	France	0.189
283	PL33	Swietokrzyskie	Polska	0.187
284	FR93	Guyane	France	0.186
285	RO31	Sud Muntenia	Romania	0.163
286	ES63	Ciudad Autónoma de Ceuta	España	0.000
287	ES64	Ciudad Autónoma de Melilla	España	0.000



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Regional level: NUTS 2

Legend

	no data
	0.0 - 3.6
	3.6 - 9.1
	9.1 - 18.0
	18.0 - 37.4
	37.4 - 207.8

Map 7. Funding in the 5FP per 1000 POP, 1998-2002, Thousands of Euros

Table 12. Funding in the 5FP per 1000 POP, 1998-2002, top and bottom regions, Thousands of Euros

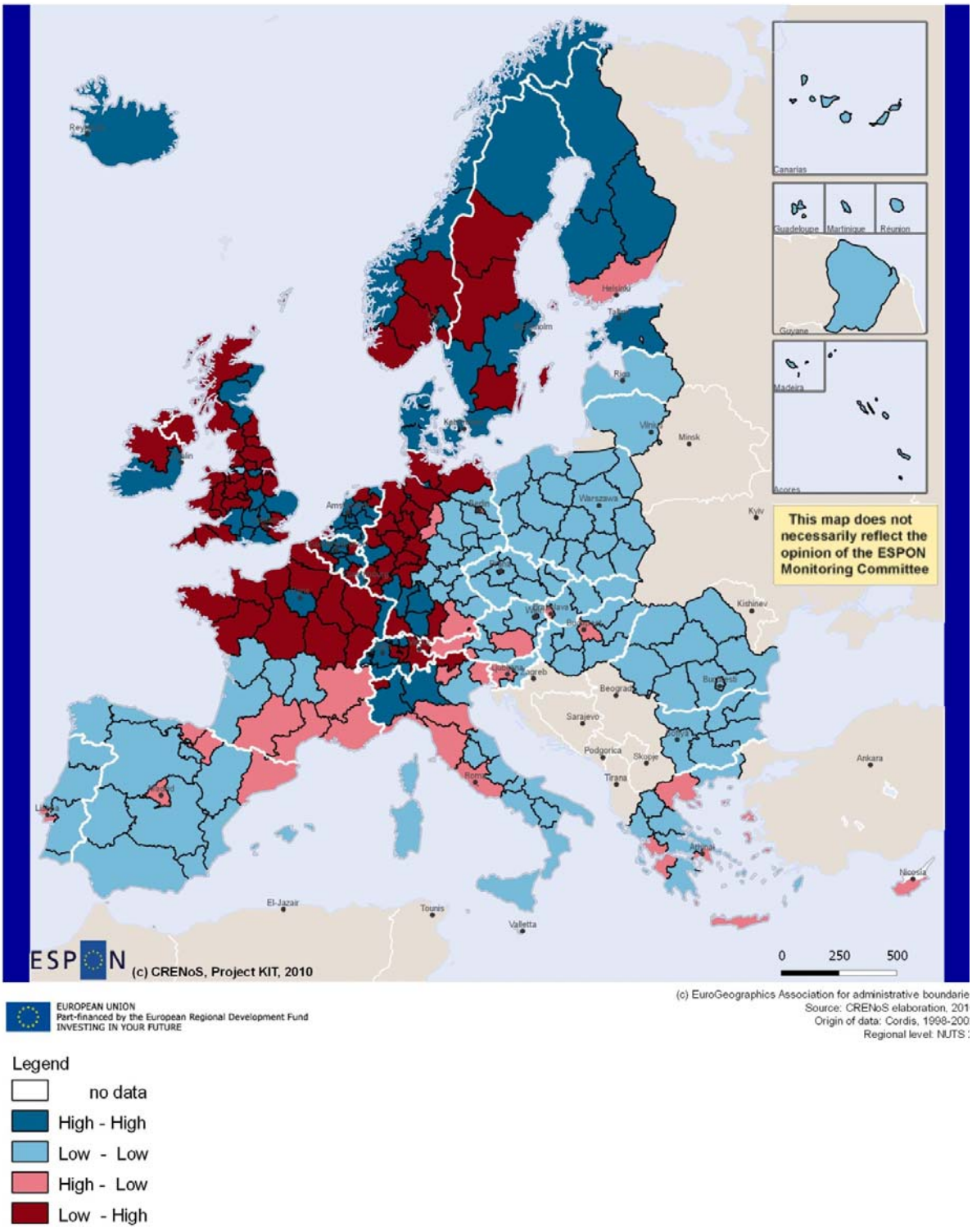
Position	Region code	Region name	Country	Project Funding per 1000 POP
		top regions		
1	BE10	Région de BruxellesCapitale/ Brussels Hoofdstedelijk Gewest	Belgique-België	207.8
2	DK01	Hovedstaden	Danmark	121.8
3	LI00	Liechtenstein	Liechtenstein	119.1
4	NO06	Trøndelag	Norge	117.6
5	BE24	Prov. Vlaams Brabant	Belgique-België	115.2
6	BE31	Prov. Brabant Wallon	Belgique-België	112.4
7	NO01	Oslo og Akershus	Norge	108.0
8	UKI1	Inner London	United Kingdom	108.0
9	SE11	Stockholm	Sverige	91.3
10	UKM5	North Eastern Scotland	United Kingdom	81.3
		bottom regions		
278	FR92	Martinique	France	0.491
279	BG34	Yugoiztochen	Bulgaria	0.390
280	RO41	Sud Vest Oltenia	Romania	0.248
281	PL43	Lubuskie	Polska	0.234
282	PL32	Podkarpackie	Polska	0.204
283	BG31	Severozapaden	Bulgaria	0.182
284	PL33	Swietokrzyskie	Polska	0.142
285	RO31	Sud Muntenia	Romania	0.048
286	ES63	Ciudad Autónoma de Ceuta	España	0.000
287	ES64	Ciudad Autónoma de Melilla	España	0.000

Table 13. 5FP, coefficient of variation for selected samples

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
Number of Participations	1.62	1.52	1.42	1.01	1.26	1.87	1.38
Project funding	1.76	1.63	1.42	0.99	1.31	2.07	1.47
Project Funding per 1000 POP	1.19	1.08	1.61	0.82	1.55	1.01	0.96

Table 14. 5FP, 1998-2002, Moran (standardized distance), whole sample

	I	z	pvalue
Number of Participations	0.009	2.570	0.005
Project funding	0.010	2.834	0.002
Project Funding per 1000 POP	0.065	13.470	0.000



Map 8. Spatial association analysis, Funding in the 5FP per 1000 POP, 1998-2002

2.2.4 Research & Development

In Table 15 we observe average values for RD variables for different samples of regions. "Competitive" regions show the highest mean value (1268 millions of euro) for RD expenditure but if we look at the other variables, RD expenditure as percentage of GDP, RD expenditure per capita and RD Personnel, regions belonging to the EFTA countries show the best performances. On the contrary, regions that show the worst performances are those belonging from New Entrants countries and "convergence" regions.

The RD expenditures maps in the biennium 2006-2007 (Map 9) show that in this field Europe proceeds with three different patterns. First of all we observe high expenditure levels in the regions of the core of Europe (Benelux, France, Germany, Switzerland, the North of Italy, the South of the United Kingdom) as well as in those of Finland and Sweden in the North. The investment appears homogeneously distributed nationwide in France, Germany and Switzerland (with over the 60% of the region between the 4th and 5th quintile of the distribution). On the other hand in Italy and in the United Kingdom it seems more concentrated in few regions. As a consequence the Center-South of Italy and the Center-North of the United Kingdom cross the threshold of the second group with Spain, Portugal and Norway, characterized by a medium level of investment in RD (almost, or slightly below the European average) and a wide heterogeneity inside the nation. Summing up, the last group is composed by the Eastern countries and Greece. For those countries, data highlights a systematically low level of expenditure in RD, with values far away from the European average.

Table 16 presents the ten best and worst performances for the RD Expenditure among the considered 287 European regions. Among the best 10 positions, 4 over 10 regions are from Germany, namely Stuttgart, Oberbayern, Darmstadt and Köln, 2 are French regions, Île de France and Rhône Alpes, together with regions from Denmark, United Kingdom, Sweden end Italy.

Among the last 10 performances, 4 over 10 are Bulgarian regions (note that Bulgaria is divided into 6 regions), one is from Poland, one is from Finland. There are also 2 Greek and 2 Spanish regions.

Map 10 shows the RD Expenditures per 1000 population. The map clearly shows that, once weighing for the population, the RD expenditure is still high in Benelux, Germany, Switzerland, in the Scandinavian peninsula countries and in the United Kingdom. In the other countries, at the national level, the differences have completely been smoothed: around the European average in France, Italy and Spain, below in Greece, Portugal and the Eastern countries.

Table 17 presents the ranking for RD Expenditure per 1000 population: among the top ten regions we may still note German regions (3 over 10), namely Stuttgart, Braunschweig and Oberbayern. In the first position there is Hovedstaden, from Denmark and after the region of Stockholm, 2 Norwegian regions, 2 Swiss regions and an English region. Among the bottom positions there are all Eastern countries, i.e. 3 Romanian regions, 5 Bulgarian regions and 2 Polish regions.

Map 11 shows RD Expenditures in percentage of GDP. Data list the highest level of this variable in the core of Europe (except for the North of Italy). Compared to Maps 9 and 10, there are not sensible differences in the second group, for a smoothing among the differences at the country level, while Eastern of European countries do not show any differences.

Table 18 shows the ranking of regions for RD Expenditure over regional GDP and, as it could be observed, there are regions that re-appear among the best and the worst practices. For example, we have still Braunschweig, Stuttgard and Oberbayern (Germany), Hovedstaten (Denmark) and East Anglia (United Kingdom).

Furthermore, among the worst ten performances there are some already known Eastern regions: Centru (Romania), Lubuskie and Swietokrzyskie (Poland), Severozapaden and Severen Tsentralen (Bulgaria). Nevertheless, among the worst ten performances we also find other Greek regions (Notio Aigaio and Dytiki Makedonia), a Finnish regions (Åland) and Spanish regions (Ciudad Autónoma de Ceuta).

Map 12 shows the percentage of employment in Research and Development activities: it is easy to note the similarities to the previous map for Expenditures in Research and Development over GDP (Map 11). Both maps exhibit high values for the European core regions, especially for Austria, Switzerland, south and centre Germany and south of France. Furthermore, there is a concentration of high values for the capital regions. Scandinavian regions show high values as well as England. Mid values are more dispersed, but all very close to those regions that exhibit an high percentage of employment in Research and Development. On the contrary, low values are very frequent in peripheral regions, such as Bulgaria, south of Greece, and north of Scotland.

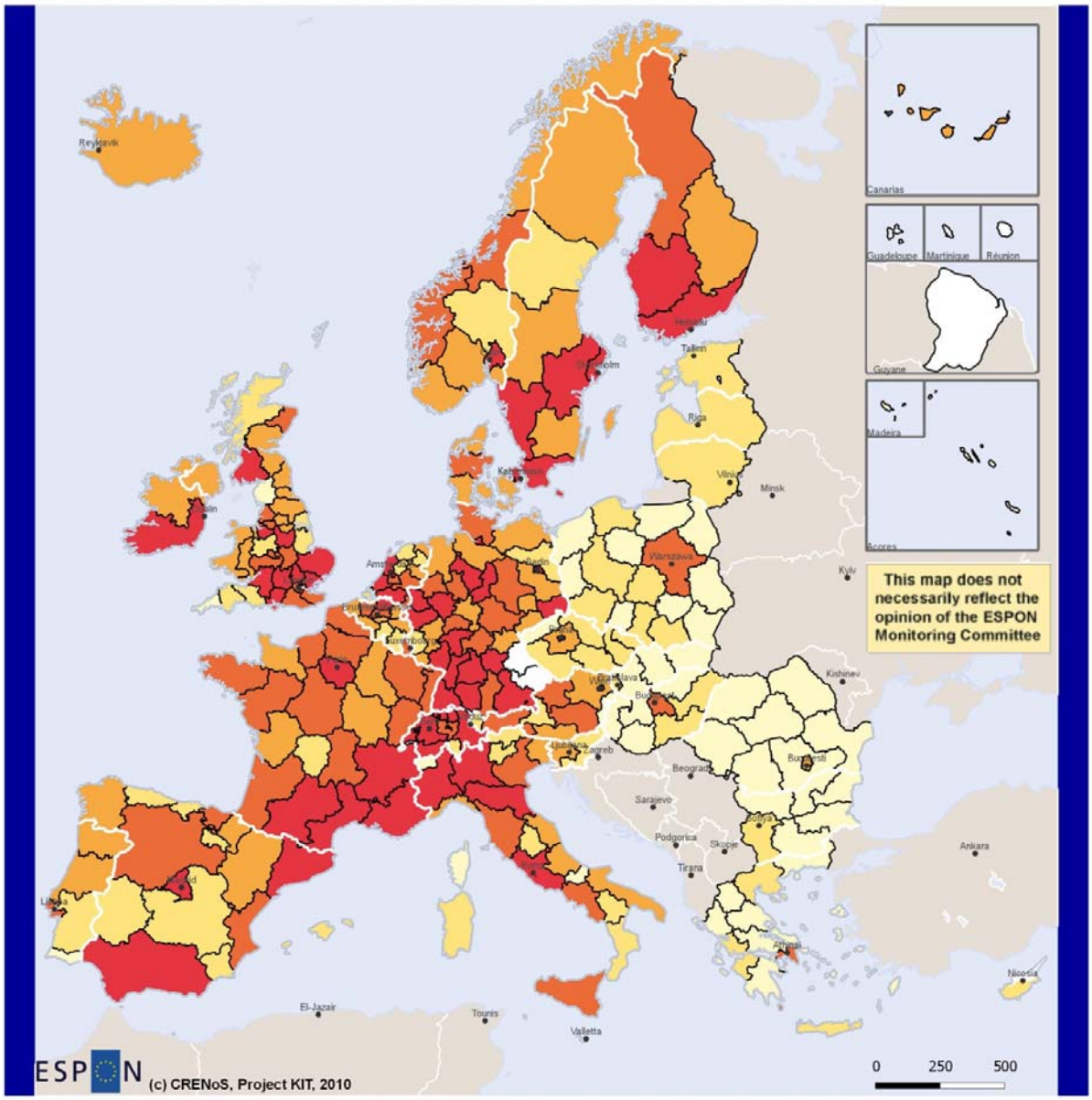
The ranking for the top and bottom regions for the percentage of employment in research and development activities is shown in Table 19. Northern regions appear to be the most performing European regions for this indicator: North Eastern Scotland, Hovedstaden (Denmark), Trøndelag and Oslo (Norway), Braunschweig (north of Germany), Inner London, the region of Bruxelles, and Pohjois Suomi (Finland) are among the best performing regions. Nevertheless, high values are indicated also for Prague and Wien. Among the worst performance of this indicator are those regions that we previously saw with low values for the other indicators, such as 4 Romanian regions, Lubuskie and Swietokrzyskie from Poland and, as said before while commenting the map, Cornwall and the Highlands in Scotland.

In Table 20 we observe values for the coefficient of variation. For the first variable, RD expenditure in millions of euro, we have the highest dispersion value for the whole sample and this result underlies the strong heterogeneity among European regions. For all the other variables, we observe the highest values of the coefficient of variation for regions belonging to the EU new entrants and "convergence" regions.

Table 21 presents regional Moran index values for R&D variables. Again all values indicate the presence of spatial association with statistical evidence. Map 13 presents the map for the LISA index for funding per 1000 population and, as expected, it shows that regions with similar values of this indicator are strongly concentrated above all regions presenting low values.

Table 15. RD, average values for selected samples, 2006-2007

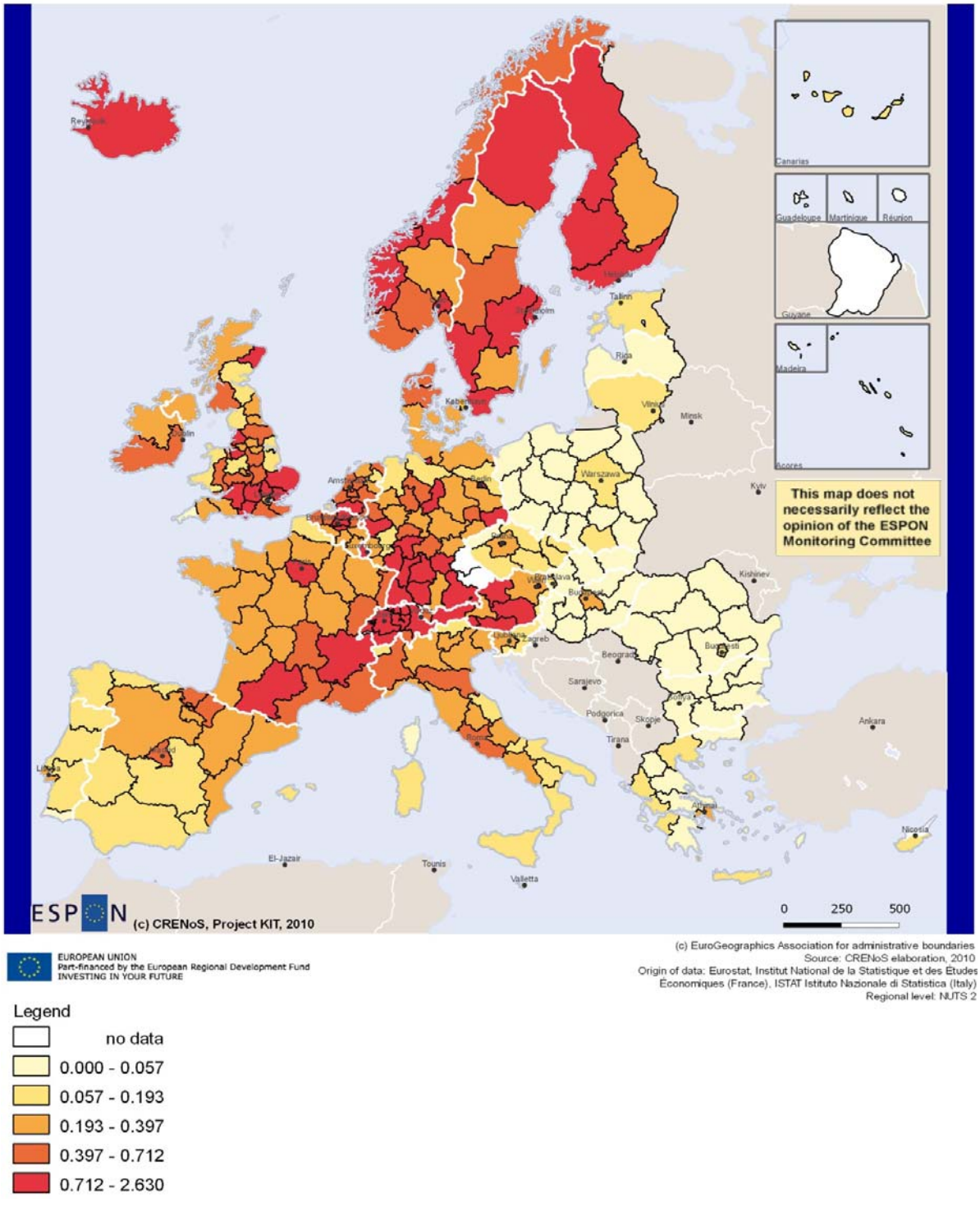
	ESPON whole sample	Countries			EU Regions		
		EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
RD expenditure (Millions of Euro)	843	1029	114	962	186	279	1268
RD expenditure % GDP	1.45	1.62	0.63	2.23	0.68	0.84	1.88
RD expenditure per 1000 POP (Millions of Euro)	0.44	0.49	0.07	1.09	0.09	0.18	0.60
RD Personnel % EMP	1.46	1.56	0.88	2.35	0.86	1.09	1.76



Map 9. R&D expenditure, Average 2006-2007, Millions of Euros

Table 16. RD Expenditure, top and bottom regions, Millions of Euros

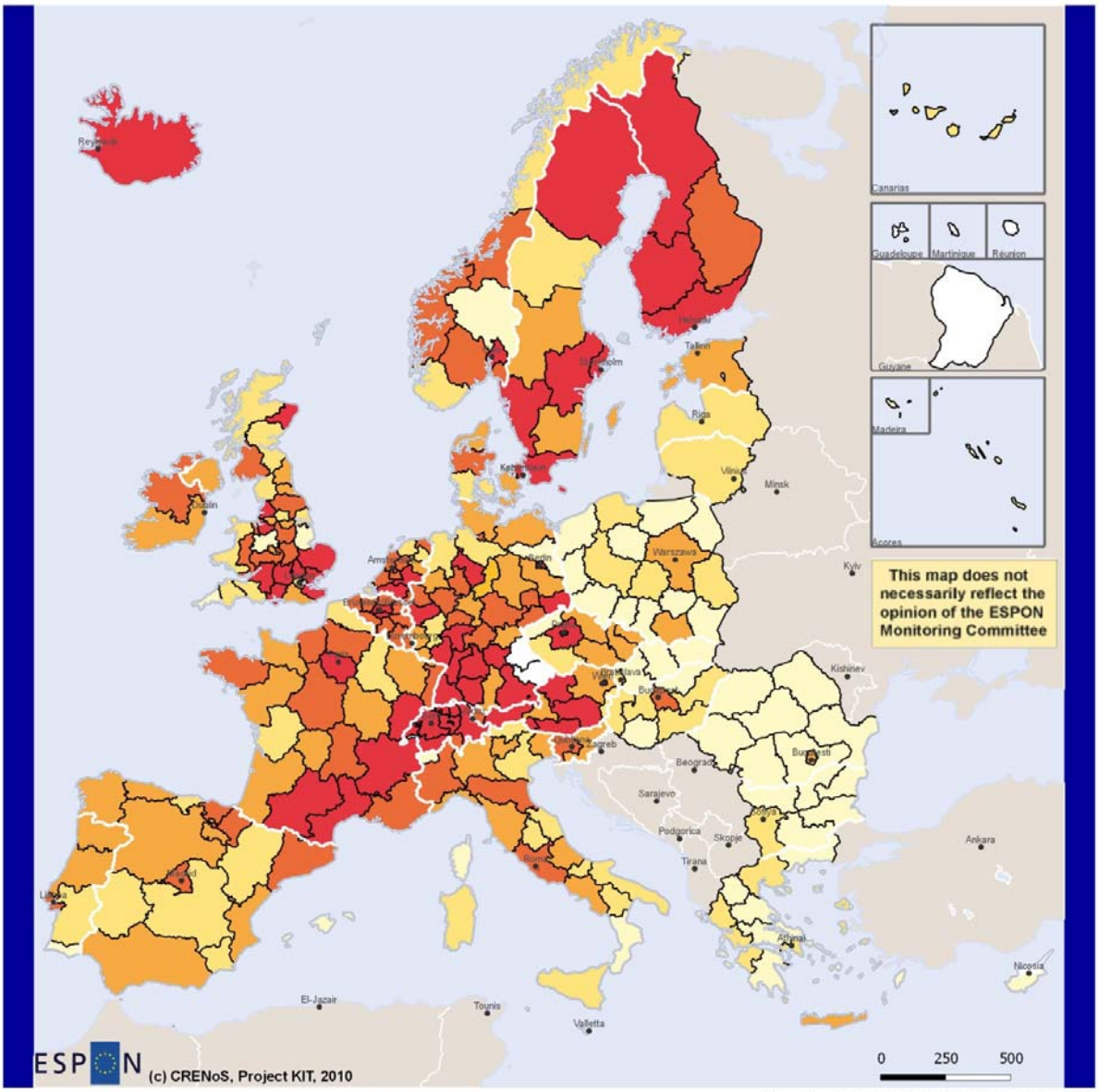
Position	Region code	Region name	Country	RD expenditure
		top regions		
1	FR10	Île de France	France	15121.08
2	DE11	Stuttgart	Deutschland	8443.47
3	DE21	Oberbayern	Deutschland	7783.84
4	DE71	Darmstadt	Deutschland	4677.63
5	FR71	Rhône Alpes	France	4560.31
6	DK01	Hovedstaden	Danmark	4305.57
7	UKH1	East Anglia	United Kingdom	4009.09
8	SE11	Stockholm	Sverige	3929.62
9	ITC4	Lombardia	Italia	3771.63
10	DEA2	Köln	Deutschland	3506.74
		bottom regions		
271	BG33	Severoiztochen	Bulgaria	7.21
272	PL43	Lubuskie	Polska	6.48
273	GR22	Ionia Nisia	Ellada	5.86
274	GR13	Dytiki Makedonia	Ellada	5.82
275	BG34	Yugoiztochen	Bulgaria	5.45
276	ES64	Ciudad Autónoma de Melilla	España	3.45
277	BG31	Severozapaden	Bulgaria	3.39
278	BG32	Severen tsentralen	Bulgaria	2.28
279	ES63	Ciudad Autónoma de Ceuta	España	2.21
280	FI20	Åland	Suomi / Finland	1.69



Map 10. RD Expenditure per 1000 POP, average 2006-2007, Millions of Euros

Table 17. R&D Expenditure per 1000 POP, average 2006-2007, top and bottom regions, Millions of Euros

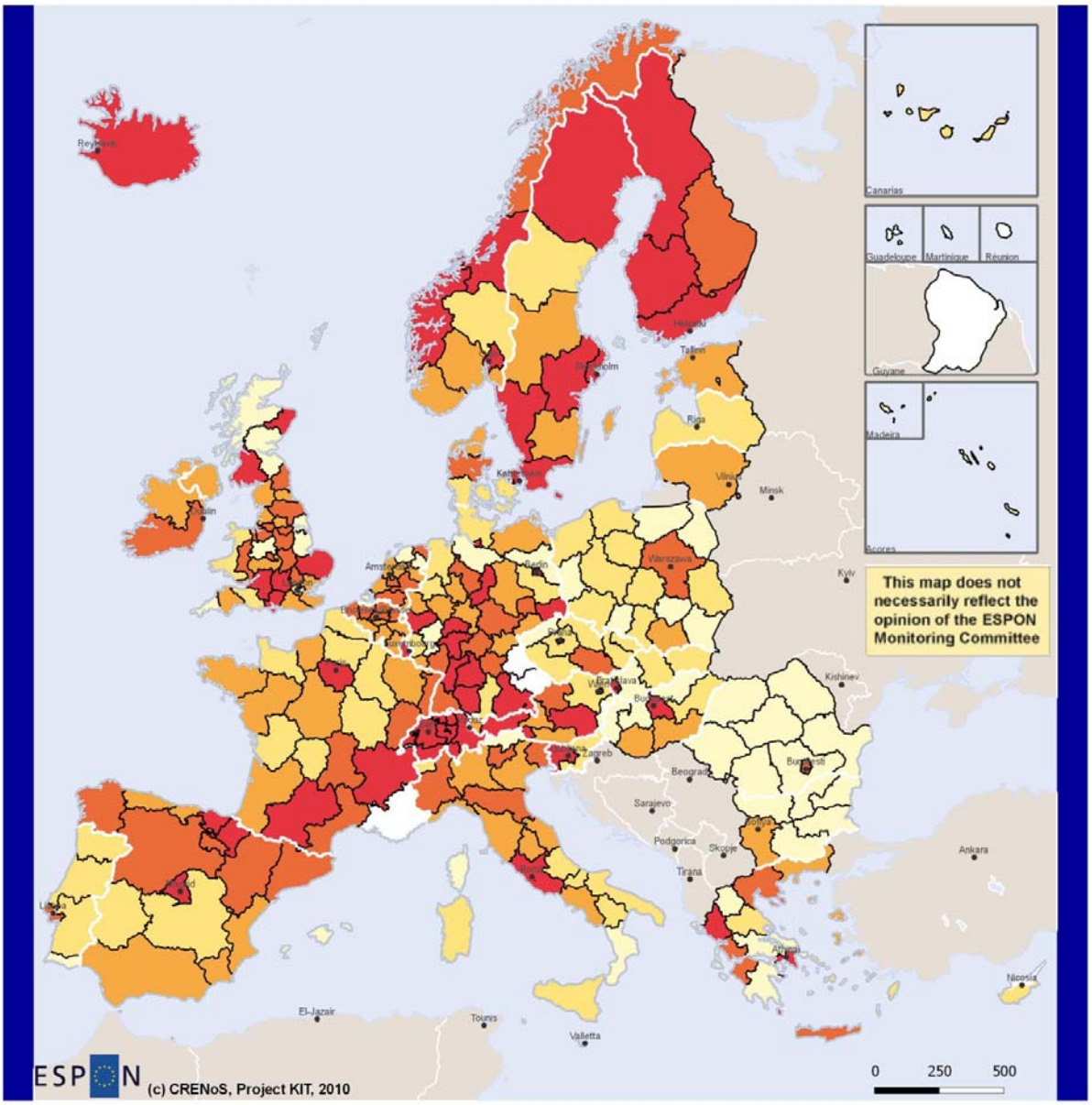
Position	Region code	Region name	Country	RD expenditure per 1000 POP
		top regions		
1	DK01	Hovedstaden	Danmark	2.63
2	DE11	Stuttgart	Deutschland	2.11
3	SE11	Stockholm	Sverige	2.05
4	DE91	Braunschweig	Deutschland	1.92
5	NO06	Trøndelag	Norge	1.90
6	NO01	Oslo og Akershus	Norge	1.86
7	DE21	Oberbayern	Deutschland	1.82
8	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	1.80
9	UKH1	East Anglia	United Kingdom	1.75
10	CH04	Zürich	Schweiz/Suisse/Svizzera	1.61
		bottom regions		
271	RO12	Centru	Romania	0.008
272	RO41	Sud Vest Oltenia	Romania	0.008
273	BG33	Severoiztochen	Bulgaria	0.007
274	RO22	SudEst	Romania	0.007
275	PL43	Lubuskie	Polska	0.006
276	PL33	Swietokrzyskie	Polska	0.006
277	BG42	Yuzhen tsentralen	Bulgaria	0.005
278	BG34	Yugoiztochen	Bulgaria	0.005
279	BG31	Severozapaden	Bulgaria	0.004
280	BG32	Severen tsentralen	Bulgaria	0.002



Map 11. RD Expenditure % of GDP, average 2006-2007

Table 18. RD Expenditure % of GDP, average 2006-2007, top and bottom regions

Position	Region code	Region name	Country	RD expenditure (% GDP)
		top regions		
1	DE91	Braunschweig	Deutschland	6.77
2	DE11	Stuttgart	Deutschland	5.84
3	UKH1	East Anglia	United Kingdom	5.63
4	FI1A	Pohjois Suomi	Suomi / Finland	5.10
5	DK01	Hovedstaden	Danmark	5.09
6	SE22	Sydsverige	Sverige	4.91
7	SE23	Västsverige	Sverige	4.47
8	BE31	Prov. Brabant Wallon	Belgique-België	4.36
9	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	4.32
10	DE21	Oberbayern	Deutschland	4.32
		bottom regions		
271	GR42	Notio Aigaio	Ellada	0.16
272	FI20	Åland	Suomi / Finland	0.15
273	RO12	Centru	Romania	0.15
274	BG31	Severozapaden	Bulgaria	0.15
275	ES63	Ciudad Autónoma de Ceuta	España	0.15
276	PL52	Opolskie	Polska	0.15
277	GR13	Dytiki Makedonia	Ellada	0.12
278	PL33	Swietokrzyskie	Polska	0.10
279	BG32	Severen tsentralen	Bulgaria	0.10
280	PL43	Lubuskie	Polska	0.09



Map 12. RD Personnel % of total employment, Average 2006-2007

Table 19. RD Personnel % of total employment, average 2006-2007, top and bottom regions

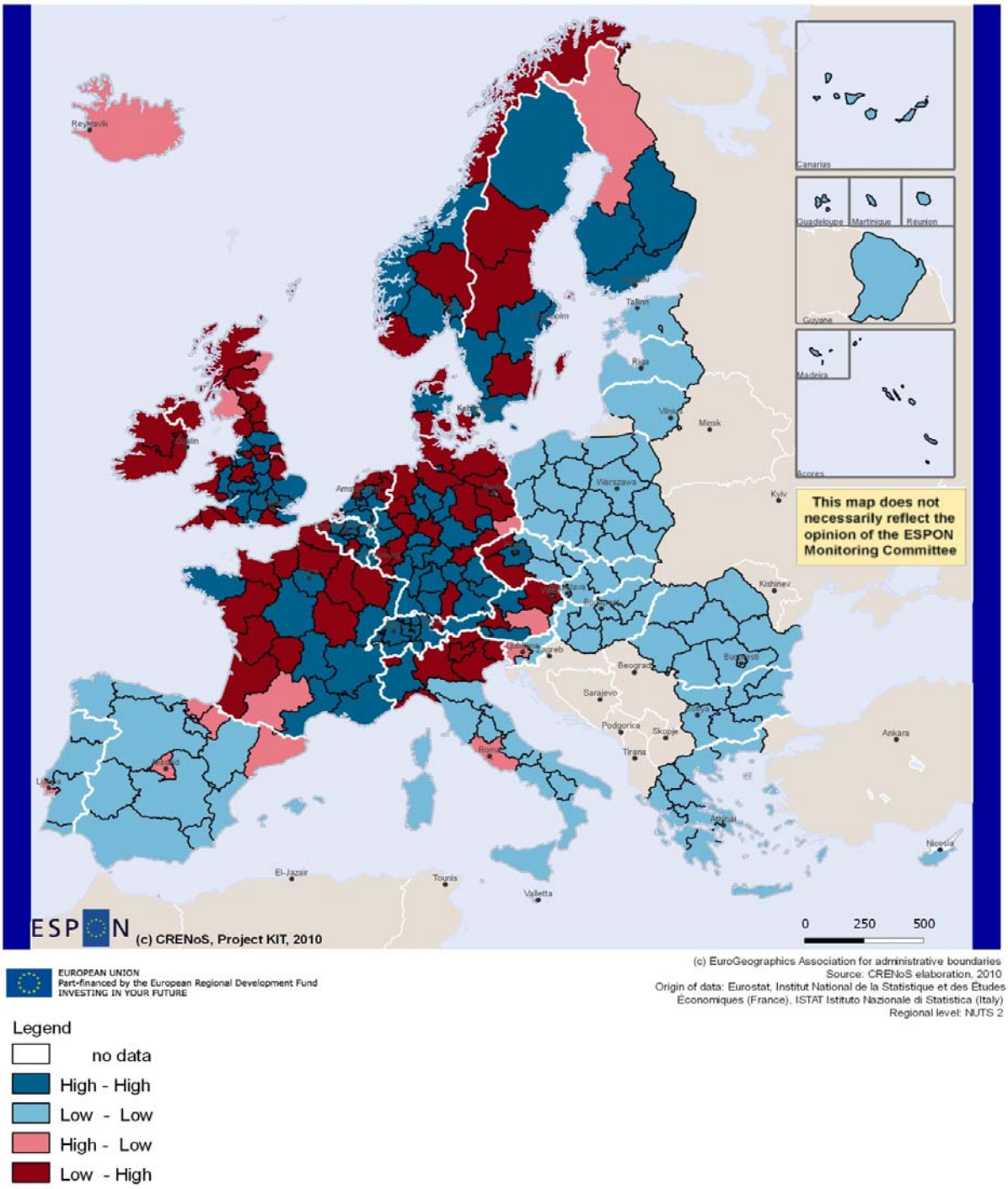
Position	Region code	Region name	Country	RD personnel (% EMP)
		top regions		
1	UKM5	North Eastern Scotland	United Kingdom	5.71
2	DK01	Hovedstaden	Danmark	4.95
3	CZ01	Praha	Ceska Republika	4.67
4	AT13	Wien	Österreich	4.66
5	NO06	Trøndelag	Norge	4.20
6	NO01	Oslo og Akershus	Norge	4.11
7	DE91	Braunschweig	Deutschland	4.06
8	UKI1	Inner London	United Kingdom	4.04
9	BE10	Région de Bruxelles Capitale/Brussels Hoofdstedelijk Gewest	Belgique-België	3.94
10	FI1A	Pohjois Suomi	Suomi / Finland	3.91
		bottom regions		
270	PL43	Lubuskie	Polska	0.26
271	RO21	NordEst	Romania	0.25
272	RO41	Sud Vest Oltenia	Romania	0.24
273	RO42	Vest	Romania	0.24
274	PL33	Swietokrzyskie	Polska	0.23
275	DE41	Brandenburg Nordost	Deutschland	0.23
276	BG31	Severozapaden	Bulgaria	0.21
277	UKK3	Cornwall and Isles of Scilly	United Kingdom	0.21
278	RO22	Sud Est	Romania	0.19
279	UKM6	Highlands and Islands	United Kingdom	0.18

Table 20. RD, coefficient of variation for selected samples, 2006-2007

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
RD expenditure	1.68	1.53	1.40	0.72	1.58	0.93	1.37
RD expenditure % GDP	0.82	0.75	0.88	0.52	0.89	0.61	0.66
RD expenditure per 1000 POP	1.07	0.92	1.52	0.49	1.39	0.67	0.78
RD Personnel % EMP	0.65	0.59	0.90	0.40	0.62	0.56	0.56

Table 21. Moran (standardized distance), whole sample, 2006-2007

Variable	I	z	pvalue*
RD expenditure	0.030	6.919	0.000
RD expenditures % of GDP	0.076	15.556	0.000
RD expenditures per 1000 POP	0.091	18.391	0.000
RD Personnel % EMP	0.026	5.791	0.000



Map 13. Spatial association analysis, Funding in the 5FP per 1000 POP, 2006-2007

2.2.5 Patents

Table 22 shows average values for the number of patents for the initial (1995-1997) and final (2005-2006) period of our analysis. The table is divided in two horizontal blocks: the first one patents for the total of IPC sectors are considered; the second block is dedicated to high-tech IPC sectors. In the first 2 rows of the first block we observe values for absolute number of patents. For all the chosen samples, the average value of patents grows over time. "Competitive" regions show the best performances while regions belonging to the "new entrants" countries show the worst ones. In the last 2 rows of the same block, we may observe average values for selected samples of number of patents per million population from 1995 to 2006. As happened when we measured the number of patents in absolute terms, the number of patents per capita grows for all selected samples over time. Again, the best performance can be attributed to the regions belonging to EFTA countries and the worst one are attributed to the group of regions belonging to "new entrants" countries.

If we consider data for high-tech sectors, in the same table, it is easy to note that higher values are always listed for the EU15 regions, then the EFTA countries and, finally, a much lower values for the new 12 EU entrants countries. On the Regions sample the values are obviously higher for the competitive regions, then the transition ones and finally for the convergence regions. Anyway, a high value differential stands between the competitive regions and the convergence ones. Considering data per million population, we note that higher values are listed for EFTA countries, although they are very close to the EU15 countries. EU 12 new entrants show very low values. The EU regions samples describes a high differential between the competitive, transition and convergence regions.

Maps from 14 to 23 show the spatial distribution of values for total sectors patents and they clearly show that the patents distribution does not change in the time span under observation, neither considering absolute values or patents per 1000 population. The core of Europe seems to be an area of high concentration of patents both at the beginning and at the end of the period, while the Southern and the Eastern regions have a persisting low propensity to patent from 1995 to 2006.

Table 23 shows top and bottom ten positions for number of patents (absolute value) awarded for the period 2005-2006. Among the first ten positions of our ranking, we still see Stuttgart and Oberbayern (Germany) but also, as in the first table on RD Expenditure (Table 24), Île de France and Rhône Alpes (France) and Lombardia (Italy) together with Noord Brabant (Nederland), Darmstadt, Karlsruhe, Düsseldorf and Köln (Germany). Because of these results we can deduce a leading position assumed by Germany in patent activity. Among the bottom ten positions there are four Greek regions – Ipeiros, Anatoliki Macedonia, Ionia Nisia and Voreio Aigaio – together with Liechtenstein, Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla (Spain), Island and 2 Portuguese regions, Região Autónoma dos Açores and Região Autónoma da Madeira. Among the ten worst performances the table points out some peripheral regions such as Anatoliki Makedonia, Ionia Nisia and Voreio Aigaio (Greece), Região Autónoma da Madeira and Região Autónoma dos Açores (Portugal), Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla (Spain) and Ísland.

Table 24 shows patent activity per capita: results are not really different with regard to Table 23. Indeed, the role played by German regions is always stronger: Stuttgart, Oberbayern, Tübingen, Karlsruhe, Freiburg and Mittelfranken are ranked among the first ten positions. Among the high performing regions we also note Noord Brabant (Nederland), Nordwestschweiz and Zürich (Swiss) and Vorarlberg (Austria).

The analysis of the yearly rate of change (Maps 24 and 25) reveals some interesting aspects: the regions which in the last 10 years had the lowest number of patents, are those with the best rates of change in the period 2002-2006. The regions of Greece, Spain, the South of Italy and the Eastern Countries have had a significant growth in the number of patents awarded. Moreover the map points out that this improvement is wide and homogeneously distributed nationwide in Czech Republic, Portugal, Romania, Spain and Slovakia. On the other hand many European core regions exhibit great difficulty to increase the number of patents awarded: this is particularly true for Finland, Germany, Sweden and the United Kingdom.

While analysing the best and worst performances, when we consider the rate of change instead of the number of patents, results change considerably. Table 25 and 26 present the rate of change and rate of change per capita for patents awarded between 2002 and 2006; data point out that among the regions that exhibit the best performances there are some territories that appeared earlier among the worst rankings. An example is Centru (Romania). Among the worst performances there are regions from really different parts of Europe: Herefordshire, Worcestershire, East Wales and Warks and Devon (United Kingdom), Sud Est and Sud Vest Oltenia (Romania), Åland (Finland), Swietokrzyskie (Poland), Lithuania, Martinique (France), Liechtenstein, Região Autónoma da Madeira (Portugal). Among them, there are regions showing good performances regarding absolute value for patent activity, like English regions. Other territories, on the contrary, show bad performances both in absolute values and in the rate of change, like Åland (Finland), Liechtenstein, Sud Vest Oltenia (Romania) and Região Autónoma da Madeira (Portugal). The results on Maps 25 and 26 and Tables 25 and 26 seem to point out a slow convergence path on patent production.

Figures from 26 to 29 describe, respectively the spatial distribution of patents in high-technology fields in absolute value and per thousand population. In both cases and for both considered periods, 1995-1997 and 2005-2006, high values are concentrated in the core and the north of the European territory while southern, eastern and western regions are characterized by lower values.

Table 27 shows the ranking for top and bottom regions on high tech patents for 1995-1997 period. The table shows a high dispersion among the top regions values, with the first (Île de France) and the second (Oberbayern) with very high values (393 and 370 respectively), while the 9^{th} and 10^{th} positions (Lombardia and Darmstadt) shows much lower values (80 and 77 respectively). Among the first and the tenth positions there are some northern regions (NoordBrabant, EteläSuomi, Stockholm and East Anglia) and European core regions (Stuttgart and RhôneAlpes). Bottom regions are those with 0 values, which are more than those ranked on Table 24. Those ranked on the above mentioned table are eastern country regions, mostly from Bulgaria and Czech Republic.

Table 28 shows the ranking for top and bottom regions on high tech patents for the last period considered, 2005-2006. Top ranking regions appear to be the same as seen in the previous period, with Île de France as ranking leader and Oberbayern and NoordBrabant following in the 2^{nd} and 3^{rd} position. On top position we find 2 other French regions (Rhône Alpes and Bretagne), other 3 German regions (Stuttgart, Köln and Darmstadt), Etelä Suomi (Finland) and Stockholm (Sweden). As said before, the bottom regions appear to be those with a 0 value: among them we find 6 Greek regions, 1 Bulgarian (Yugoiztochen), 2 Spanish regions (Ceuta and Melilla) and Iceland.

Table 29 shows the ranking for top and bottom regions on high tech patents per million population for the 1995-1997 period. Comparing this table with the absolute value one, we see that Île de France is not on the first positions any more (as seen for the other indicator), but it still helds one of the top 10 ranking. Top values are listed for 2 German Regions (Oberbayern, which is the first one, and Stuttgart), 2 Sweden regions (Stockholm and Sydsverige), 2 Finnish regions (Pohjois Suomi and Etelä Suomi), then East Anglia (UK), and Zürich (Switzerland). On the bottom of the ranking we find, as seen on previous indicator, regions with 0 values: among them we find 6 Greek regions, 2 Spanish regions (Ceuta and Melilla), Iceland and Yugoiztochen (Bulgaria).

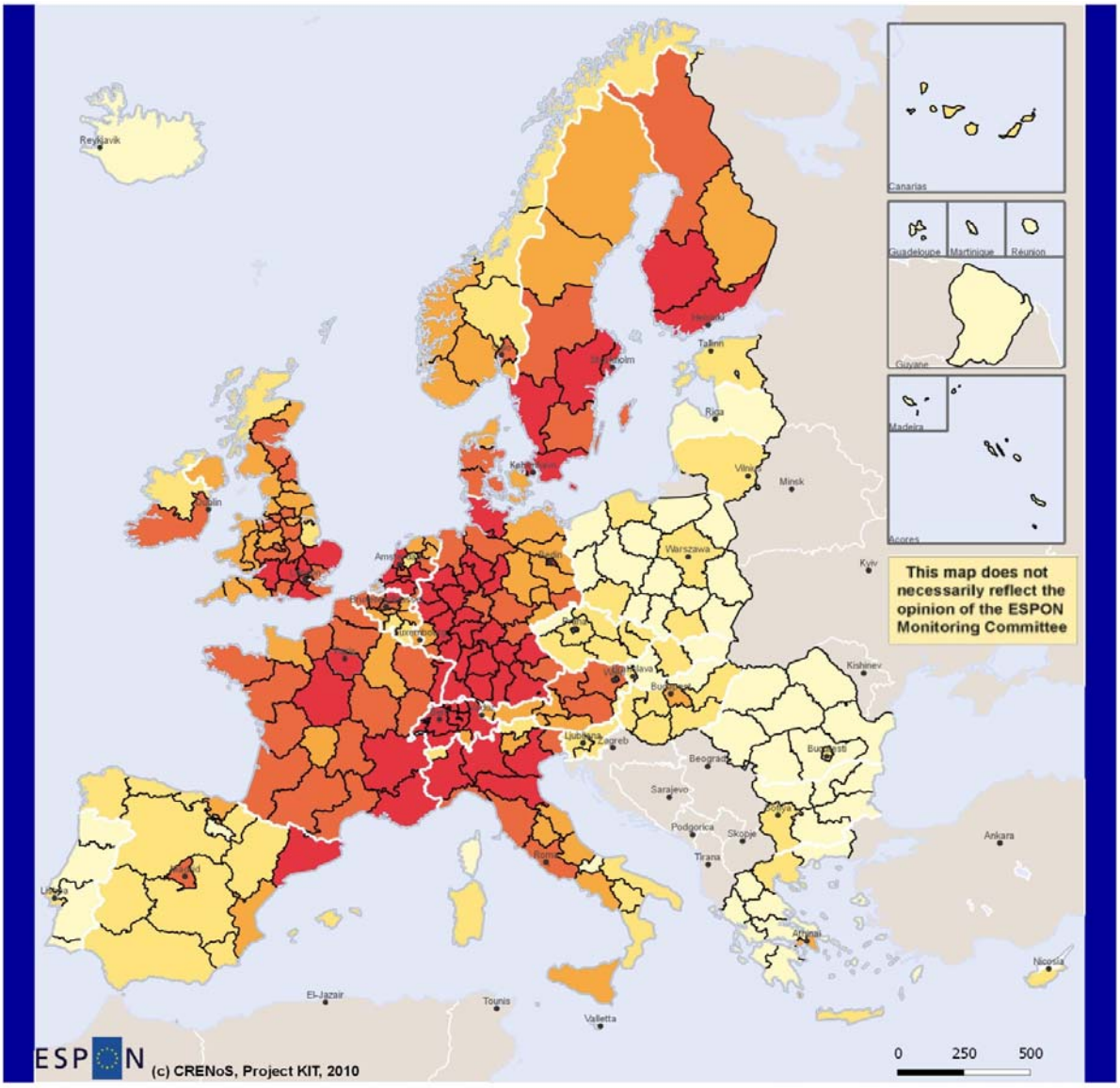
Table 30 shows the ranking for top and bottom regions on high tech patents per million population for the last period considered, 2005-2006. As seen for previous periods the top ranking does not change considerably, for the 2005-06 period a new region enters the top ten positions: Zürich. The rest of the regions still are the same as seen in the other periods: Noord Brabant (Netherland), 3 Finnish regions (Etelä Suomi, Pohjois Suomi and Länsi Suomi) 3 German regions (Oberbayern, Mittelfranken and Oberpfalz) and 2 Swedish regions (Stockholm and Sydsverige). On the bottom positions of the ranking we note 6 Greek regions, Ceuta and Melilla (Spain), a Polish region and a Bulgarian one.

Table 31 displays the coefficient of variation for the number of patents. Again, highest values of the coefficient of variation are shown by regions belonging to the EU "new entrants" and "convergence" regions, and this result underlies the strong heterogeneity of these territories. EFTA countries show the lowest value and this result is constant over time. Again, this result stresses the heterogeneity of regions classified in the above mentioned samples. In this case, lowest values for dispersion are attributed to "competitive" regions. The values of the coefficient of variation don't change considerably over time.

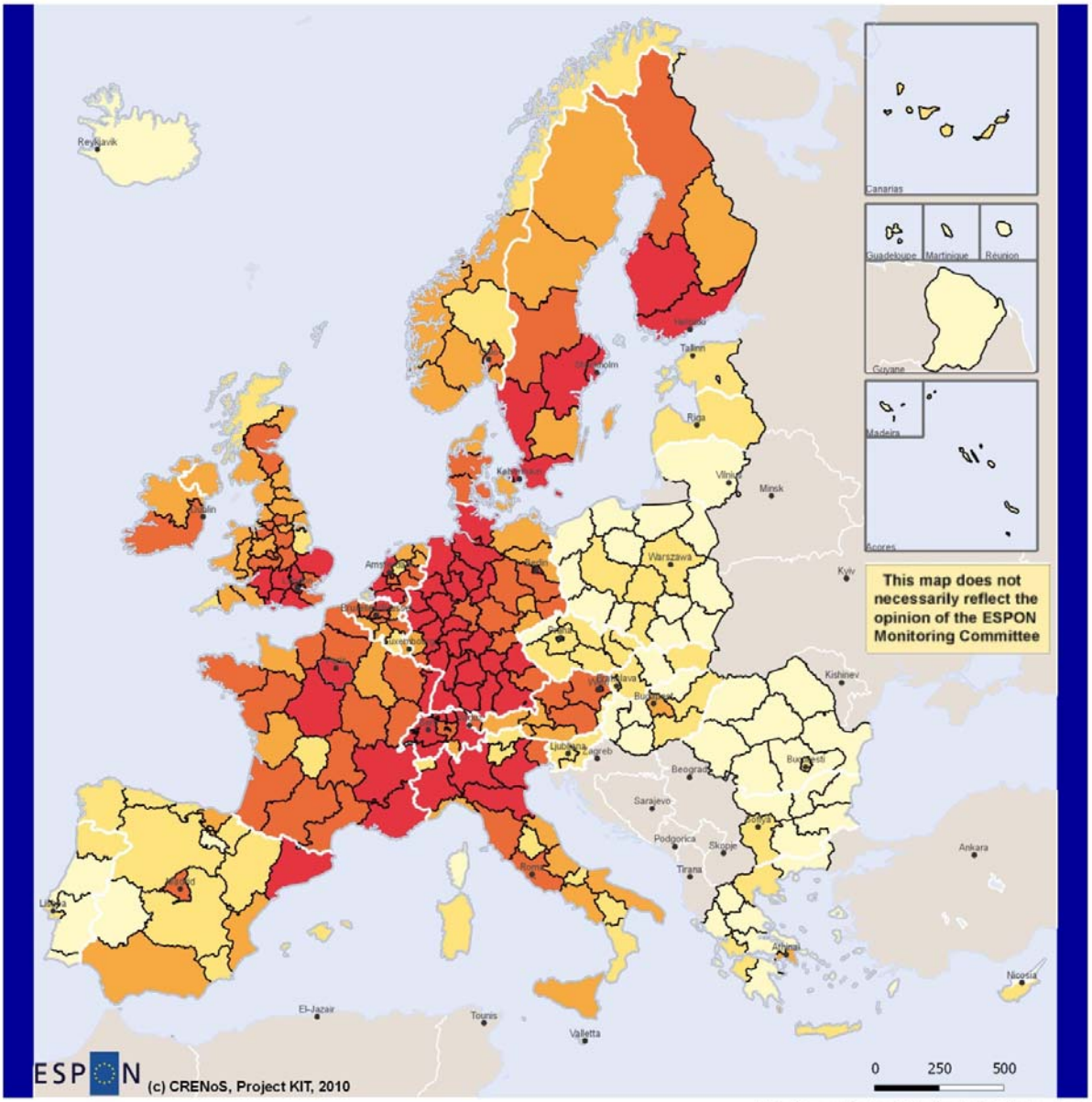
Table 32 presents regional Moran index values for number of patents (absolute values and per 1000 population). Again all values indicate the presence of spatial association with statistical evidence. Figures 30 and 31 present the map of the LISA index for variables measuring the number of patents per capita (1000 population) for the initial (1995-1997) and final period (2005-2006). Again, for both periods the core of Europe presents spatial concentration of high values while low values are concentrated in the periphery. In Maps 32 and 33 we can observe the LISA representation for patents in high-technology fields for initial and final period and we can deduce the same as for all sectors' patents.

Table 22. Number of patents, average values for selected samples

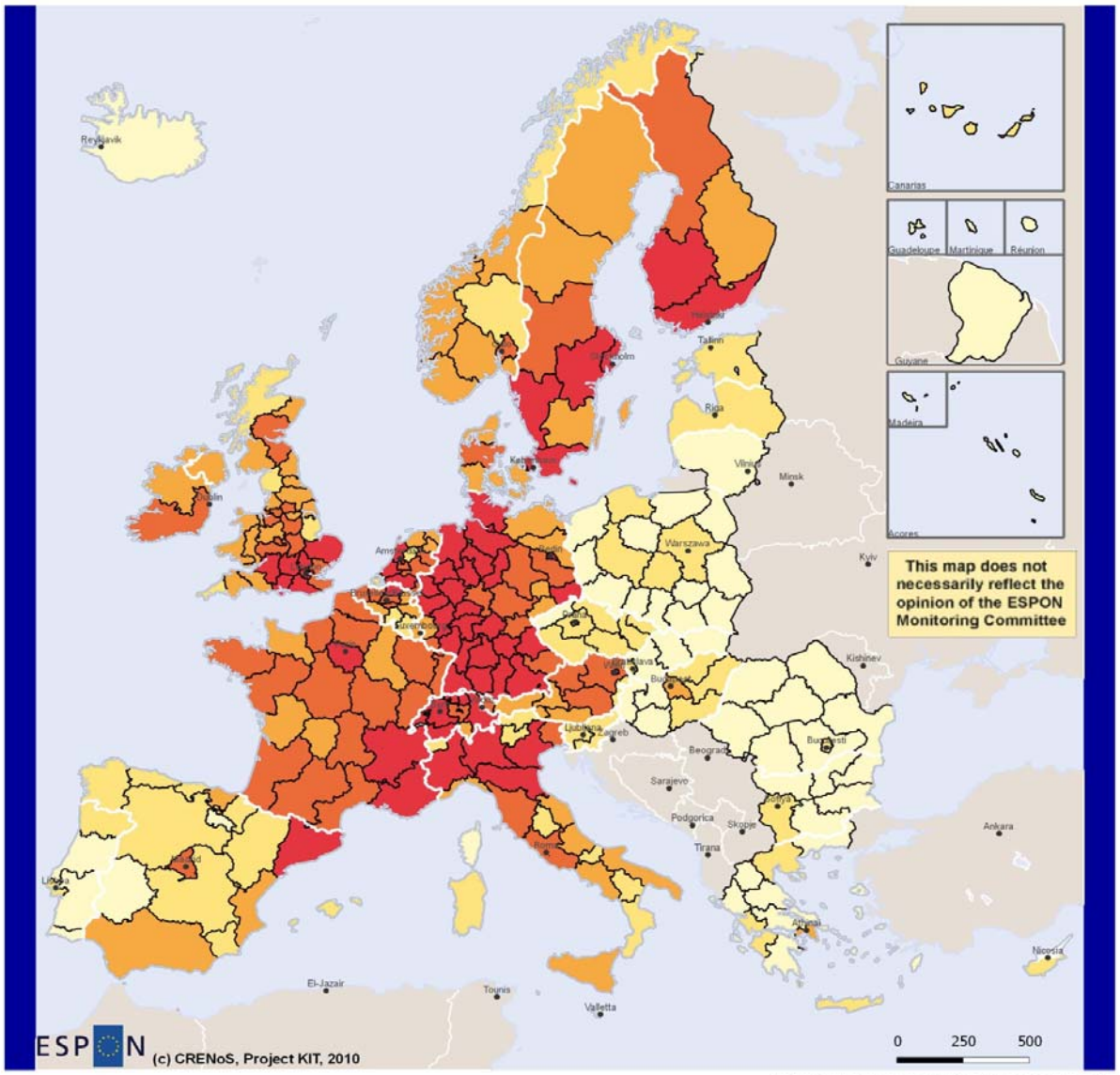
		ESPON whole sample	Countries			EU Regions		
Total sectors			EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
Absolute values	Average 1995-1997	120.7	150.7	2.5	131.1	7.4	20.7	197.4
	Average 2005-2006	204.2	253.7	10.3	217.1	21.1	47.6	327.5
Million Population	Average 1995-1997	62.8	73.6	1.6	134.6	4.2	14.3	93.7
	Average 2005-2006	103.2	120.2	7.2	210.6	11.8	32.9	153.1
High-tech sectors								
Absolute values	Average 1995-1997	14.56	18.63	0.14	10.32	0.80	1.42	24.58
	Average 2005-2006	27.30	34.58	1.17	20.82	2.78	5.02	44.85
Million Population	Average 1995-1997	6.98	8.64	0.09	9.36	0.37	0.96	11.15
	Average 2005-2006	13.12	15.90	0.85	18.61	1.52	3.46	20.40



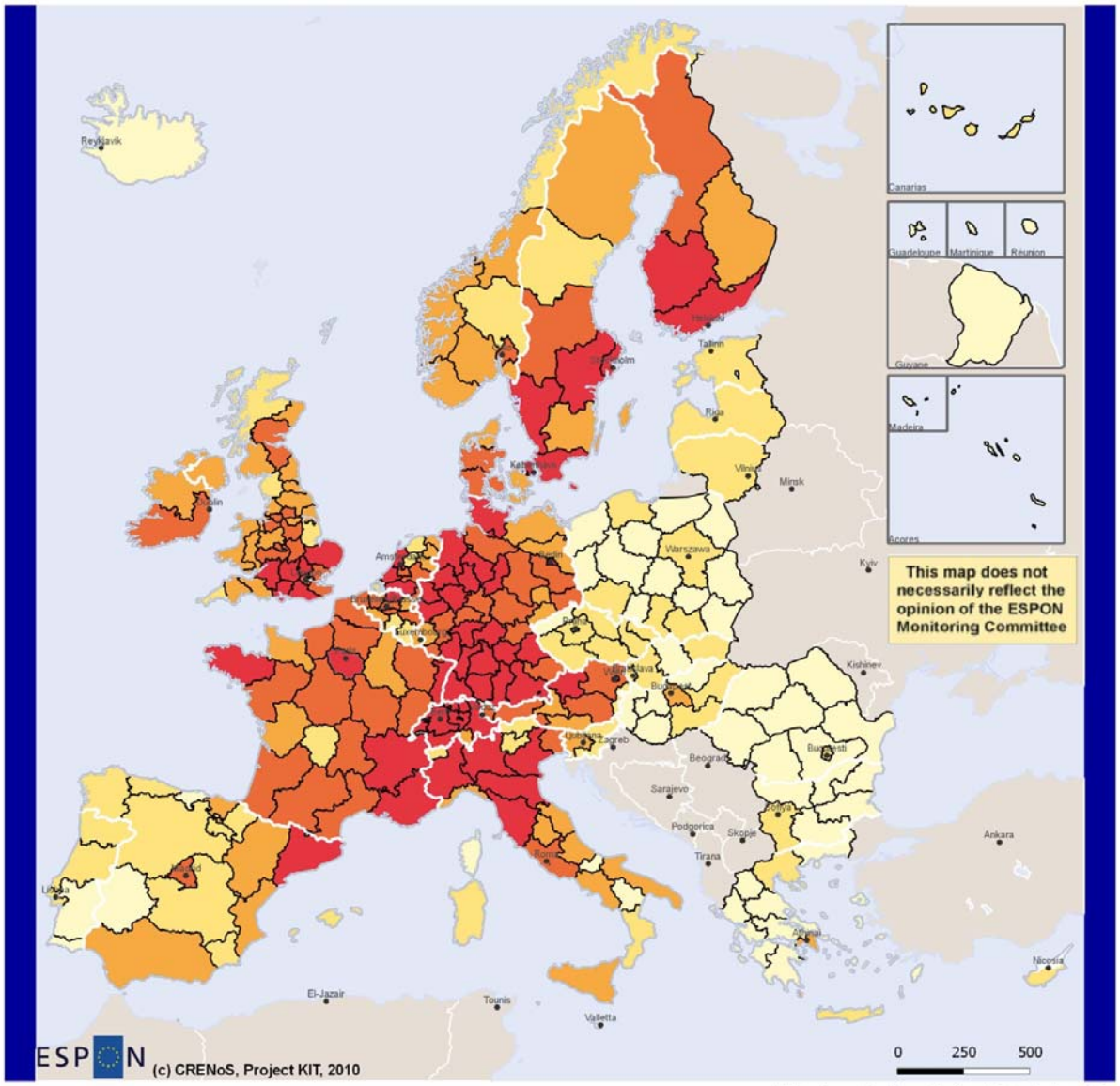
Map 14. Number of patents, absolute value, average 1995-1997



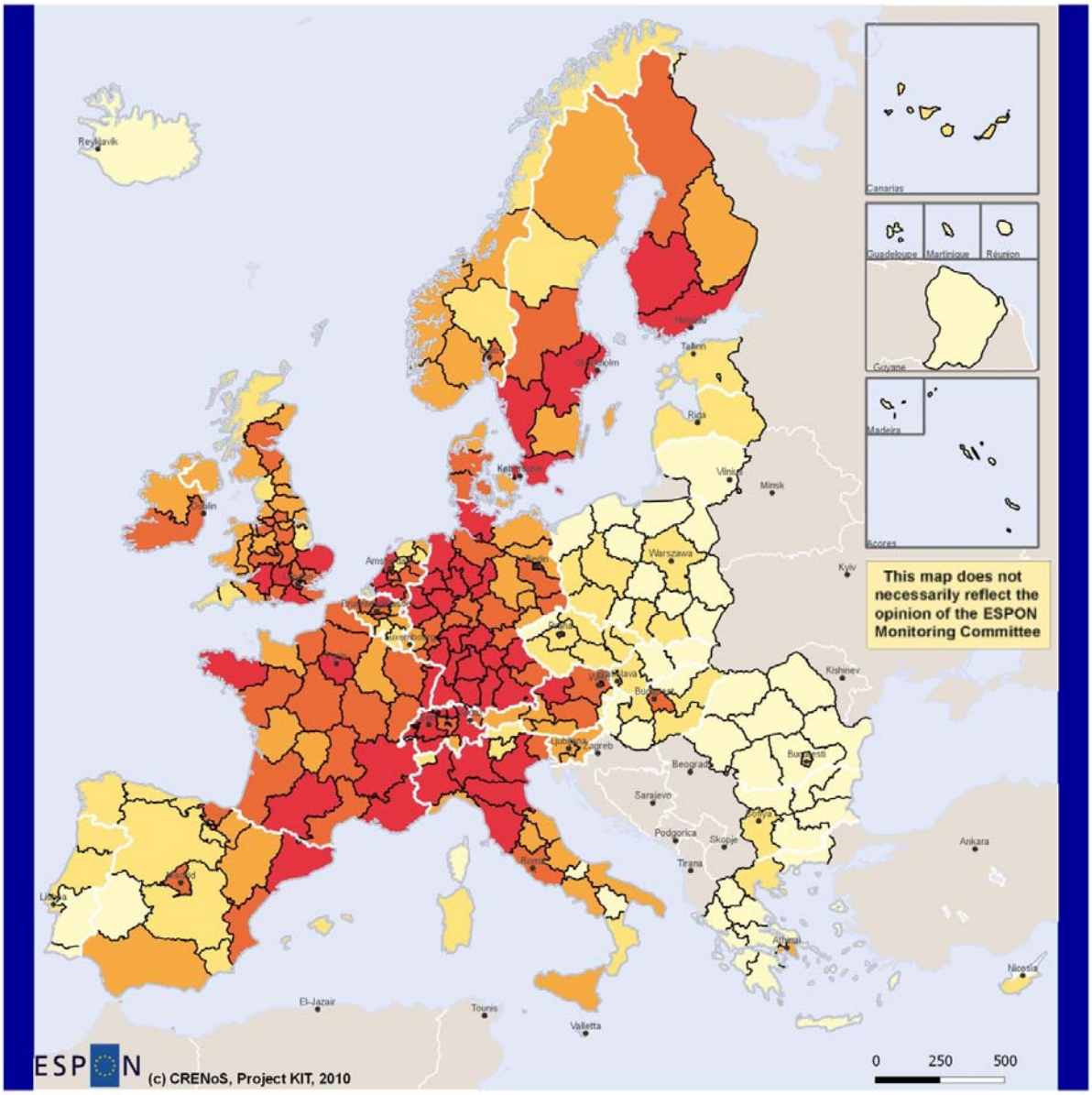
Map 15. Number of patents, absolute value, average 1998-2000



Map 16. Number of patents, absolute value, average 1999-2001



Map 17. Number of patents, absolute value, average 2002-2004



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Source: CRENoS elaboration, 2010
Origin of data: OECD REGPAT Database, 2010
Regional level: NUTS 2

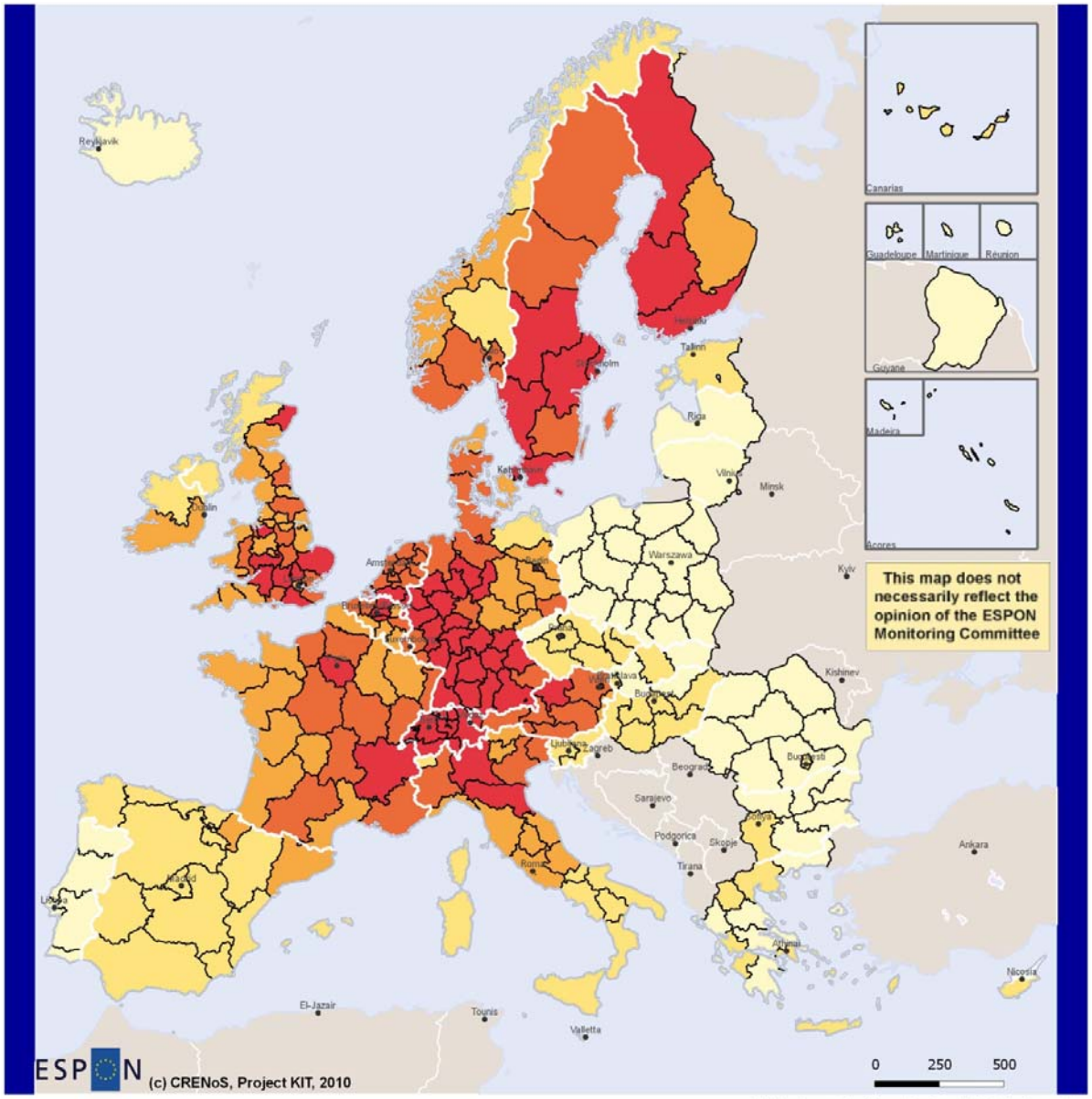
Legend

no data	
0.00 -	5.93
5.93 -	42.41
42.41 -	108.95
108.95 -	290.64
290.64 -	3161.97

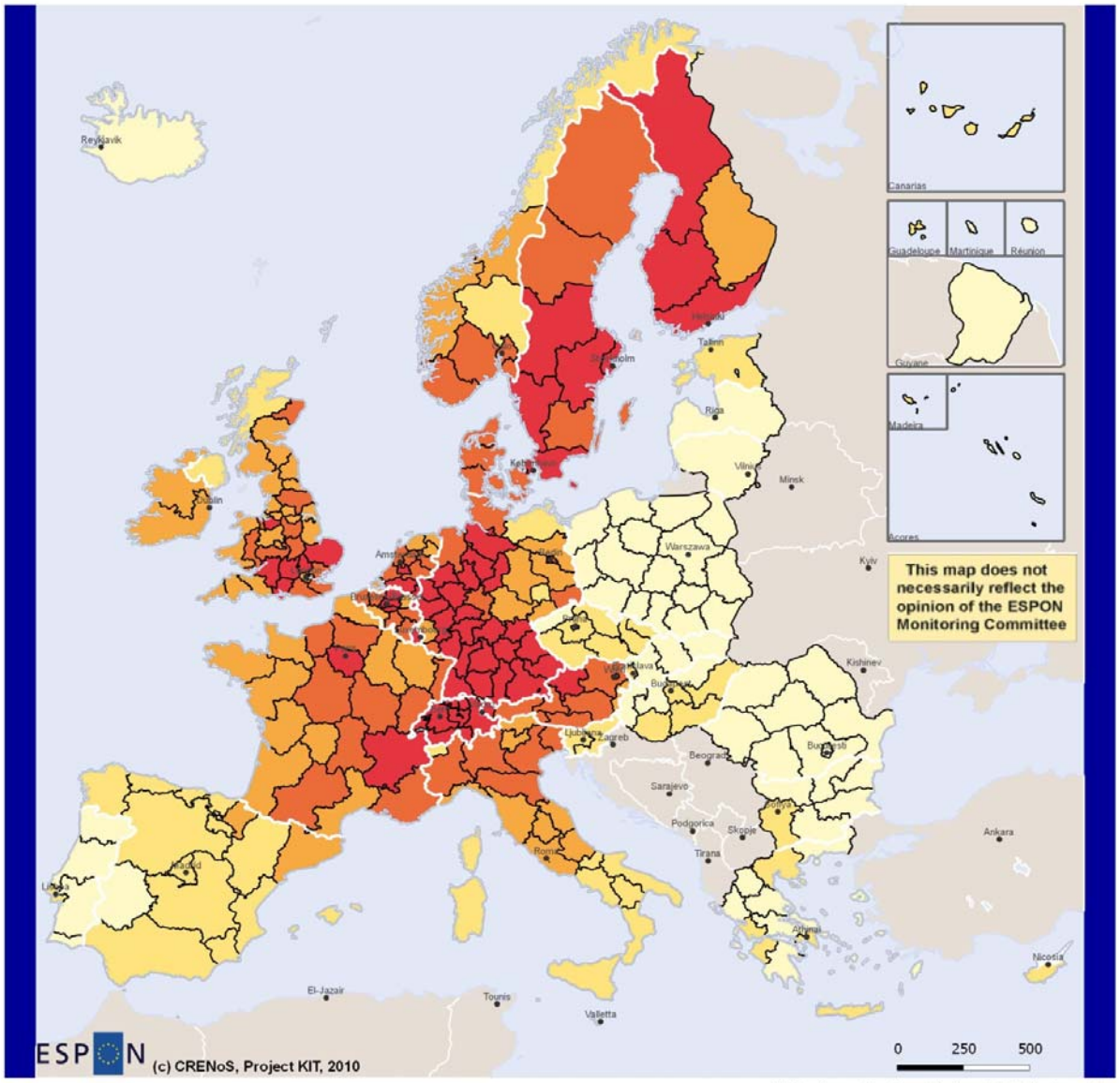
Map 18. Number of patents, absolute value, average 2005-2006

Table 23. Number of patents, absolute value, average 2005-2006, top and bottom regions

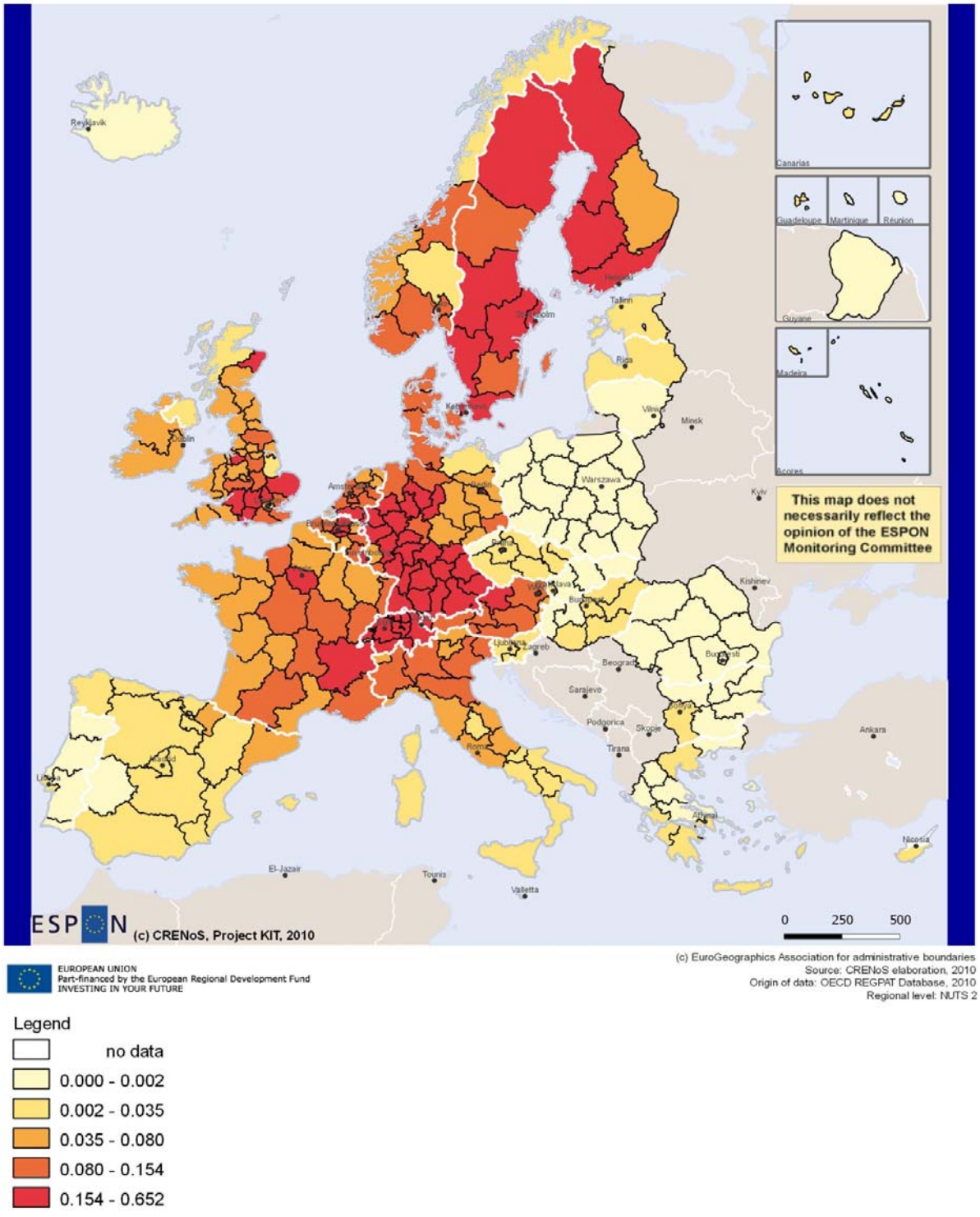
Position	Region code	Region name	Country	N. of patents
		top regions		
1	FR10	Île de France	France	3162.0
2	DE11	Stuttgart	Deutschland	2544.1
3	DE21	Oberbayern	Deutschland	2459.2
4	NL41	Noord Brabant	Nederland	1756.8
5	DE71	Darmstadt	Deutschland	1519.0
6	DE12	Karlsruhe	Deutschland	1433.3
7	DEA1	Düsseldorf	Deutschland	1430.6
8	ITC4	Lombardia	Italia	1419.7
9	DEA2	Köln	Deutschland	1403.5
10	FR71	Rhône Alpes	France	1363.3
		bottom regions		
278	GR21	Ipeiros	Ellada	0.350
279	GR11	Anatoliki Makedonia, Thraki	Ellada	0.125
280	LI00	Liechtenstein	Liechtenstein	0.100
281	ES63	Ciudad Autónoma de Ceuta	España	0.000
282	ES64	Ciudad Autónoma de Melilla	España	0.000
283	GR22	Ionia Nisia	Ellada	0.000
284	GR41	Voreio Aigaio	Ellada	0.000
285	IS00	Iceland	Ísland	0.000
286	PT20	Região Autónoma dos Açores	Portugal	0.000
287	PT30	Região Autónoma da Madeira	Portugal	0.000



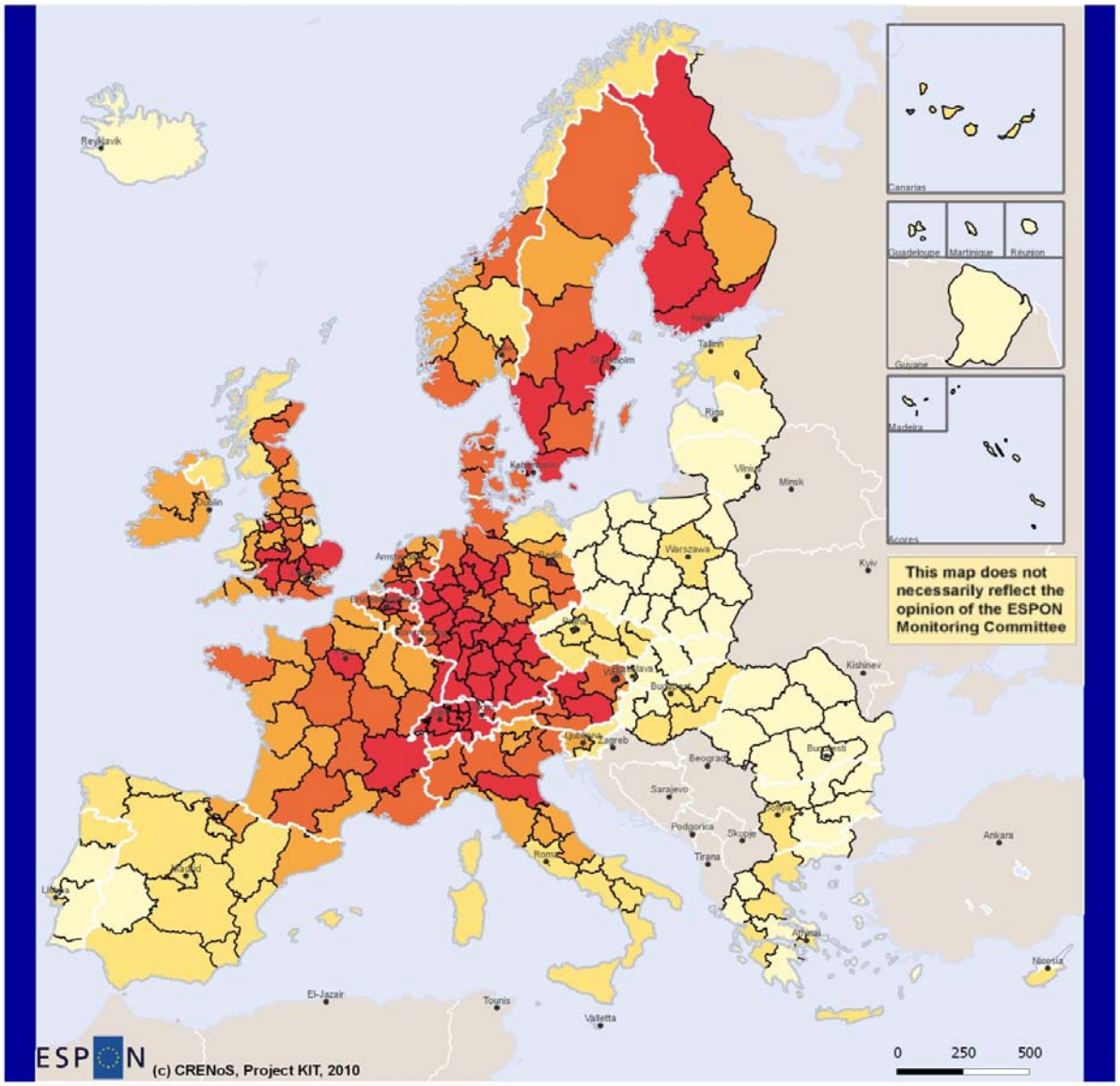
Map 19. Number of patents per 1000 POP, average 1995-1997



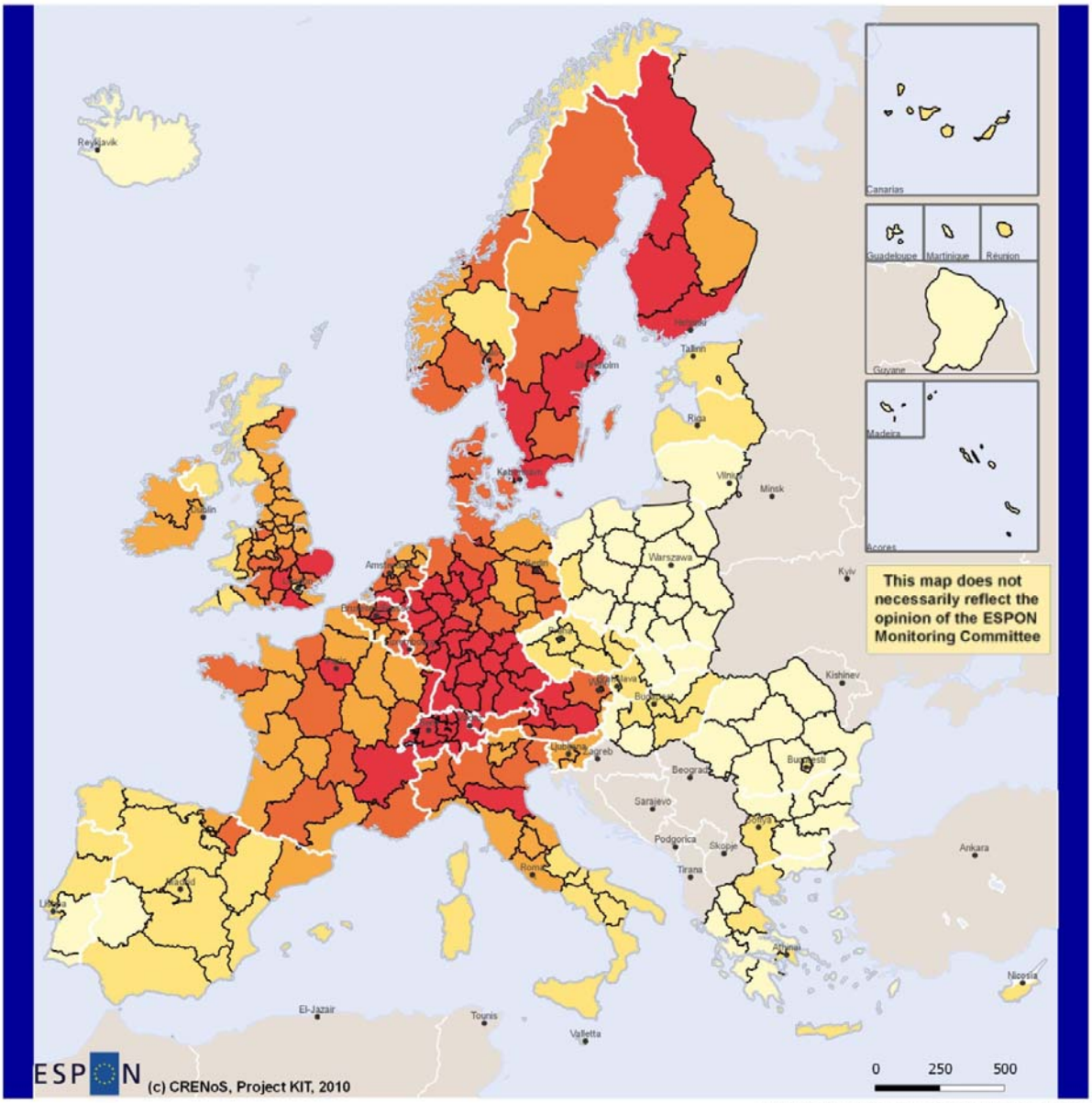
Map 20. Number of patents per 1000 POP, average 1998-2000



Map 21. Number of patents per 1000 POP, average 1999-2001



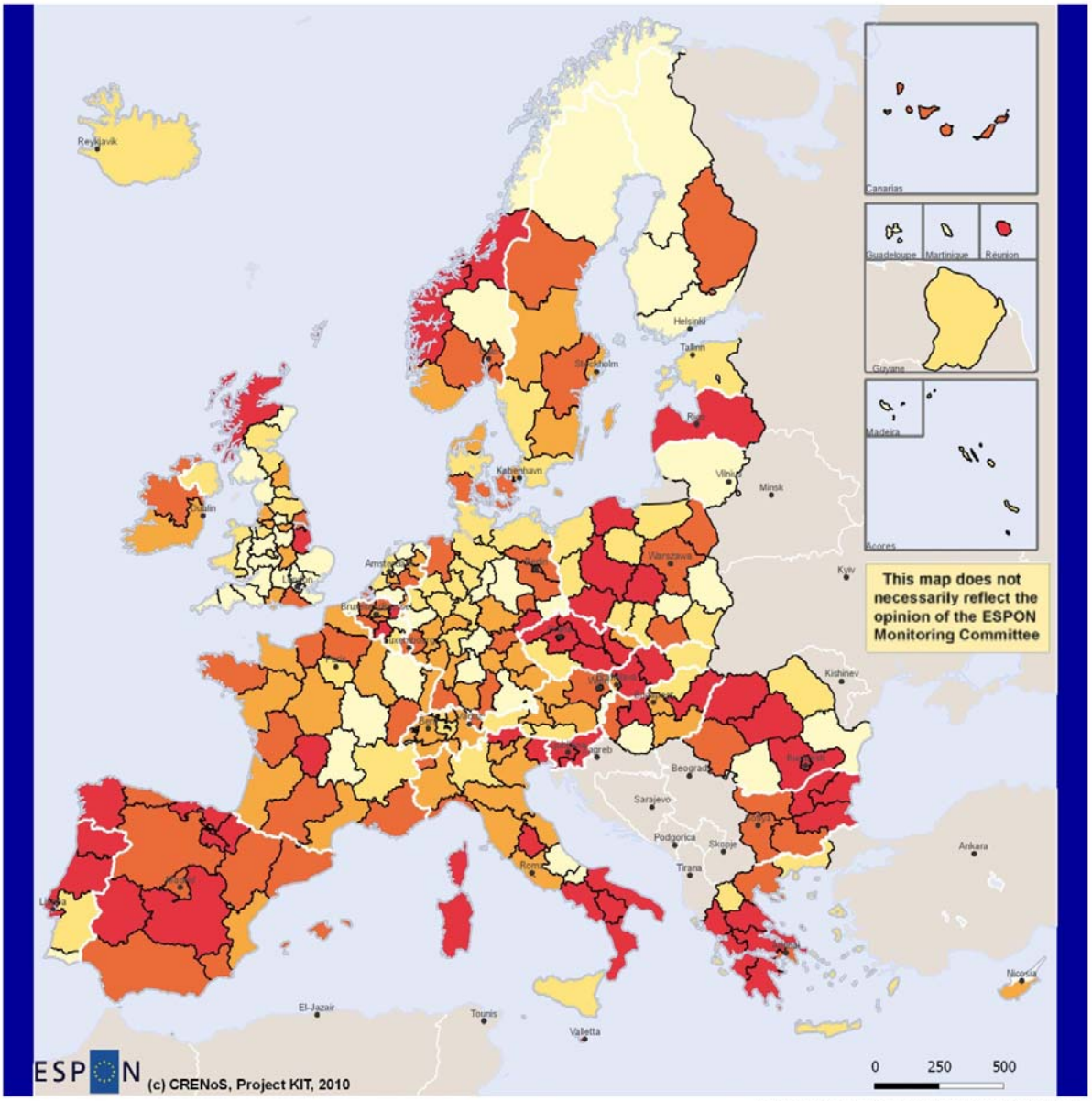
Map 22. Number of patents per 1000 POP, average 2002-2004



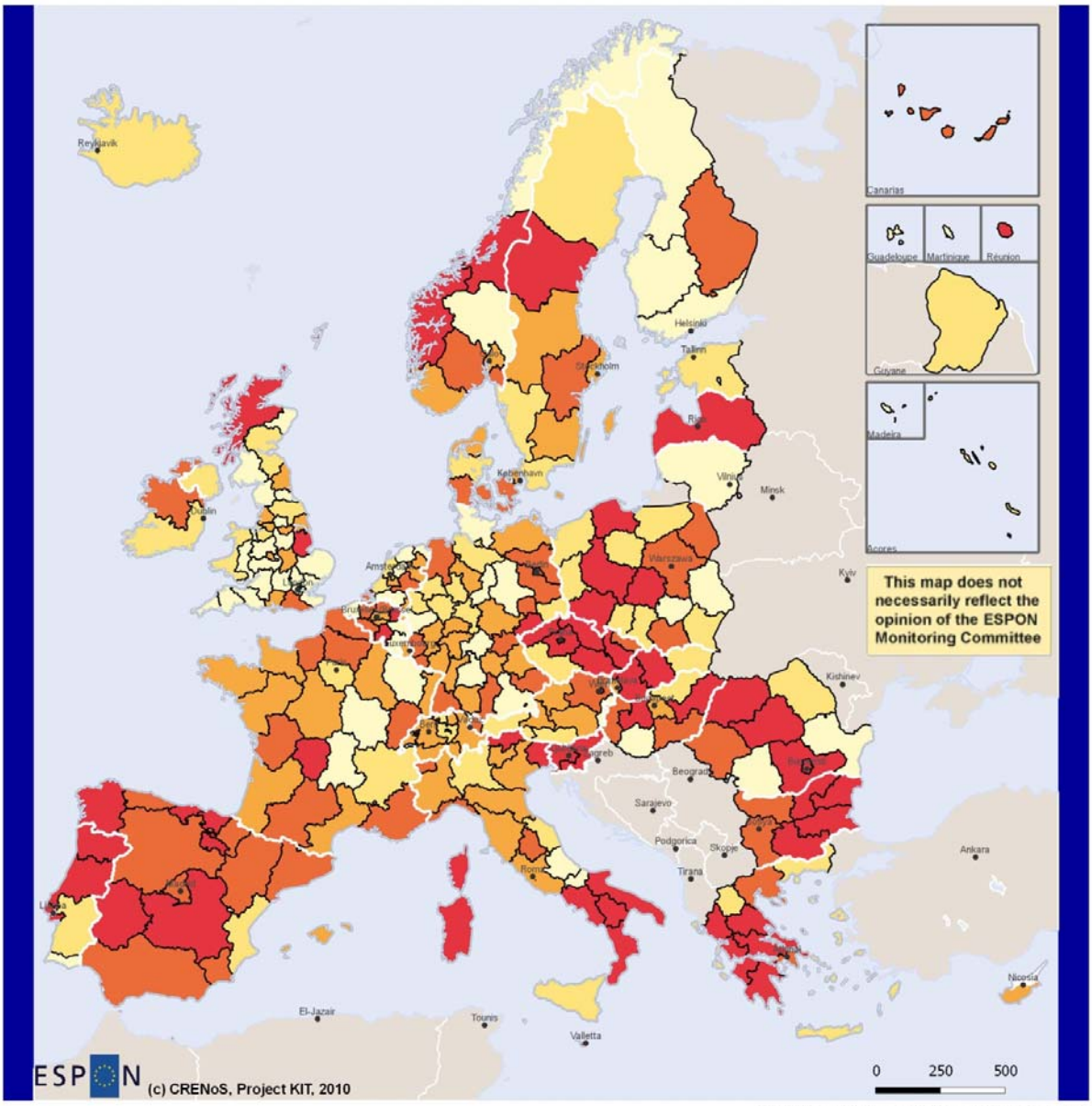
Map 23. Number of patents per 1000 POP, average 2005-2006

Table 24. Number of patents per 1000 POP, average 2005-2006, top and bottom regions

Position	Region code	Region name	Country	N. of patents per 1000 POP
		top regions		
1	NL41	Noord Brabant	Nederland	0.728
2	DE11	Stuttgart	Deutschland	0.635
3	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	0.599
4	DE21	Oberbayern	Deutschland	0.582
5	DE14	Tübingen	Deutschland	0.528
6	DE12	Karlsruhe	Deutschland	0.525
7	CH04	Zürich	Schweiz/Suisse/Svizzera	0.513
8	DE13	Freiburg	Deutschland	0.497
9	DE25	Mittelfranken	Deutschland	0.495
10	AT34	Vorarlberg	Österreich	0.450
		bottom regions		
278	RO41	SudVest Oltenia	Romania	0.000
279	GR11	Anatoliki Makedonia, Thraki	Ellada	0.000
280	RO22	SudEst	Romania	0.000
281	PT30	Região Autónoma da Madeira	Portugal	0.000
282	ES63	Ciudad Autónoma de Ceuta	España	0.000
283	ES64	Ciudad Autónoma de Melilla	España	0.000
284	GR22	Ionia Nisia	Ellada	0.000
285	GR41	Voreio Aigaio	Ellada	0.000
286	IS00	Iceland	Ísland	0.000
287	PT20	Região Autónoma dos Açores	Portugal	0.000



Map 24. Number of patents, yearly rate of change, 2002-2006



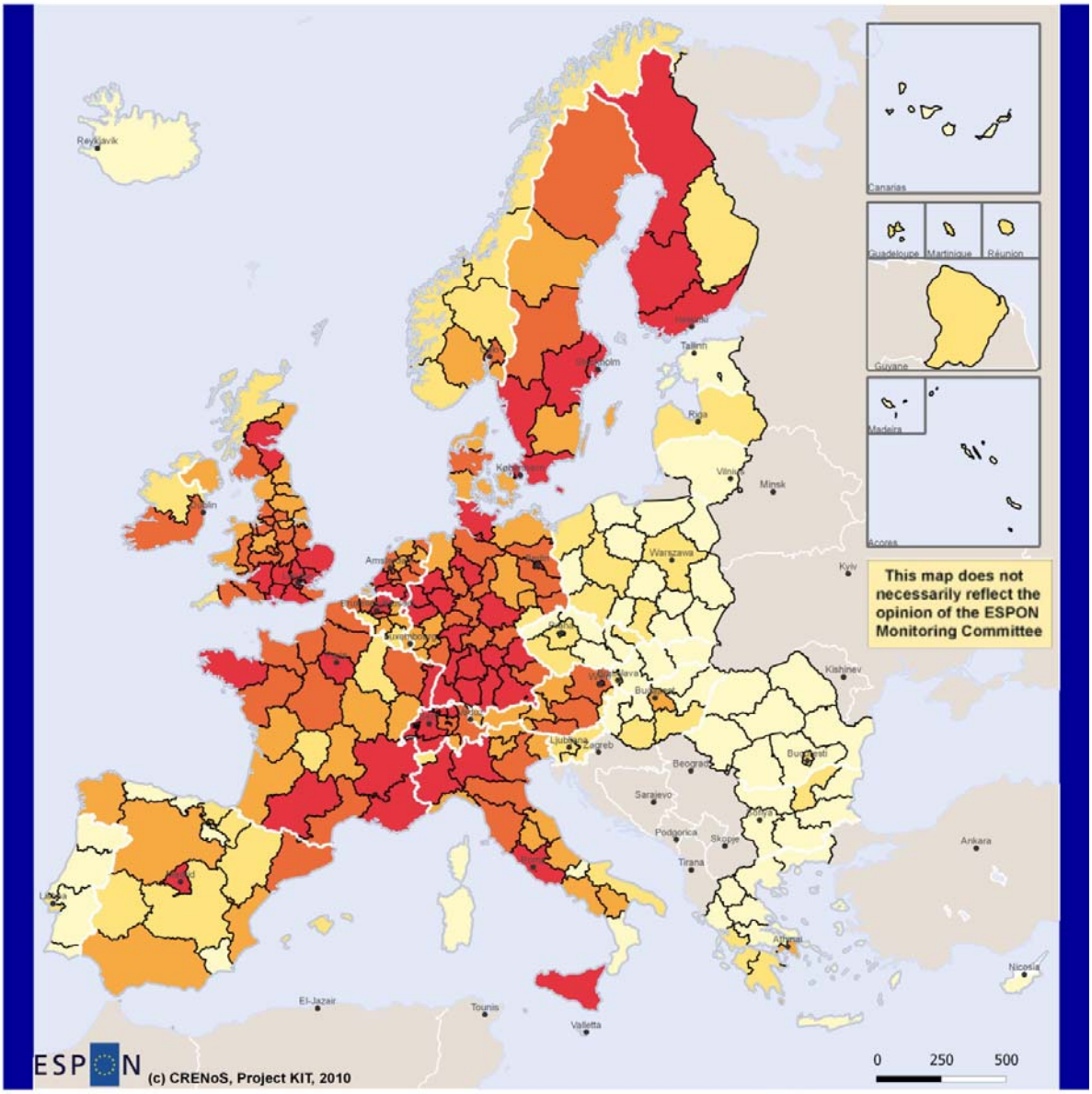
Map 25. Number of patents per 1000 POP, yearly rate of change, 2002-2006

Table 25. Number of patents, yearly rate of change, 2002-2006, top and bottom regions

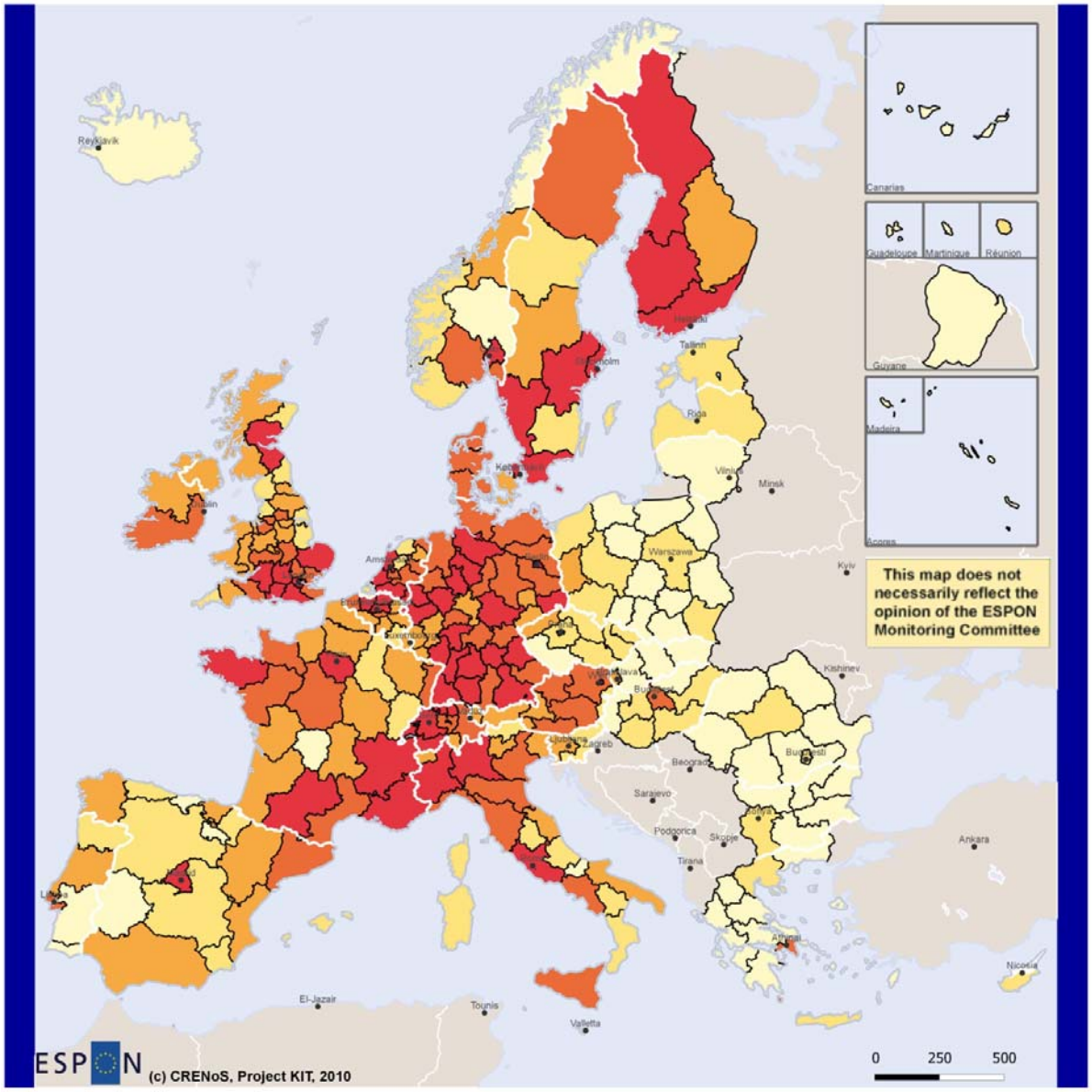
Position	Region code	Region name	Country	Rate of change
		top regions		
1	RO12	Centru	Romania	4.805
2	RO31	Sud Muntenia	Romania	1.666
3	CZ04	Severozápad	Ceska Republika	1.417
4	SK03	Stredné Slovensko	Slovenska Republika	1.052
5	PT16	Centro	Portugal	0.918
6	ES23	La Rioja	España	0.746
7	PT17	Lisboa	Portugal	0.611
8	FR83	Corse	France	0.600
9	RO11	NordVest	Romania	0.567
10	SK02	Západné Slovensko	Slovenska Republika	0.520
		bottom regions		
261	UKG1	Herefordshire, Worcestershire and Warks	United Kingdom	-0.077
262	RO22	SudEst	Romania	-0.078
263	UKL2	East Wales	United Kingdom	-0.080
264	FI20	Åland	Suomi / Finland	-0.100
265	PL33	Swietokrzyskie	Polska	-0.100
266	LT00	Lithuania	Lietuva	-0.152
267	FR92	Martinique	France	-0.164
268	LI00	Liechtenstein	Liechtenstein	-0.200
269	PT30	Região Autónoma da Madeira	Portugal	-0.200
270	RO41	SudVest Oltenia	Romania	-0.200

Table 26. Number of patents per 1000 POP, yearly rate of change, 2002-2006, top and bottom regions

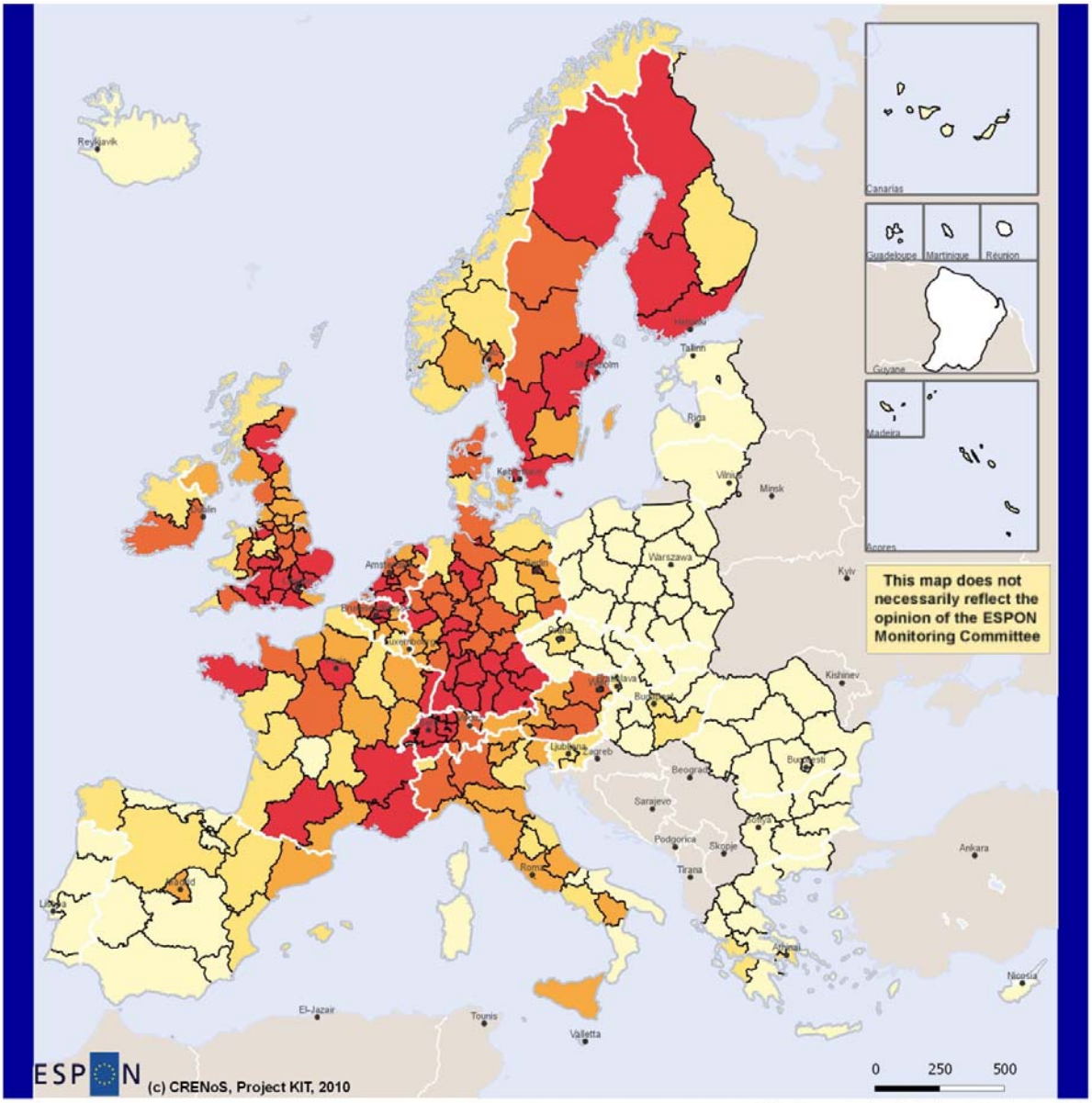
Position	Region code	Region name	Country	Rate of change
		top regions		
1	RO12	Centru	Romania	4.839
2	RO31	Sud Muntenia	Romania	1.701
3	CZ04	Severozápad	Ceska Republika	1.411
4	SK03	Stredné Slovensko	Slovenska Republika	1.054
5	PT16	Centro	Portugal	0.899
6	ES23	La Rioja	España	0.671
7	PT17	Lisboa	Portugal	0.584
8	RO11	NordVest	Romania	0.576
9	FR83	Corse	France	0.546
10	PL11	Lódzkie	Polska	0.528
		bottom regions		
261	UKG1	Herefordshire, Worcestershire and Warks	United Kingdom	-0.080
260	UKK4	Devon	United Kingdom	-0.081
263	UKL2	East Wales	United Kingdom	-0.083
265	PL33	Swietokrzyskie	Polska	-0.099
264	FI20	Åland	Suomi / Finland	-0.104
266	LT00	Lithuania	Lietuva	-0.151
267	FR92	Martinique	France	-0.164
268	LI00	Liechtenstein	Liechtenstein	-0.200
269	RO41	SudVest Oltenia	Romania	-0.200
270	PT30	Região Autónoma da Madeira	Portugal	-0.200



Map 26. Number of patents in high-technology fields, absolute value, average 1995-1997



Map 27. Number of patents in high-technology fields, absolute value, average 2005-2006



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(c) EuroGeographics Association for administrative boundaries
Source: CRENoS elaboration, 2010
Origin of data: OECD REGPAT database 2010
Regional level: NUTS 2

Legend

- no data
- 0.00 - 0.31
- 0.31 - 1.62
- 1.62 - 4.11
- 4.11 - 9.60
- 9.60 - 93.08

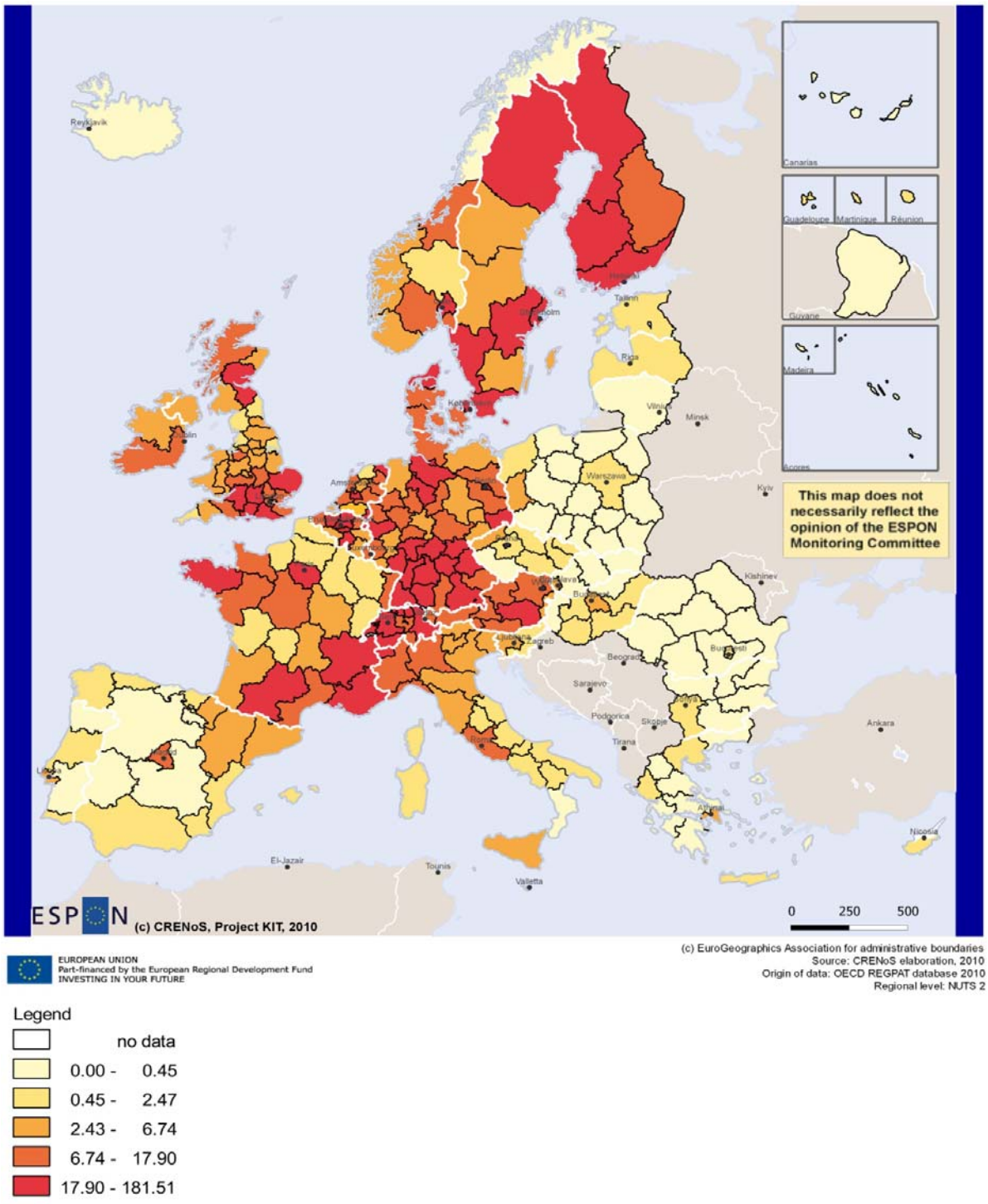
Map 28. Number of patents in high-technology fields per 1000 POP, average 1995-1997

Table 27. Number of patents in high-technology fields, 1995-1997, top and bottom regions

Position	Region code	Region name	Country	N. of patents
		top regions		
1	FR10	Île de France	France	393.52
2	DE21	Oberbayern	Deutschland	370.11
3	NL41	NoordBrabant	Nederland	205.31
4	FI18	EteläSuomi	Suomi / Finland	168.43
5	SE11	Stockholm	Sverige	160.35
6	DE11	Stuttgart	Deutschland	128.53
7	UKH1	East Anglia	United Kingdom	123.28
8	FR71	RhôneAlpes	France	110.29
9	ITC4	Lombardia	Italia	80.49
10	DE71	Darmstadt	Deutschland	77.83
		bottom regions		
278	BG31	Severozapaden	Bulgaria	0.00
279	BG33	Severoiztochen	Bulgaria	0.00
280	BG34	Yugoiztochen	Bulgaria	0.00
281	BG41	Yugozapaden	Bulgaria	0.00
282	BG42	Yuzhen tsentralen	Bulgaria	0.00
283	CY00	Cyprus	Kypros / Kibris	0.00
284	CZ04	Severozápad	Ceska Republika	0.00
285	CZ05	Severovýchod	Ceska Republika	0.00
286	CZ06	Jihovýchod	Ceska Republika	0.00
287	CZ07	Strední Morava	Ceska Republika	0.00

Table 28. Number of patents in high-technology fields, 2005-2006. top and bottom regions

Position	Region code	Region name	Country	N. of patents
		top regions		
1	FR10	Île de France	France	603.70
2	DE21	Oberbayern	Deutschland	443.51
3	NL41	NoordBrabant	Nederland	438.07
4	FI18	EteläSuomi	Suomi / Finland	334.60
5	DE11	Stuttgart	Deutschland	237.36
6	SE11	Stockholm	Sverige	219.77
7	FR71	RhôneAlpes	France	210.25
8	DEA2	Köln	Deutschland	183.76
9	FR52	Bretagne	France	176.03
10	DE71	Darmstadt	Deutschland	150.97
		bottom regions		
278	BG34	Yugoiztochen	Bulgaria	0.00
279	ES63	Ciudad Autónoma de Ceuta (ES)	España	0.00
280	ES64	Ciudad Autónoma de Melilla (ES)	España	0.00
281	GR11	Anatoliki Makedonia. Thraki	Ellada	0.00
282	GR13	Dytiki Makedonia	Ellada	0.00
283	GR14	Thessalia	Ellada	0.00
284	GR22	Ionia Nisia	Ellada	0.00
285	GR41	Voreio Aigaio	Ellada	0.00
286	GR42	Notio Aigaio	Ellada	0.00
287	IS00	Iceland	Ísland	0.00



Map 29. Number of patents in high-technology fields per 1000 POP, average 2005-2006

Table 29. Number of patents in high-technology fields per million population, 1995-1997, top and bottom regions

Position	Code	Region name	Country	Per capita patents
		top regions		
1	DE21	Oberbayern	Deutschland	93.08
2	SE11	Stockholm	Sverige	92.88
3	NL41	NoordBrabant	Nederland	89.65
4	FI1A	PohjoisSuomi	Suomi / Finland	81.00
5	FI18	EteläSuomi	Suomi / Finland	69.01
6	UKH1	East Anglia	United Kingdom	58.53
7	CH04	Zürich	Schweiz/Suisse/Svizzera	38.46
8	FR10	Île de France	France	36.17
9	SE22	Sydsverige	Sverige	35.05
10	DE11	Stuttgart	Deutschland	33.28
		bottom regions		
274	BG34	Yugoiztochen	Bulgaria	0.00
275	ES63	Ciudad Autónoma de Ceuta (ES)	España	0.00
276	ES64	Ciudad Autónoma de Melilla (ES)	España	0.00
277	GR11	Anatoliki Makedonia, Thraki	Ellada	0.00
278	GR13	Dytiki Makedonia	Ellada	0.00
279	GR14	Thessalia	Ellada	0.00
280	GR22	Ionia Nisia	Ellada	0.00
281	GR41	Voreio Aigaio	Ellada	0.00
282	GR42	Notio Aigaio	Ellada	0.00
283	IS00	Iceland	Ísland	0.00

Table 30. Number of patents in high-technology fields per million population, 2005-2006, top and bottom regions

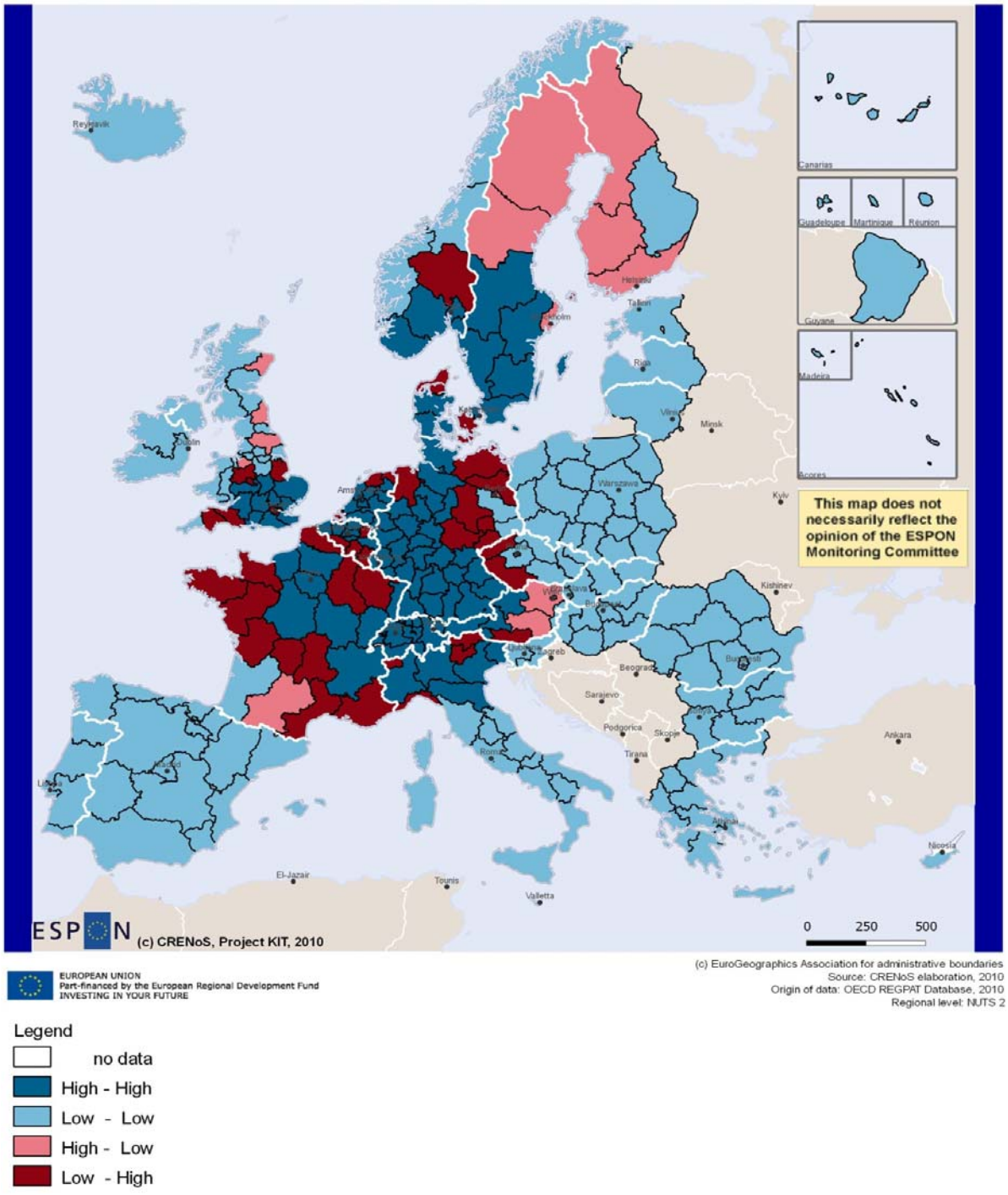
Position	Region code	Region name	Country	N. of patents per capita
		top regions		
1	NL41	NoordBrabant	Nederland	181.51
2	FI18	EteläSuomi	Suomi / Finland	129.27
3	SE11	Stockholm	Sverige	116.81
4	DE21	Oberbayern	Deutschland	104.98
5	FI1A	PohjoisSuomi	Suomi / Finland	99.77
6	FI19	LänsiSuomi	Suomi / Finland	93.98
7	SE22	Sydsverige	Sverige	90.04
8	DE25	Mittelfranken	Deutschland	82.45
9	DE23	Oberpfalz	Deutschland	80.17
10	CH04	Zürich	Schweiz/Suisse/Svizzera	65.32
		bottom regions		
278	PL22	Slaskie	Polska	0.00
279	BG34	Yugoiztochen	Bulgaria	0.00
280	ES63	Ciudad Autónoma de Ceuta	España	0.00
281	ES64	Ciudad Autónoma de Melilla	España	0.00
282	GR11	Anatoliki Makedonia, Thraki	Ellada	0.00
283	GR13	Dytiki Makedonia	Ellada	0.00
284	GR14	Thessalia	Ellada	0.00
285	GR22	Ionia Nisia	Ellada	0.00
286	GR41	Voreio Aigaio	Ellada	0.00
287	GR42	Notio Aigaio	Ellada	0.00

Table 31. Number of patents, coefficient of variation for selected samples

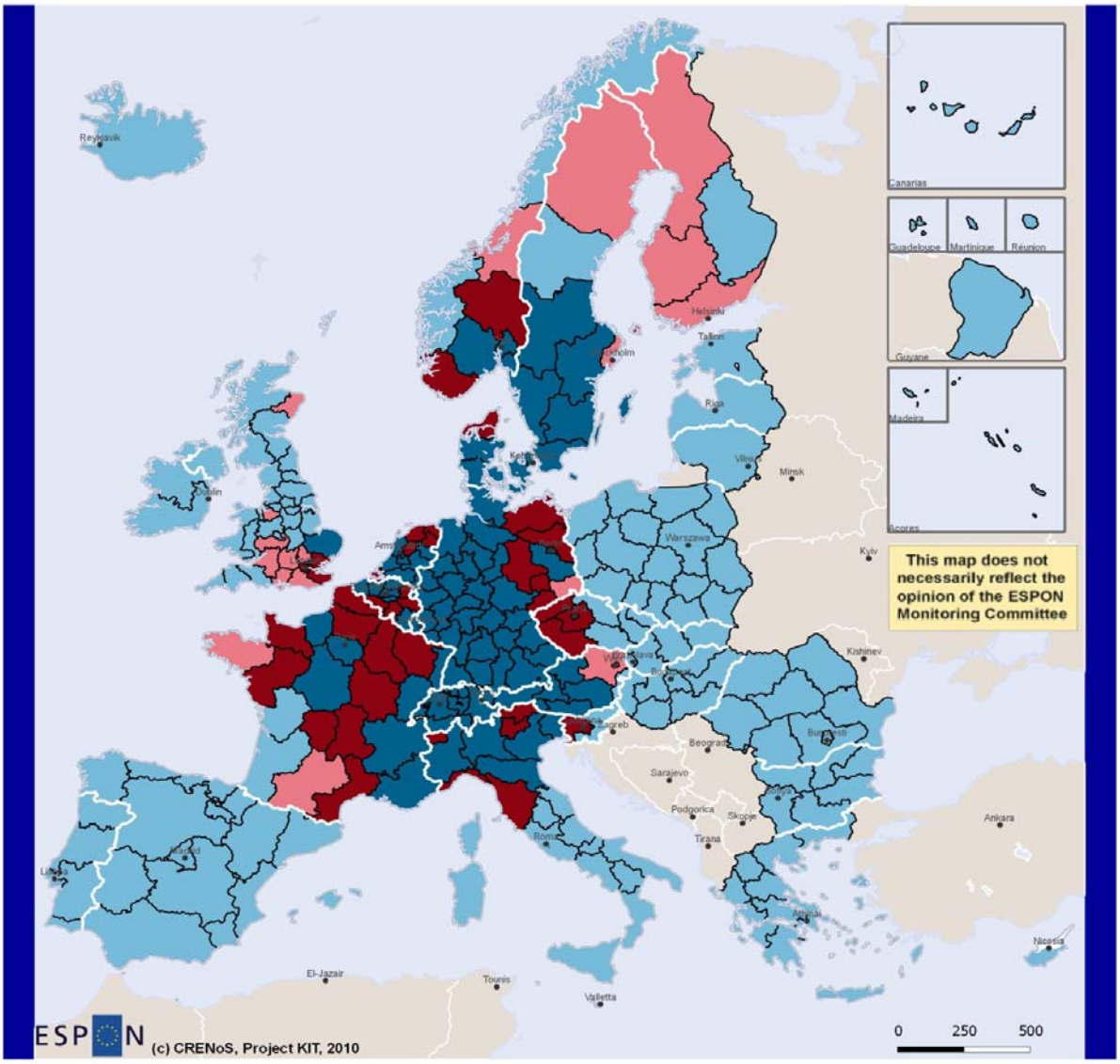
Total sectors		ESPON whole sample	Countries			EU Regions		
			EU 15	EU new entrants 12	EFTA 4	Convergence	Transition	Competitive
Absolute values	Average 1995-1997	2.0	1.8	2.3	1.1	2.4	1.5	1.5
	Average 2005-2006	1.9	1.7	1.7	1.1	2.0	1.2	1.4
Per 1000 population	Average 1995-1997	1.26	1.03	1.75	0.97	2.37	1.38	0.82
	Average 2005-2006	1.25	1.05	1.61	0.89	1.99	1.10	0.85
High-tech sectors								
Absolute values	Average 1995-1997	2.76	2.44	2.32	1.44	3.37	1.77	2.10
	Average 2005-2006	2.38	2.12	2.13	1.27	2.66	1.53	1.84
Per million population	Average 1995-1997	1.96	1.74	2.18	1.26	2.95	1.68	1.48
	Average 2005-2006	1.74	1.56	1.67	1.07	2.70	1.38	1.34

Table 32. Number of patents, Moran (standardized distance), whole sample

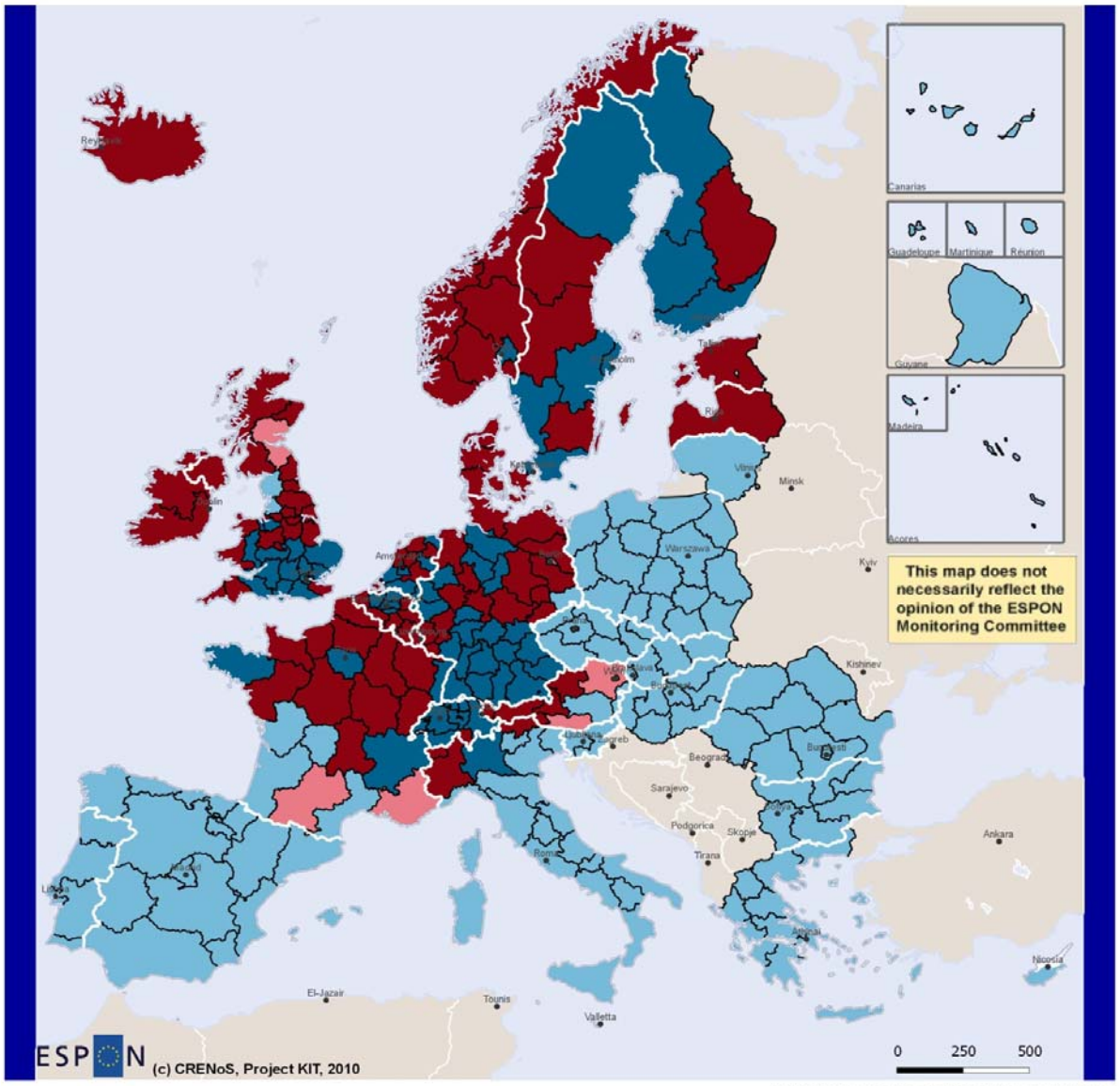
		I	z	pvalue*
Total sectors				
Absolute value	Average 1995-1997	0.064	13.643	0.000
	Average 2005-2006	0.068	14.381	0.000
Per 1000 population	Average 1995-1997	0.156	31.171	0.000
	Average 2005-2006	0.156	31.168	0.000
High-tech sectors				
Absolute value	Average 1995-1997	0.018	4.655	0.000
	Average 2005-2006	0.023	5.414	0.000
Per million population	Average 1995-1997	0.050	10.735	0.000
	Average 2005-2006	0.056	11.882	0.000



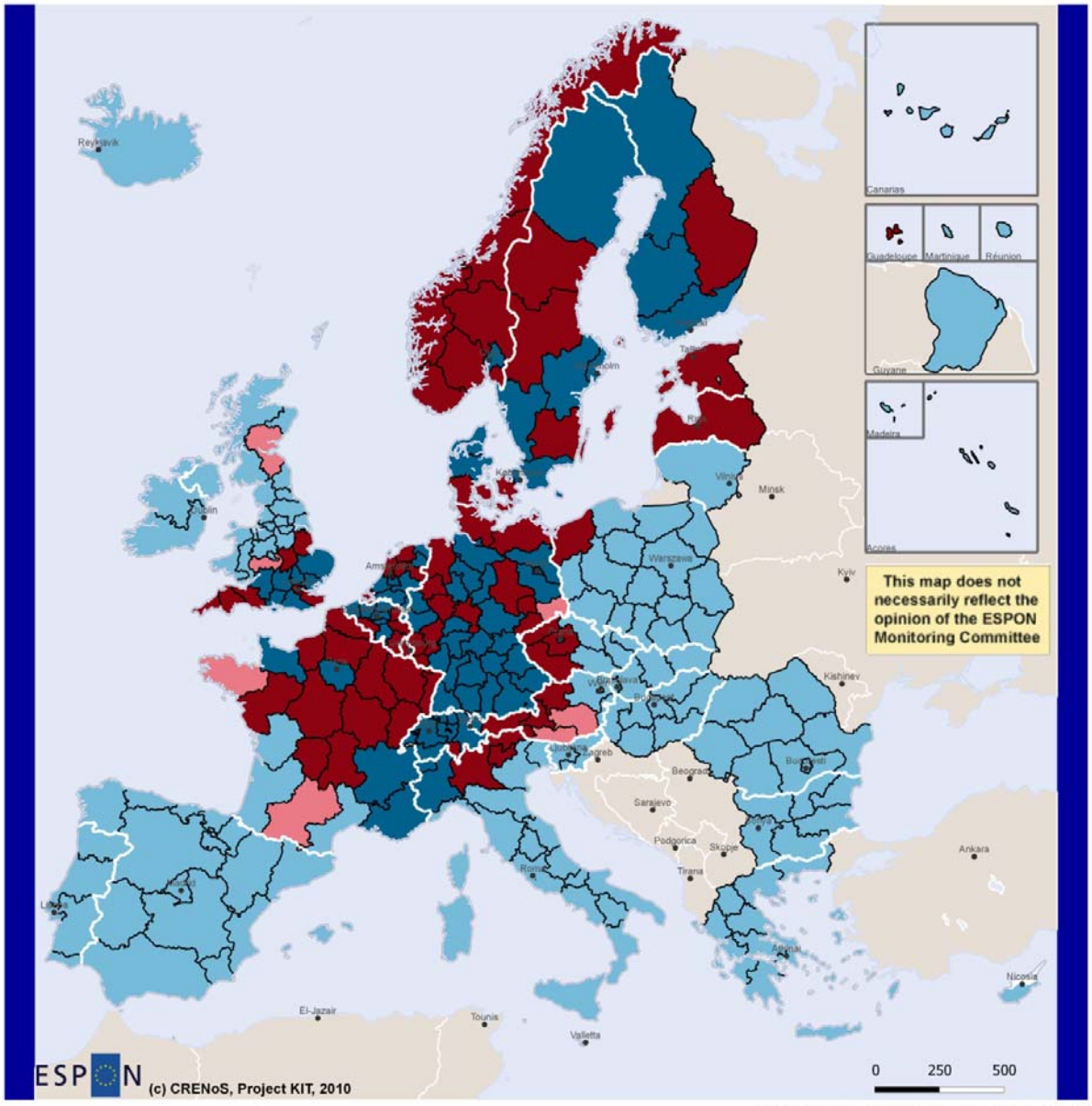
Map 30. Spatial association analysis, Number of patents per 1000 POP, 1995-1997



Map 31. Spatial association analysis, Number of patents per 1000 POP, 2005-2006



Map 32. Spatial association analysis, Number of patents in high-technology fields per 1000 POP, average 1995-1997



Map 33. Spatial association analysis, Number of patents in high-technology fields per 1000 POP, average 2005-2006

2.3 The scientific regions

2.3.1 Introduction

The functional approach emphasizes the importance of pervasive and horizontal functions like high education and innovation efforts and the role of this advanced functions in creating and diffusing knowledge is grounded in the economics of knowledge literature. Following this approach the definition of scientific regions is based on two fundamental pillars that are human capital and research activities. It is important to remark that these two elements are able to capture both the production of knowledge carried out within the region and the capacity of the local firm to absorb knowledge spilling from the external economies.

The aim of this section is to identify the subsample of scientific regions under the two main perspectives of research activities and human capital. We thus aim at selecting those regions which exhibit a value above the European average in terms of specialisation on both dimensions. This will allow us at developing a synthetic indicator that provide, first, a unique classification of European regions according to the functional approach and, second, the rankings of the regions according to their scientific innovative performance.

As described in Section 2.2, we measure the level of human capital stock in a region by means of the following indicators:

- the percentage of population employed in the education sector
- the share of population that has attained at least a university degree
- funding per capita in the activities of the 5th Framework Programmes

Similarly, the level of research activities is measured by:

- the R&D expenditures per capita
- the percentage of employees in R&D
- the number of patent per capita for all economic sectors
- the number of patent per capita for the subsample of high-tech sectors.

We have also tried with alternative indicators, or different combinations of them, to test for the robustness of our results. For instance, as an alternative to Employment in Education we have included Human Resources in Science and Technology, however the latter includes also graduates and thus it duplicates our indicator of Population with a university degree. Moreover we have tried to substitute R&D expenditure per capita with R&D expenditure as % of GDP. In general, changes in the composition of the indicators used to define our synthetic measure do not modify significantly the classification and ranking of the Scientific Regions presented in this section.

2.3.2 Describing scientific regions

We develop two synthetic measures by standardizing all simple indicators around the European average imposed equal to zero and by constraining the distribution within the range -1 and 1. Following the methodology used in the Community innovation scoreboard, re-scaled values are calculated by first subtracting the minimum sample value and then dividing by the difference between the maximum and minimum value. The maximum re-scaled value is thus equal to 1 and the minimum re-scaled score is equal to -1. For positive and negative outliers and small countries where the value of the relative value is above the maximum score or below the minimum score, the re-scaled value is thus set equal to 1 respectively -1. [2] In this way we have no longer the problem of different unit of measurement (and this allows us to add the various indicators) and we solve the problem of outliers.

[2] Re-scaled value = $[(xi)- \min(x_{1\text{-}n})]/(\max(x_{1\text{-}n})-\min(x_{1\text{-}n})$. For more info see "European Innovation Scoreboard 2009"

We construct the two synthetic measures by imposing the same weight to each simple indicator: 1/3 for each human capital indicator and 1/4 for each research activity indicator.[3] In Table 33 we present indicators used to develop the synthetic indicators.

We detect *Scientific regions* as a subsample of the total number of European regions showing for both indicators values greater than zero. Regions showing values greater than zero for human capital indicator but less than zero for research activity are labelled *Human capital intensive regions*. On the contrary, regions characterized by values greater than zero for research activity and less than zero for the human capital indicator are indicated as *Research intensive regions*. Finally, regions showing values less than zero for both indicators are defined as *Regions with no specialisations in knowledge activities*. In Figure 1 we can see this classification. Notice that we measure human capital on the x axis and research activity on the y axis.

In Figure 2 we present the scatter of regions with respect the two dimensions of human capital and research activity. We can observe 74 Scientific regions, 30 Research Intensive regions and 52 Human capital Intensive regions. But most of regions, 126, are concentrated on the third quadrant where we identify regions with no specialisation in knowledge activities.

In order to classify territories with respect to a single dimension, we build a synthetic indicator as the sum of the human capital and research activity composite indicators. In Table 34 we can observe the ranking for the 74 Scientific Regions related the value of this synthetic indicator, that is shown in the third and sixth column. In the highest part of the ranking, Scandinavian countries are largely represented and if we look at the whole sample of Scientific Regions we can observe that most of regions that make up these countries are indicated: for Denmark 3 out of 5, for Finland 4 out of 5, for Norway 4 out of 7 and for Sweden 5 out of 8. Furthermore notice that are listed all the Swiss regions and most part of Belgian regions. Among Scientific regions there are also 12 (out of 39) German regions, 6 regions belonging to Netherlands and 14 (out of 37) British regions. Moreover there are regions where important administrative towns are located: the Wien region for Austria, Praha for Czech republic, Madrid and Paris regions.

Map 34 shows the spatial distributions of the four categories of regions and we can observe that Scientific regions are concentrated on the centre and on the north of Europe. Among the 74 Scientific regions there are 59 regions belonging to EU 15 countries, 3 belonging to New Entrants countries and 12 belonging to Efta countries. Moreover, 58 are competitive regions, 3 are convergence regions and only one is a transition region.

Regions with no specialization in knowledge activities are mainly located on the peripheral territories of Europe and Research Intensive regions are concentrated on territories characterized by a manufacturing productive specialization (i.e. Northern Italy, German regions). Finally, as expected Human capital Intensive regions are mainly on the north.

[3] Since the choice of the weights is arbitrary, we have done extensive simulations with different weights structures, but the classification of the scientific regions remains quite stable. Therefore we have preferred to adopt a distribution with equal weights.

Table 33. Description of indicators used for synthetic indicators

Pillar	Variable	Description	Measurement unit	Primary Source	Years considered	Weights
1. Human Capital	**Tertiary Education**	Percentage of people with ISCED 5-6	Percentage	Eurostat	2005-2007	1/3
	Employment in Education	Number of employees in education per 1000 population	Employees per 1000 population	Eurostat	2005-2007	1/3
	5th Framework Programme	Funding per 1000 population	Thousands of Euro per 1000 populaion	CORDIS	1998-2002	1/3
2. Research activity	**R&D expenditure**	Expenditure per 1000 population	Millions of Euro per 1000 population	Eurostat	2006-2007	1/4
	R&D employment	Percentage of employment in R&D sectors over total employment	Percentage	Eurostat	2006-2007	1/4
	Patent	Number of patents per 1000 population	Patents per 1000 POP	CRENoS database	1995-2006	1/4
	High Tech patent	Number of patents per million population in High tech IPC sectors	Patents High-Tech per million POP	CRENoS database	1995-2006	1/4

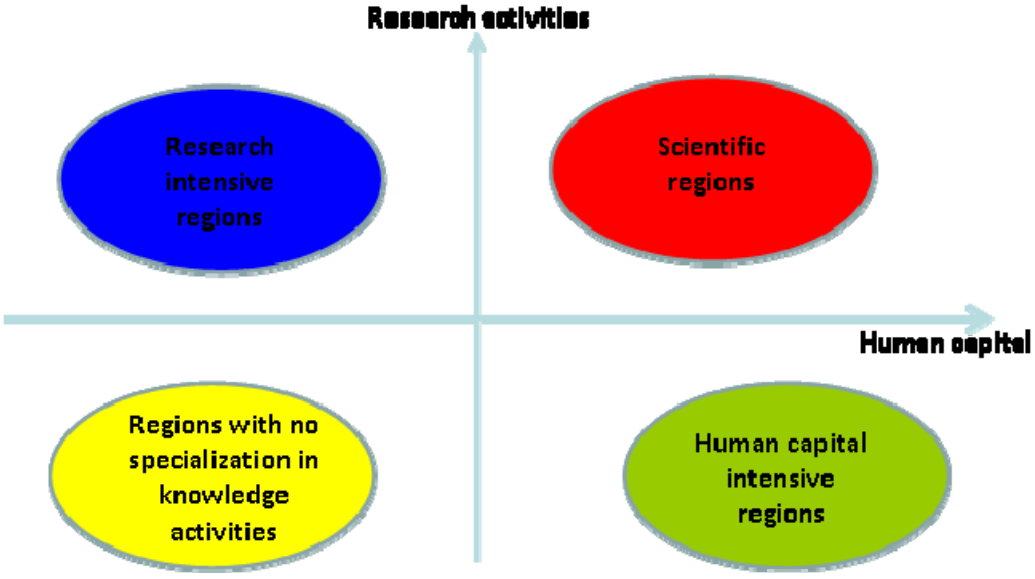


Figure 1. The functional approach: a typology of scientific regions

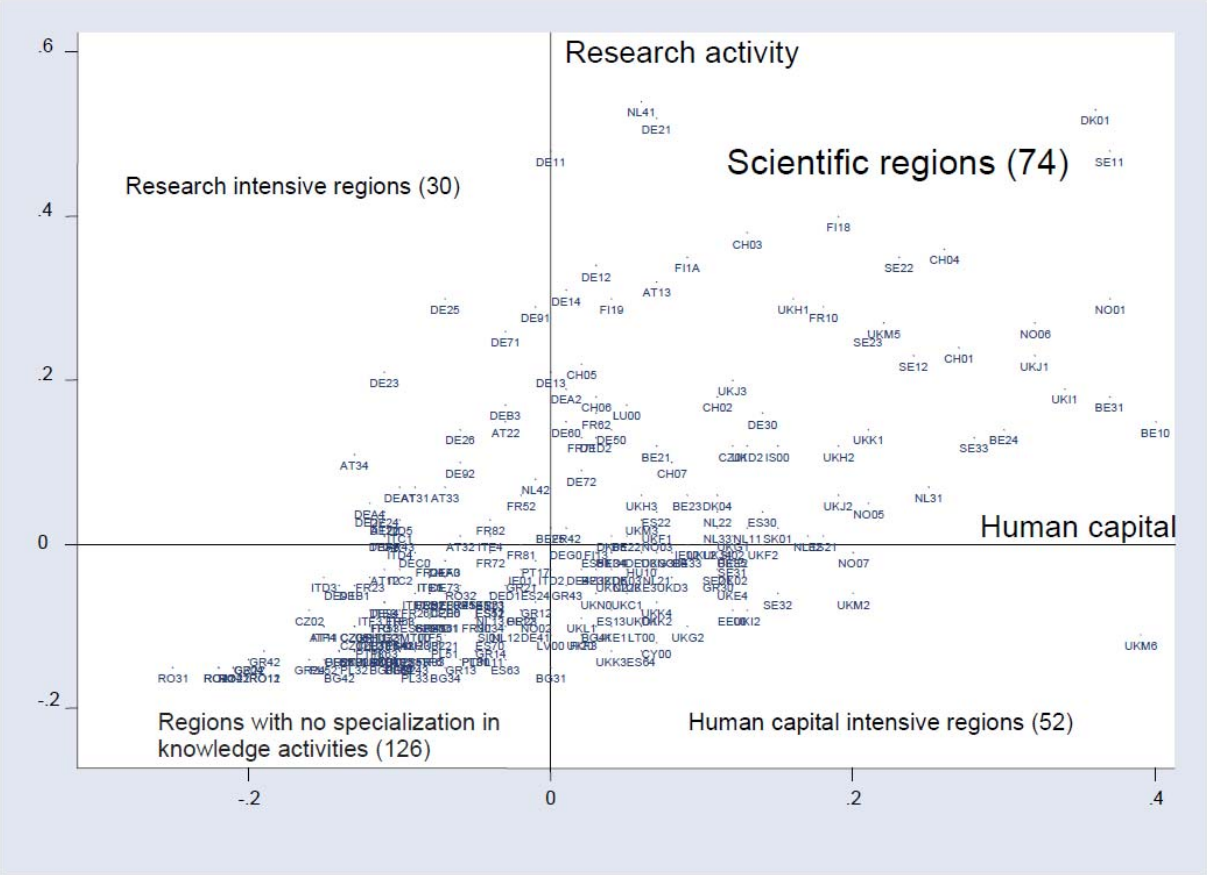
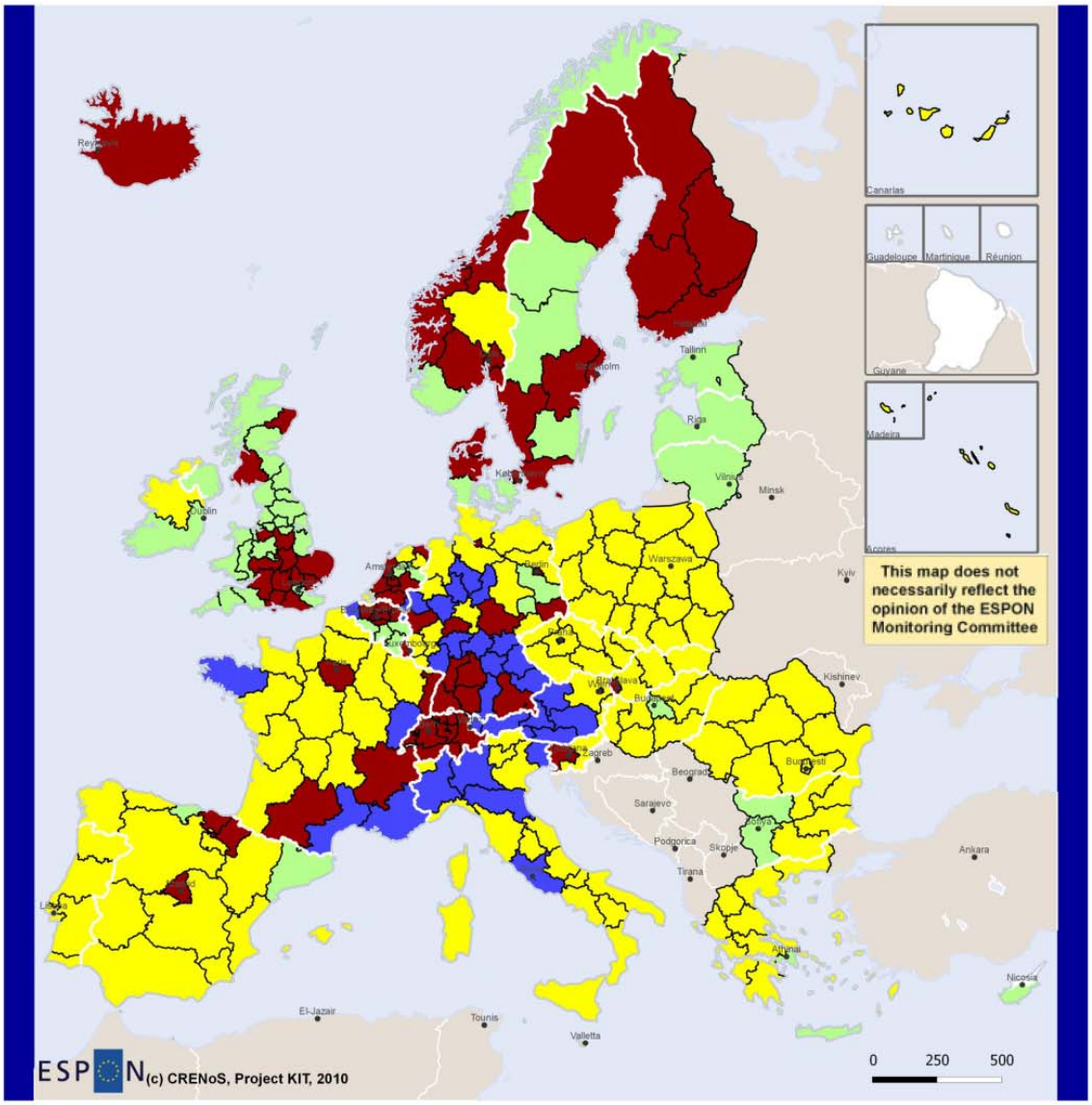


Figure 2. The typology of scientific regions in Europe

Table 34. Ranking of Scientific Regions

Code	Region Name	Synt Ind	Code	Region Name	Synt Ind
DK01	Hovedstaden	0.89	UKD2	Cheshire	0.25
SE11	Stockholm	0.85	CZ01	Praha	0.25
NO01	Oslo og Akershus	0.67	CH05	Ostschweiz	0.25
CH04	Zürich	0.62	LU00	Luxembourg	0.22
NL41	Noord Brabant	0.59	CH06	Zentralschweiz	0.22
NO06	Trøndelag	0.59	DE13	Freiburg	0.21
FI18	Etelä Suomi	0.59	BE21	Prov. Antwerpen	0.20
SE22	Sydsverige	0.58	ES21	Pais Vasco	0.19
DE21	Oberbayern	0.58	DEA2	Köln	0.19
BE31	Brabant Wallon	0.55	FR62	Midi Pyrénées	0.19
UKJ1	Berkshire, Bucks, Oxfordshire	0.55	ES30	Comunidad de Madrid	0.18
BE10	Région de Bruxelles	0.55	CH07	Ticino	0.18
UKI1	Inner London	0.53	DK04	Midtjylland	0.18
CH03	Nordwestschweiz	0.51	DE50	Bremen	0.17
CH01	Région lémanique	0.51	SK01	Bratislavský kraj	0.17
UKM5	North Eastern Scotland	0.49	NL32	Noord Holland	0.17
DE11	Stuttgart	0.48	DED2	Dresden	0.17
SE23	Västsverige	0.47	DE60	Hamburg	0.16
SE12	Östra Mellansverige	0.47	FR71	Rhône Alpes	0.16
UKH1	East Anglia	0.47	BE23	Prov. Oost Vlaanderen	0.16
FR10	Île de France	0.47	NL11	Groningen	0.15
BE24	Prov. Vlaams Brabant	0.45	UKF2	Leicestershire, Rutland, Northants	0.15
FI1A	Pohjois Suomi	0.45	NL22	Gelderland	0.14
SE33	Övre Norrland	0.41	NL33	Zuid Holland	0.13
AT13	Wien	0.39	SI02	Zahodna Slovenija	0.13
DE12	Karlsruhe	0.36	UKH3	Essex	0.12
UKK1	Gloucestershire, Wiltshire, Bristol	0.35	UKG1	Herefordshire, Worcestershire, Warks	0.12
FI19	Länsi Suomi	0.34	DE72	Gießen	0.12
NL31	Utrecht	0.32	ES22	Comunidad Foral de Navarra	0.12
DE14	Tübingen	0.32	UKF1	Derbyshire and Nottinghamshire	0.09
UKJ3	Hampshire and Isle of Wight	0.32	UKM3	South Western Scotland	0.09
UKH2	Bedfordshire, Hertfordshire	0.31	NO03	SørØstlandet	0.07
DE30	Berlin	0.30	BE22	Prov. Limburg	0.06
CH02	Espace Mittelland	0.29	DK05	Nordjylland	0.05
IS00	Iceland	0.27	FI13	Itä Suomi	0.03
NO05	Vestlandet	0.26	FR42	Alsace	0.03
UKJ2	Surrey, East, West Sussex	0.25	DEG0	Thüringen	0.01



Map 34. Spatial distribution of scientific regions in Europe

2.3 Typologies of scientific regions

To better describe the subsample of regions, in Table 35 we can observe which group they belong from a political point of view.

Among the 74 Scientific regions, 59 belong to EU 15 countries but there are also 3 regions belonging to New Entrants countries and 12 (over 15) Efta regions. Furthermore, most part of regions belong to the group of Competitive'. Human capital intensive regions are distributed among the different groups and the same happens for the regions with other specialisation than R&D. Contrary, Research Intensive regions are concentrated in two groups: EU 15 countries and Competitive regions.

In Table 36 we show some descriptive statistics for variables used to develop the synthetic indicator and, as we could expect, the highest average values are shown by the sample of scientific regions.

Table 35 Typology of regions

	Total	EU15	New Entrants	Efta	Convergence	Transition	Competitive
Scientific regions	74	59	3	12	3	1	58
Human capital intensive regions	52	43	7	2	8	10	32
Reserach Intensive regions	30	30	0	0	0	0	30
Regions with other specialisations than RD	126	79	46	1	69	18	39

Table 36. Descriptive statistics

	Scientific regions						
	Tertiary edu	**Empl edu**	**VFP Fund**	**Patents**	**Patents HT**	**Exp RD**	**Pers RD**
Average	16.92	0.04	49.28	0.22	34.00	1.01	2.56
Median	15.96	0.04	42.55	0.16	26.55	0.91	2.27
Min	11.95	0.02	4.79	0.00	0.00	0.19	1.16
Max	26.06	0.06	207.83	0.73	181.51	2.63	5.71
St. deviation	3.32	0.01	33.74	0.16	33.06	0.49	0.95
Coefficient variation	0.20	0.22	0.68	0.73	0.97	0.49	0.37
	Human capital intensive regions						
	Tertiary edu	**Empl edu**	**VFP Fund**	**Patents**	**Patents HT**	**Exp RD**	**Pers RD**
Average	14.83	0.04	20.68	0.06	5.08	0.28	1.21
Median	13.97	0.04	16.80	0.05	3.95	0.26	1.25
Min	10.39	0.03	0.00	0.00	0.00	0.00	0.18
Max	33.19	0.05	78.28	0.14	21.51	0.72	2.29
St. deviation	3.43	0.01	15.90	0.04	4.70	0.17	0.53
Coefficient variation	0.23	0.18	0.77	0.64	0.93	0.61	0.43
	Research Intensive regions						
	Tertiary edu	**Empl edu**	**VFP Fund**	**Patents**	**Patents HT**	**Exp RD**	**Pers RD**
Average	10.67	0.03	19.64	0.22	21.96	0.60	1.77
Median	10.48	0.03	18.32	0.19	16.76	0.51	1.68
Min	6.76	0.02	0.54	0.04	1.98	0.12	0.84
Max	15.41	0.03	51.49	0.49	82.45	1.92	4.06
St. deviation	2.26	0.00	11.84	0.12	19.92	0.34	0.60
Coefficient variation	0.21	0.10	0.60	0.55	0.91	0.56	0.34
	Regions with other specialisations than R&D						
	Tertiary edu	**Empl edu**	**VFP Fund**	**Patents**	**Patents HT**	**Exp RD**	**Pers RD**
Average	9.23	0.03	7.60	0.03	2.57	0.13	0.86
Median	8.65	0.03	5.73	0.01	0.80	0.11	0.81
Min	4.09	0.02	0.00	0.00	0.00	0.00	0.19
Max	17.98	0.04	46.52	0.19	41.16	0.45	2.50
St. deviation	3.09	0.00	8.46	0.04	4.95	0.11	0.44
Coefficient variation	0.34	0.16	1.11	1.37	1.93	0.82	0.51

Notice: **Unit of measurement** - **Tertiary edu**: % population; **Empl edu**: per capita (1000 population); **VFP Fund**: 1000 Euro/1000 population; **Patents**: per capita (1000 population); **Patents HT**: per capita (Million population); **Exp RD**: Million Euro/1000 population; **Pers RD**: % total employment.

Annexes: Dataset construction

Population with ISCED 5 or 6 degree, 2005-2007

Population aged 15 and over by ISCED level of education attained

Source:

All European data collected from Eurostat

- Liechtenstein data missing.
- Germany: DEE0 data available only for 2007.
- Denmark: data at NUTS2 level available only for 2007.
- France: FR91, FR92, FR93 and FR94 data available only for 2007.

Fifth Framework Programme 1998-2002

Sources:

All data collected from CORDIS

Employment in technology and knowledge-intensive sectors, 2005-2007

Employment in technology and knowledge-intensive sectors in Head Count.

Source: All data collected from Eurostat.

- Data for French overseas regions (FR91, FR92, FR93, FR94) missing.
- Data for Liechtenstein missing.

RD Expenditures, 2006-2007

Total intramural R&D expenditure

Sources:

All European data collected from Eurostat except for:

French data for 2006 collected from *Institut National de la Statistique et des Études Économiques.*

Italian data for 2006 and 2007 collected from *Istituto Nazionale di Statistica (ISTAT)*.

Greece and Netherlands 2006 data:

http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/RY_CH08_2009/EN/RY_CH08_2009-EN.XLS

- Belgium data at NUTS1 level
- Switzerland data at NUTS0 level
- France: FR91, FR92, FR93 and FR94 data missing
- Liechtenstein data missing

Elaborations:

a. Belgium:

1. Elaboration of the NUTS2 share of patents for years 2006 and 2007 (starting from NUTS1 patent data)

2. Application of the NUTS2 share of patents to compute the respective share of RD expenditures for each NUTS1 region. The elaboration output is the NUTS2 RD expenditures.

b. Switzerland:

1. Elaboration of the NUTS2 share of patents for years 2004 (starting from NUTS0 patent data)

2. Application of the NUTS2 share of patents to compute the respective share of RD expenditures for each NUTS2 region. The elaboration output is the NUTS2 RD expenditures.

3. Elaboration of the Patent rate of change at NUTS2 level from year 2004 to year 2006.

4. Application of the Patent rate of change to the previous elaboration of 2004 RD expenditures in order to compute the RD expenditures data for 2006.

c. Greece and Netherlands:

1. Starting data refer to Eurostat Regional Innovation data, RD expenditures percentage of GDP 2006.

2. Application of the RD expenditures percentage of GDP 2006 at NUTS2 level to GDP 2006 NUTS2 level data, in order to compute the amount of RD expenditures per NUTS2 level.

d. Germany: DE22 and DE23

1. Elaboration of the NUTS2 share of RD for years 1997, applied from NUTS1 data (DE2).

2. Application of the NUTS2 share of RD for NUTS1 2007 RD (DE2) to compute the respective share of RD expenditures.

RD Personnel, 2006-2007

Total R&D personnel and researchers

Sources:

All European data collected from Eurostat, except for:

1. French data collected from *Institut National de la Statistique et des Études Économiques*. Data refer to Personnel in Research and Development in Full Time Equivalent. Head count data for previous years collected from EUROSTAT.
2. Italian data collected from *Istituto Nazionale di Statistica (ISTAT)*. Data refer to Personnel in Research and Development in Full Time Equivalent. Head count data for previous years collected from EUROSTAT
    - Belgium: data at NUTS1 level
    - Switzerland: data at NUTS0 level
    - Germany: DE22 and DE23 data missing
    - France: FR91, FR92, FR93 and FR94 data missing
    - FR82 data refer to year 2003
    - Liechtenstein: data missing

Elaborations:

a. French and Italian data:

1. Elaboration of the yearly rate of change in RD employment in FTE from year 2004 to 2007 (France) and from year 2005 to 2007 (Italy)

2. Application of the FTE rate of change to Head Count data (Eurostat data), in order to compute the RD personnel head count data for the respective years (France 2004-2007, Italy 2005-2007).

3. Elaboration of the percentage of RD personnel by dividing RD employment in Head count for Total Employment in Head Count (source Eurostat).

b. Brandenburg - Nordost (DE41); Brandenburg - Südwest (DE42) (Germany)

1. Elaboration of the rate of change in RD expenditures from year 2003 to 2005 and from 2005 to 2007.

2. Application of the rate of change in RD expenditures to the RD employment (Head Count)

3. Elaboration of the percentage of RD personnel by dividing RD employment in Head count for Total Employment in Head Count (source Eurostat).

c. Greece

1. Elaboration of the rate of change in RD expenditures from year 2005 to 2006.

2. Application of the rate of change in RD expenditures to the RD employment (Head Count) in order to compute the RD personnel data.

3. Elaboration of the percentage of RD personnel by dividing RD employment in Head count for Total Employment in Head Count (source Eurostat).

d. Netherlands

1. Elaboration of the rate of change in RD expenditures from year 2003 to 2006.

2. Application of the rate of change in RD expenditures to the RD employment (Head Count) in order to compute the RD personnel data.

3. Elaboration of the percentage of RD personnel by dividing RD employment in Head count for Total Employment in Head Count (source Eurostat).

e. Switzerland

1. Elaboration of the rate of change in RD expenditures from year 2004 to 2006.

2. Application of the rate of change in RD expenditures to the RD employment (Head Count) in order to compute the RD personnel data.

3. Elaboration of the percentage of RD personnel by dividing RD employment in Head count for Total Employment in Head Count (source Eurostat).

f. Germany: DE22 and DE23

1. Elaboration of the NUTS2 share of RD personnel with respect to total employment distribution for year 2007.

2. Application of the NUTS2 2007 share of RD personnel for NUTS2 2007 employment to compute the respective share of RD personnel.

Number of patents 1998-2006

Number of Patents awarded at NUTS2 level

Sources:

All data collected from the OECD REGPAT database

Patent applications published at EPO in high-technology fields, 1995-2006

Number of Patents awarded at NUTS2 level in high-technology fields

Sources:

All data from OECD-REGPAT database, January 2010.

Patents are regionalised on the basis of inventors' residence. In case of multiple inventors a fraction was attributed.

For further details: Eurostat Statistical books "Science, technology and innovation in Europe-2010 Edition".

The definition and the IPC codes used can be found in the methodological notes.

GDP

Gross domestic product (GDP) at current market prices at NUTS level 2

Source:

All European data collected from Eurostat

- Switzerland data at NUTS0 level.
- Norway data for 2006 and 2007 at NUTS0 level.

Elaborations:

a. Switzerland:

1. elaboration of the population share at NUTS2 level.

2. application of the NUTS2 share of population to NUTS0 GDP data in order to compute NUTS2 GDP data.

b. Norway:

1. elaboration of the 2004 GDP share at NUTS2 level.

2. application of the 2004 GDP share at NUTS2 level to 2006 and 2007 NUTS0 GDP data, in order to compute the 2006 and 2007 NUTS2 GDP data.

Population, 1990-2007

Resident population at NUTS level 2

Source:

All European data collected from Eurostat

- DE4 data from 1990 to 1994 and year 2000 at NUTS1 level
- DED data from 1990 to 1994 at NUTS1 level
- DK data from 1990 to 2006 at NUTS0 level
- ES63 and ES64 data from 1990 to 1991 at NUTS1 level
- IE data from 1990 to 1996 at NUTS0 level
- PT16, PT17 and PT18 data for 1991 at NUTS1 level
- SK data from 1990 to 1995 at NUTS0 level
- UKI data from 1990 to 1991 at NUTS1 level
- UKK3 and UKK4 data from 1990 to 1991 at NUTS1 level
- UKL data from 1990 to 1991 at NUTS1 level
- UKM data from 1990 to 1992 at NUTS1 level

Elaborations:

for all NUTS level 0 and 1:

1. elaboration of the shares of population at NUTS2 level from the closer data available.

2. application of the NUTS2 share of population to the NUTS1 or NUTS0 level in order to compute the NUTS2 level data.

Employment, 2005-2007

Total employment in Head Count

Source: All European data collected from Eurostat

ELABORATIONS

Legend:

- RD_E: Research and Development Expenditures
- RD_P: Research and Development Personnel
- HK: Population with ISCED 5 or 6 degree
- PAT: Patents
- PAT_ht: Patents in High Technology sectors
- 5FP: 5th Framework Programme
- 5FP_F: 5th Framework Programme Funding
- 5FP_P: 5th Framework Programme Participations
- POP: population
- EMP: employment
- EMP_ht: Employment in High Technology sectors
- i: project
- j: region
- TFi: total funding per single project

Percentage of people with ISCED 5-6

Percentage of population aged 15 and over by highest level of education attained over total population

$$\text{Elaboration} = \left(\frac{\text{HK}}{\text{POP}} \right) * 100$$

5th Framework Programme, number of participations

Number of public or private institutions in region j participating in the 5th FP

5th Framework Programme, funding

Funding (estimated) received by the participants for project i summed up by region j.

$$\text{Elaboration} = \sum_j \left(\frac{\text{TF}_\text{i}}{\text{5FP\_P}_\text{i}} \right) * \text{5FP\_P}_{\text{ij}}$$

5th Framework Programme, funding per 1000 POP

Funding over POP divided by 1000

$$\text{Elaboration} = \frac{5FP\_F}{\left(\frac{POP}{1000}\right)}$$

Research and Development Expenditure per 1000 POP

Millions of Euro spent per RD activities over POP divided per 1000

$$\text{Elaboration} = \frac{RD\_E}{\frac{POP}{1000}}$$

Research and Development Expenditure, percentage of GDP

Millions of Euro spent per RD activities over GDP

$$\text{Elaboration} = \left(\frac{RD\_E}{GDP}\right) * 100$$

Research and Development Personnel, percentage of Employment

Head Count Employment in Research and Development activities over Employment

$$\text{Elaboration} = \left(\frac{RD\_P}{EMP}\right) * 100$$

Number of Patents per 1000 POP

Number of Patents released over POP divided by 1000

$$\text{Elaboration} = \frac{PAT}{\frac{POP}{1000}}$$

Number of Patents, yearly rate of change

Yearly rate of change in the number of patents

$$\text{Elaboration} = \frac{\left(\frac{(PATt - PATt\text{-}n)}{PATt\text{-}n}\right)}{n}$$

Patent applications published at EPO in high-technology fields per thousand population, 1995-2006

Data for French overseas regions (FR91, FR92, FR93, FR94) for the 1995-1997 period missing.

Elaborations:

Number of Patents released in high-technology fields over POP divided by 1,000

$$\text{Elaboration} = \frac{PAT\_ht}{\left(\frac{POP}{1000}\right)}$$

Patent applications published at EPO in high-technology fields per million population, 1995-2006

Data for French overseas regions (FR91, FR92, FR93, FR94) for the 1995-1997 period missing.

Elaborations:

Number of Patents released in high-technology fields over POP divided by 1,000,000

$$\text{Elaboration} = \frac{PAT\_ht}{\left(\frac{POP}{1000000}\right)}$$

Percentage of population employed in technology and knowledge-intensive sectors, 2005-2007

Data for French overseas regions (FR91, FR92, FR93, FR94) missing.

Data for Liechtenstein missing.

Elaborations:

Number of people employed in technology and knowledge-intensive sectors divided by population, per 100.

$$\text{Elaboration} = \left(\frac{EMP\_ht}{POP}\right) * 100$$

3. Networking regions

3.1 Summary of variables, sources and years available

In this Section of the Scientific Report we provide a description of all the indicators used in the relational approach to the knowledge economy. In this relational approach, we analyse knowledge transfers taking into account interactions at cross-regional level. Such transfers are not easy to trace but can be approximated in several ways.

As for the *spatial linkages*, we have used some of the variables given in the scientific approach although computed for the case of the neighbouring regions. Specifically, the variables considered are the following:

- R&D expenditures in the first order neighbouring regions (R&D expenditures weighted by a row-standardized 1st order contiguity matrix). In other words, what we obtain is the average value of R&D expenditures in the neighbouring regions (understanding "neighbouring" as the regions which share a common border with the region under consideration).
- Patent applications in the first order neighbouring regions (patent applications weighted by a row-standardized 1st order contiguity matrix): average value of patent applications in the neighbouring regions
- Framework Program participation and budgets in the first order neighbouring regions (Framework Program participation and budgets weighted by a row-standardized 1st order contiguity matrix): average value of Framework Program participation and budgets in the neighbouring regions.

The sources of the data can be found in Table A1.1 and have been explained in detail in the scientific approach.

As for the *a-spatial linkages*, we have focused on certain mechanisms of knowledge transmission through formal agreements. The idea here is to fully exploit the information contained in the patent database by building several matrices which are meant to provide different perspectives with respect to flows of knowledge across regions. Specifically, three variables are used:

- Co-patents with other ESPON regions: number of patents co-authored with inventors from outside the region.
- Inflows: number of inflows of inventors coming from other regions (from where they bring knowledge, brain gain).
- Cross-regional patent citations: number of citations made to patents of other regions. In spite of the advantages of citations as being a straightforward measure of knowledge flows, it could be argued that they represent the output of any form of knowledge transmission, instead of the exact mechanisms through which knowledge is transferred.

In the three cases, the data source is the OECD REGPAT database (see Table A1.1 for a detailed description of the three variables). In spite of the vast amount of information contained in patent documents, a single ID for each inventor and anyone else is missing. However, in order to draw the networking history of inventors, it is necessary to identify them individually by name and surname, as well as via the other useful details contained in the patent document. Thus, here, the methodology proposed by Miguélez and Miguélez (2010) is followed, who, in line with a growing number of researchers in the field, suggest several algorithms for singling out individual inventors using patent documents. By looking at the names that appear in the patent documents relating to their inventions, our approach is divided in two stages: first name matching algorithms are used in order to group possible similar names, and then an algorithm is designed to establish computationally whether inventors with the same or similar names are actually the same person, on the basis of features reported in the patent document – self-citations, the applicant, the region from where the inventor makes the application, or its technological class.

Data on co-patenting describe the relationship among multiple inventors of the same patent within the European regions. Thus, when one patent contains inventors reporting their addresses

in different regions, we assume that there exist cross-regional collaborations. We 'full-count' all the collaborations across regions, irrespective of the number of inventors reported in each patent. For each patent with multiple inventors all possible pairs of regions ij were created: each region is coupled with all the other regions in the patent by referring to the residence of inventors. This implies that single inventor patents are not included in our computation. For the moment being, we will not consider the information in the main diagonal, which accounts the relationships among inventors in the same region for the same patent.

Data on inflows reflect the number of inflows of inventors coming from other regions. A "mobile" inventor is broadly defined as an individual that moves across different organisations offering his/her services. Therefore, mobility can refer either to labour mobility understood in its strictest sense (an employee leaving a firm to take up a position in a new one), or to that demonstrated by consultants, freelance workers, university inventors, and the like. We assume both to constitute sources of knowledge flows to the extent that in the two instances knowledge is transferred from their former employers or customers to new ones. We are interested in the areas which attract talented personnel, and so we consider the sum of the number of inventors in each combination of region and year who already applied for patents from another region in a previous year (inflows of inventors).

Data on patent citations refer to citations made by each region to patents from other regions.

A summary of the list of indicators, their measurement units, their description, the sources of data as well as the years available can be found in Table 37.

Table 37. Information on the indicators used for the definition of Knowledge Networking regions

Variable	Description	Measurement unit	Sources	Years available
INDICATORS FOR THE SPATIAL LINKAGES				
R&D expenditure in the neighbouring regions	Average value of the millions of Euro spent in RD activities in the first-order neighbouring regions	Millions of Euros	CRENoS elaboration on Eurostat, ISTAT and Institut National de la Statistique et des Études Économiques	2006-2007
R&D exp. as % of GDP in the neighbouring regions	Average value of the millions of Euro spent in RD activities over GDP in the first-order neighbouring regions	Percentage		
R&D exp. per 1000 population in the neighbouring regions	Average value of the millions of Euro spent in RD activities over Population divided by 1000 in the first-order neighbouring regions	Millions of Euros per 1000 population		
Patent activity in the neighbouring regions	Average number of patents released in the first-order neighbouring regions	Absolute value	CRENoS elaboration on OECD REGPAT database	1995-1997 2005-2006
Patent activity per capita in the neighbouring regions	Average number of patents released over population divided by 1000 in the first-order neighbouring regions	Number of patents per 1000 population		
FP participants in the neighbouring regions	Average number of active projects in the 5th Framework Programme in the first-order neighbouring regions	Units	CRENos elaboration on CORDIS data	1998-2002
FP funding in the neighbouring regions	Average funding received by the 5th Farmework Programme projects in the first order neighbours	Millions of Euros		
FP funding per capita in the neighbouring regions	Average funding received by the 5th Farmework Programme projects in per capita terms in the first order neighbours	Thousands of Euros per 1000 population		
INDICATORS FOR THE A-SPATIAL LINKAGES				
Co-patents	Number of patent co-authored with inventors from outside the region	Units	AQR elaboration on OECD REGPAT database	1995-1997 1998-2000 1999-2001 2002-2004
Co-patents per million population	Number of patent co-authored with inventors from outside the region over population divided by 1 million	Units per 1 million population		
Inflows of inventors	Number of inflows of inventors coming from other regions	Units	AQR elaboration on OECD REGPAT database	1995-1997 1998-2000 1999-2001 2002-2004
Inflows of inventors per million population	Number of inflows of inventors coming from other regions over population divided by 1 million	Units per 1 million population		
Cross-regional citations	Number of citations made to patents from other regions	Units	CRENoS elaboration on OECD REGPAT database	1995-1997 1998-2000 1999-2001 2002-2004
Cross-regional citations per million population	Number of citations made to patents from other regions over population divided by 1 million	Units per 1 million population		

3.2 Descriptive analysis of the main indicators used for the spatially mediated mechanism (Spatial linkages)

In this Scientific Report we offer a descriptive analysis for each of the indicators considered for proxying the spatially mediated mechanism to access to external-to-the-region knowledge (spatial linkages). These are:

A. R&D expenditures in the first order neighbouring regions: absolute values, relative to GDP and relative to population.
B. Patent applications in the first order neighbouring regions: absolute values and relative to population.
C. Framework Program participation and budgets in the first order neighbouring regions: number of participants, absolute funding and funding per capita.

Specifically, for each of the indicators we present the following elaborations:

- A first Table with average values for macro areas in Europe
- A second Table with a regional index of concentration (coefficient of variation)
- A third Table with the list of top and bottom ten regions (several tables are given in case the variable is considered in absolute and in relative levels)
- Figures for the geographical distribution (absolute and in per capital levels)

3.2.1 R&D expenditure in the neighbouring regions

Table 38. Intramural R&D expenditure in neighbouring regions. Average values 2006-2007

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
R&D millions of euro	792.12	955.36	134.01	901.95	199.05	500.09	1148.19
R&D exp. as % of GDP	1.36	1.50	0.64	1.92	0.65	1.03	1.74
R&D exp. per capita	0.40	0.46	0.08	0.81	0.11	0.27	0.55

Table 39. Intramural R&D expenditure in neighbouring regions. Coefficient of variation, 2006-2007

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
R&D millions of euro	0.99	0.85	0.86	0.58	1.15	0.96	0.72
R&D exp. as % of GDP	0.65	0.58	0.76	0.42	0.78	0.94	0.44
R&D exp. per capita	0.86	0.72	1.23	0.39	1.23	1.13	0.57

Table 40. Intramural R&D expenditure in neighbouring regions. Top and bottom ten regions, 2006-2007

Position	Region code	Region name	Country	R&D exp., millions euro 06-07
		Top regions		
1	DK02	Sjælland	Danmark	4306.00
2	FR23	HauteNormandie	France	4252.75
3	FR26	Bourgogne	France	3693.67
4	DE14	Tübingen	Deutschland	3524.25
5	DE27	Schwaben	Deutschland	3447.17
6	FR22	Picardie	France	3417.40
7	DE25	Mittelfranken	Deutschland	3003.50
8	DE12	Karlsruhe	Deutschland	2864.57
9	DE26	Unterfranken	Deutschland	2819.71
10	ITC2	Valle d'Aosta/Vallée d'Aoste	Italia	2787.00
		Bottom regions		
257	RO21	NordEst	Romania	28.67
258	BG31	Severozapaden	Bulgaria	27.40
259	RO41	SudVest Oltenia	Romania	26.25
260	RO22	SudEst	Romania	24.80
261	GR23	Dytiki Ellada	Ellada	21.00
262	GR30	Attiki	Ellada	21.00
263	GR21	Ipeiros	Ellada	19.50
264	BG32	Severen tsentralen	Bulgaria	18.00
265	BG33	Severoiztochen	Bulgaria	9.00
266	BG34	Yugoiztochen	Bulgaria	5.00

Note: Regions with 0 value are ES53, FI20, FR91, FR93, PT20, MT00, FR83, GR41, PT30, ES63, FR94, ITG2, CY00, GR43, ITG1, GR42, IS00, ES64, ES70, GR22, FR92.

Table 41. R&D expenditure as % of GDP in neighbouring regions. Top and bottom 10 regions, 2006-07

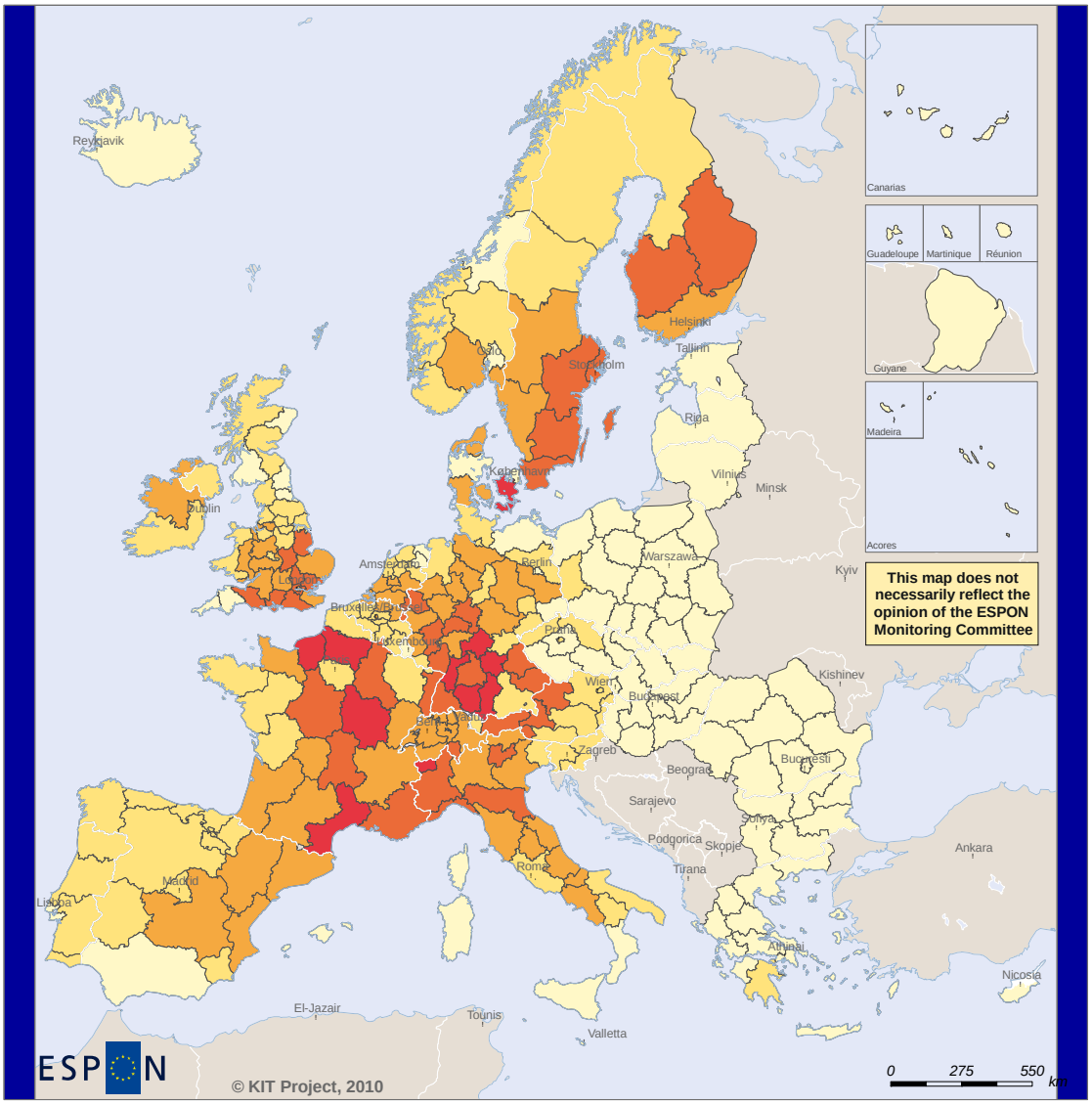
Position	Region code	Region name	Country	R&D exp., % GDP 06-07
		Top regions		
1	DK02	Sjælland	Danmark	5.09
2	SE21	Småland med öarna	Sverige	4.39
3	FI13	ItäSuomi	Suomi / Finland	4.07
4	SE11	Stockholm	Sverige	3.79
5	DE13	Freiburg	Deutschland	3.41
6	DE27	Schwaben	Deutschland	3.40
7	FI19	LänsiSuomi	Suomi / Finland	3.36
8	DE14	Tübingen	Deutschland	3.30
9	UKH3	Essex	United Kingdom	3.19
10	CH04	Zürich	Schweiz/Suisse/Svizzera	3.11
		Bottom regions		
257	RO12	Centru	Romania	0.27
258	RO22	SudEst	Romania	0.24
259	RO41	SudVest Oltenia	Romania	0.23
260	GR30	Attiki	Ellada	0.22
261	BG32	Severen tsentralen	Bulgaria	0.22
262	GR21	Ipeiros	Ellada	0.22
263	RO21	NordEst	Romania	0.22
264	GR23	Dytiki Ellada	Ellada	0.22
265	BG34	Yugoiztochen	Bulgaria	0.17
266	BG33	Severoiztochen	Bulgaria	0.14

Note: Regions with 0 value are GR41, ITG1, FR92, GR42, MT00, FR94, PT30, FI20, FR83, ES64, FR93, ES63, IS00, ES70, GR22, ES53, GR43, CY00, FR91, ITG2, PT20.

Table 42. Intramural R&D expenditure per capita (1000 population) in neighbouring regions. Top and bottom ten regions, 2006-2007

Position	Region code	Region name	Country	R&D exp., per capita 06-07
		Top regions		
1	DK02	Sjælland	Danmark	2.63
2	SE21	Småland med öarna	Sverige	1.46
3	FI13	ItäSuomi	Suomi / Finland	1.28
4	DE13	Freiburg	Deutschland	1.27
5	CH06	Zentralschweiz	Schweiz/Suisse/Svizzera	1.24
6	DE27	Schwaben	Deutschland	1.22
7	CH04	Zürich	Schweiz/Suisse/Svizzera	1.22
8	SE11	Stockholm	Sverige	1.19
9	NO07	NordNorge	Norge	1.11
10	DE14	Tübingen	Deutschland	1.11
		Bottom regions		
255	PL41	Wielkopolskie	Polska	0.02
256	RO42	Vest	Romania	0.02
257	PL12	Mazowieckie	Polska	0.02
258	PL63	Pomorskie	Polska	0.02
259	RO22	SudEst	Romania	0.01
260	RO12	Centru	Romania	0.01
261	RO41	SudVest Oltenia	Romania	0.01
262	RO21	NordEst	Romania	0.01
263	BG31	Severozapaden	Bulgaria	0.01
264	BG32	Severen tsentralen	Bulgaria	0.01

Note: Regions with 0 value are ES70, MT00, GR43, ES64, GR42, FR93, FR83, ES63, IS00, GR41, FI20, PT20, FR91, FR94, BG34, ITG2, ES53, ITG1, FR92, CY00, BG33, PT30, GR22.



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Regional level: NUTS 2
Source: CRENOS elaboration, 2010
Origin of data: EUROSTAT, ISTAT and Institut National de la Statistique et des Études Économiques data
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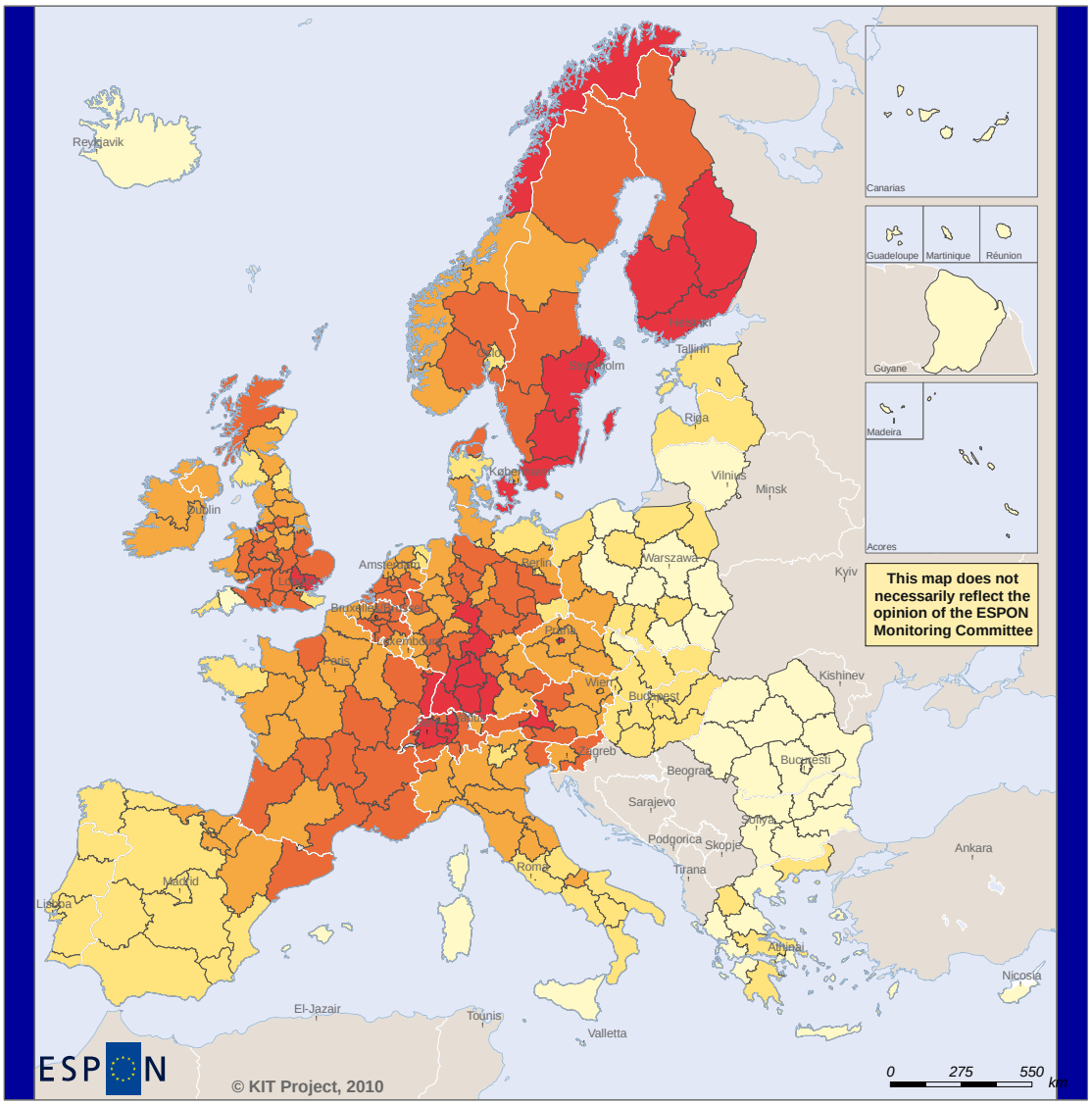
Intramural R&D expenditure in the neighbouring regions (millions of Euro). Average 2006-2007

- 0 - 323
- 324 - 825
- 826 - 1436
- 1437 - 2321
- 2322 - 4306

Map 35. R&D expenditure in the neighbouring regions. Average 2006-2007



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Origin of data: EUROSTAT, ISTAT and Institut National de la Statistique et des Études Économiques data
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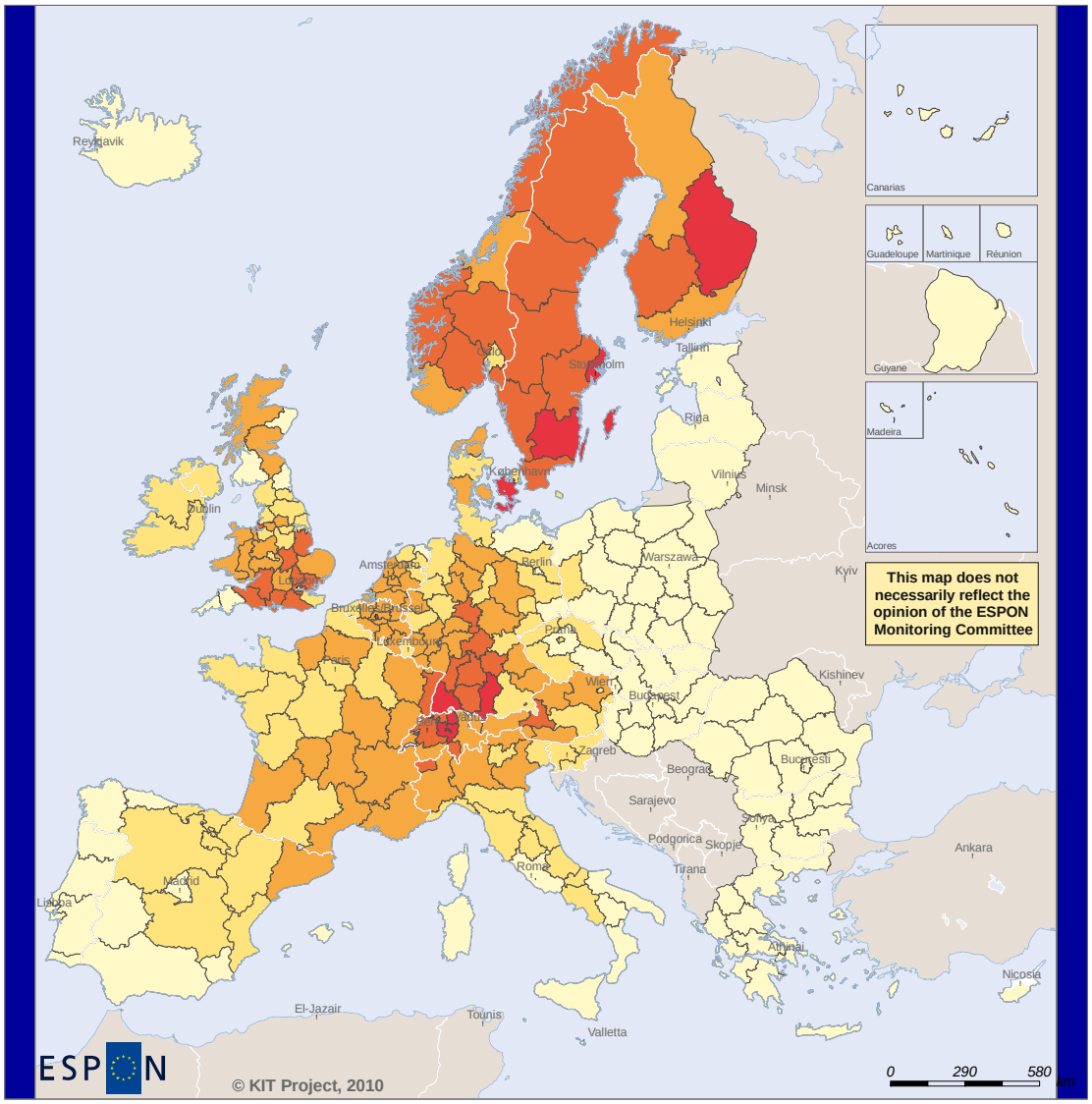
Intramural R&D expenditure as a % of GDP in the neighbouring regions. Average 2006-2007

- 0,0000 - 0,4698
- 0,4699 - 1,0491
- 1,0492 - 1,6957
- 1,6958 - 2,5700
- 2,5701 - 5,0930

Map 36. R&D expenditure as % of GDP in the neighbouring regions. Average 2006-2007



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Regional level: NUTS 2
Source: CRENOS elaboration, 2010
Origin of data: EUROSTAT, ISTAT and Institut National de la Statistique et des Études Économiques data
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Intramural R&D expenditure per capita in the neighbouring regions (1000 population). Average 2006-2007

- 0,0000 - 0,2020
- 0,2021 - 0,4601
- 0,4602 - 0,7370
- 0,7371 - 1,1127
- 1,1128 - 2,6300

Map 37. R&D expenditure per capita (1000 population) in the neighbouring regions. Average 2006-2007

3.2.2 Patent activity in the neighbouring regions

Table 43. Patent activity in neighbouring regions. Average values, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Patent activity	123.16	150.19	8.24	162.14	13.37	40.59	192.06
Patent activity per capita	0.06	0.07	0.01	0.14	0.01	0.02	0.09

Table 44. Patent activity in neighbouring regions. Coefficient of variation, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Patent activity	1.23	1.05	1.99	0.83	1.90	1.36	0.85
Patent activity per capita	1.05	0.86	2.56	0.66	2.20	1.49	0.65

Table 45. Patent activity in neighbouring regions. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Patent activity 95-97
		Top regions		
1	DE14	Tübingen	Deutschland	769.09
2	DE12	Karlsruhe	Deutschland	696.28
3	DE27	Schwaben	Deutschland	655.36
4	DE25	Mittelfranken	Deutschland	646.97
5	FR23	HauteNormandie	France	638.54
6	DE26	Unterfranken	Deutschland	600.32
7	FR26	Bourgogne	France	582.52
8	DEB1	Koblenz	Deutschland	529.09
9	DE72	Gießen	Deutschland	505.02
10	FR22	Picardie	France	502.07
		Bottom regions		
255	RO22	SudEst	Romania	0.41
256	PL12	Mazowieckie	Polska	0.33
257	BG32	Severen tsentralen	Bulgaria	0.29
258	BG33	Severoiztochen	Bulgaria	0.27
259	GR23	Dytiki Ellada	Ellada	0.26
260	GR30	Attiki	Ellada	0.26
261	GR21	Ipeiros	Ellada	0.25
262	RO12	Centru	Romania	0.25
263	RO21	NordEst	Romania	0.22
264	RO41	SudVest Oltenia	Romania	0.15

Note: Regions with 0 value are ES64, GR43, MT00, GR41, FI20, ITG1, FR93, FR91, RO32, GR22, ITG2, FR92, FR83, ES63, IS00, ES53, FR94, GR42, PT30, PT17, ES70, CY00, PT20.

Table 46. Patent activity per capita in neighbouring regions. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Patent activity per capita 95-97
		Top regions		
1	CH04	Zürich	Schweiz/Suisse/Svizzera	0.30
2	DE14	Tübingen	Deutschland	0.28
3	DE13	Freiburg	Deutschland	0.27
4	DE12	Karlsruhe	Deutschland	0.27
5	CH06	Zentralschweiz	Schweiz/Suisse/Svizzera	0.26
6	DE27	Schwaben	Deutschland	0.26
7	FR42	Alsace	France	0.24
8	DE25	Mittelfranken	Deutschland	0.24
9	DE11	Stuttgart	Deutschland	0.24
10	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	0.23
		Bottom regions		
195	SK02	Západné Slovensko	Slovenska Republika	0.01
196	ES52	Comunidad Valenciana	España	0.01
197	ES41	Castilla y León	España	0.01
198	PL42	Zachodniopomorskie	Polska	0.01
199	ITF6	Calabria	Italia	0.01
200	CZ05	Severovýchod	Ceska Republika	0.01
201	PL51	Dolnoslaskie	Polska	0.01
202	ES62	Región de Murcia	España	0.01
203	ITF4	Puglia	Italia	0.01
204	CZ06	Jihovýchod	Ceska Republika	0.01

Note: Regions with 0 value are GR12, PL22, PL31, PT16, LT00, RO12, PL52, CZ01, GR11, BG32, HU32, HU21, PL61, BG42, GR14, PL12, GR42, BG34, PT30, PL41, FI20, ES30, EE00, CY00, PT20, BG33, RO32, CZ08, ES64, RO41, ITG2, GR21, PL63, PL32, HU10, RO42, ES63, RO11, HU23, HU31, PL62, GR13, FR94, ITF5, ES61, RO31, PT18, MT00, PL33, GR30, FR93, HU33, GR24, SK04, BG31, PT17, RO21, PT15, GR43, ES70, PL21, CZ02, ES43, PL11, GR41, SK03, RO22, ES11, LV00, FR92, PL34, BG41, FR83, ITG1, ES12, IS00, ES53, PT11, GR22, GR25, FR91, GR23, CZ07.

Table 47. Patent activity in neighbouring regions. Average values, 2005-2006

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Patent activity	207.86	251.95	21.42	268.01	30.56	80.48	318.58
Patent activity per capita	0.10	0.12	0.01	0.21	0.02	0.04	0.15

Table 48. Patent activity in neighbouring regions. Coefficient of variation, 2005-2006

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Patent activity	1.19	1.03	1.64	0.83	1.65	1.23	0.84
Patent activity per capita	1.04	0.86	2.09	0.67	1.88	1.32	0.67

Table 49. Patent activity in neighbouring regions. Top and bottom ten regions, 2005-2006

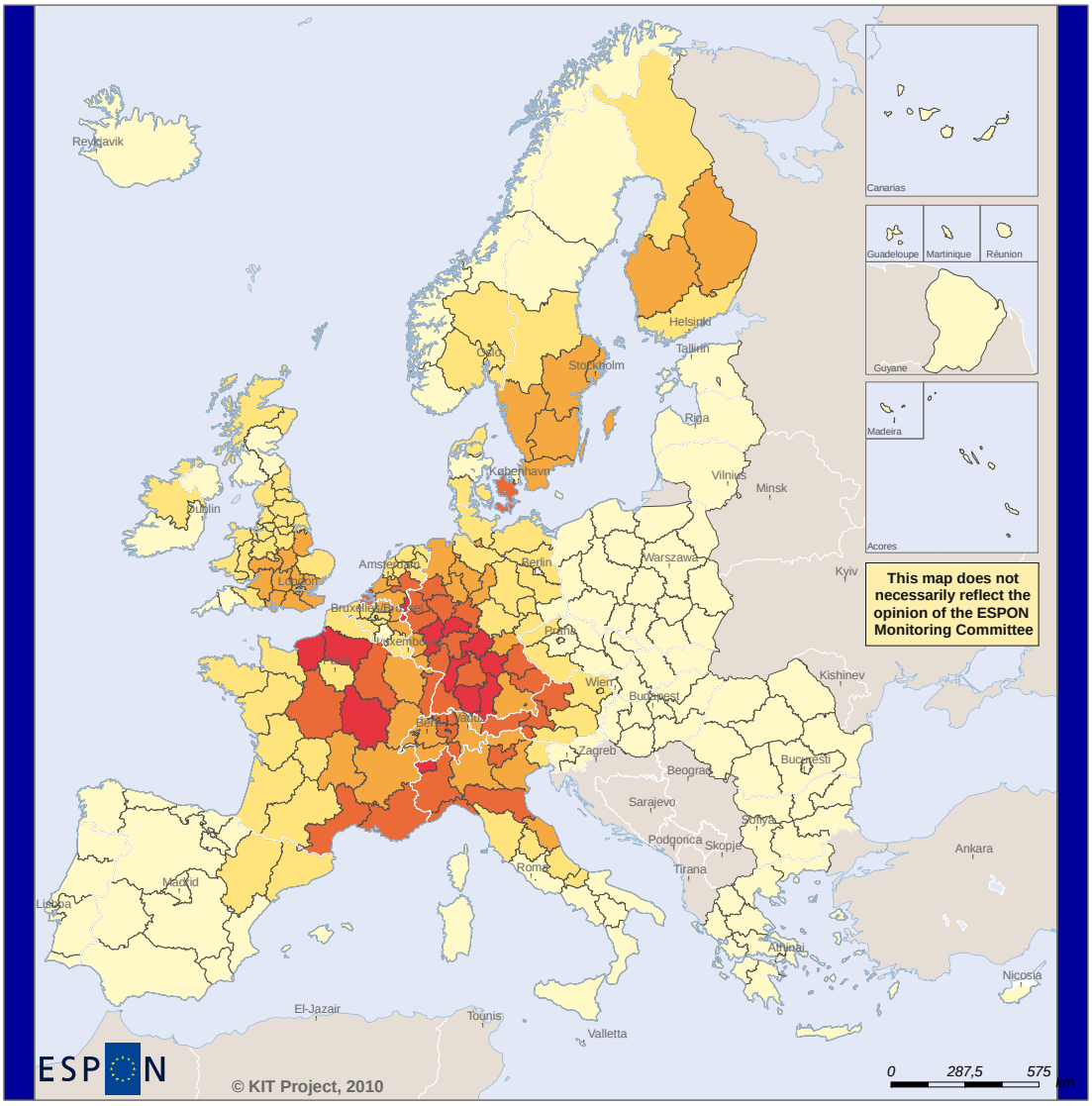
Position	Region code	Region name	Country	Patent activity 05-06
		Top regions		
1	DE14	Tübingen	Deutschland	1409.54
2	DE27	Schwaben	Deutschland	1177.95
3	DE25	Mittelfranken	Deutschland	1136.62
4	DE12	Karlsruhe	Deutschland	1118.60
5	DE26	Unterfranken	Deutschland	1001.29
6	FR23	HauteNormandie	France	925.04
7	DE11	Stuttgart	Deutschland	868.73
8	FR26	Bourgogne	France	857.87
9	NL42	Limburg (NL)	Nederland	844.01
10	ITC2	Valle d'Aosta/Vallée d'Aoste	Italia	815.41
		Bottom regions		
257	PL12	Mazowieckie	Polska	2.05
258	BG34	Yugoiztochen	Bulgaria	1.79
259	RO22	SudEst	Romania	1.77
260	RO12	Centru	Romania	1.58
261	RO41	SudVest Oltenia	Romania	1.54
262	GR23	Dytiki Ellada	Ellada	1.48
263	GR30	Attiki	Ellada	1.48
264	BG32	Severen tsentralen	Bulgaria	1.30
265	RO32	Bucuresti Ilfov	Romania	1.19
266	BG33	Severoiztochen	Bulgaria	1.00

Note: Regions with 0 value are IS00, PT20, ES64, CY00, ES70, ES53, GR42, ITG1, FR92, FR91, ES63, GR43, GR41, FR94, FR93, MT00, FI20, ITG2, FR83, GR22, PT30.

Table 50. Patent activity per capita in neighbouring regions. Top and bottom ten regions, 2005-2006

Position	Region code	Region name	Country	Patent activity per capita 05-06
		Top regions		
1	DE14	Tübingen	Deutschland	0.49
2	DE27	Schwaben	Deutschland	0.47
3	DE13	Freiburg	Deutschland	0.45
4	DE11	Stuttgart	Deutschland	0.45
5	CH04	Zürich	Schweiz/Suisse/Svizzera	0.45
6	DE12	Karlsruhe	Deutschland	0.44
7	DE25	Mittelfranken	Deutschland	0.43
8	LI00	Liechtenstein	Liechtenstein	0.41
9	CH06	Zentralschweiz	Schweiz/Suisse/Svizzera	0.40
10	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	0.37
		Bottom regions		
220	CZ07	Střední Morava	Ceska Republika	0.01
221	PT18	Alentejo	Portugal	0.01
222	HU10	KözépMagyarország	Magyarorszag	0.01
223	GR25	Peloponnisos	Ellada	0.01
224	ES30	Comunidad de Madrid	España	0.01
225	PT15	Algarve	Portugal	0.01
226	HU33	DélAlföld	Magyarorszag	0.01
227	GR11	Anatoliki Makedonia, Thraki	Ellada	0.01
228	PT17	Lisboa	Portugal	0.01
229	ITF5	Basilicata	Italia	0.01

Note: Regions with 0 value are PL31, PL22, FI20, RO22, GR21, IS00, GR22, FR93, PT30, MT00, GR23, PL32, BG34, BG31, PL21, RO31, FR92, PL62, PT20, BG42, RO42, PL63, LV00, ES53, ES63, GR14, BG32, ES70, PL12, GR41, ITG1, RO41, RO21, ITG2, PL11, CZ08, GR42, SK03, FR94, CY00, PL41, PL33, ES64, GR12, PL34, PL52, FR91, BG33, LT00, GR30, BG41, RO11, FR83, RO32, RO12, GR43, PL61, SK04.



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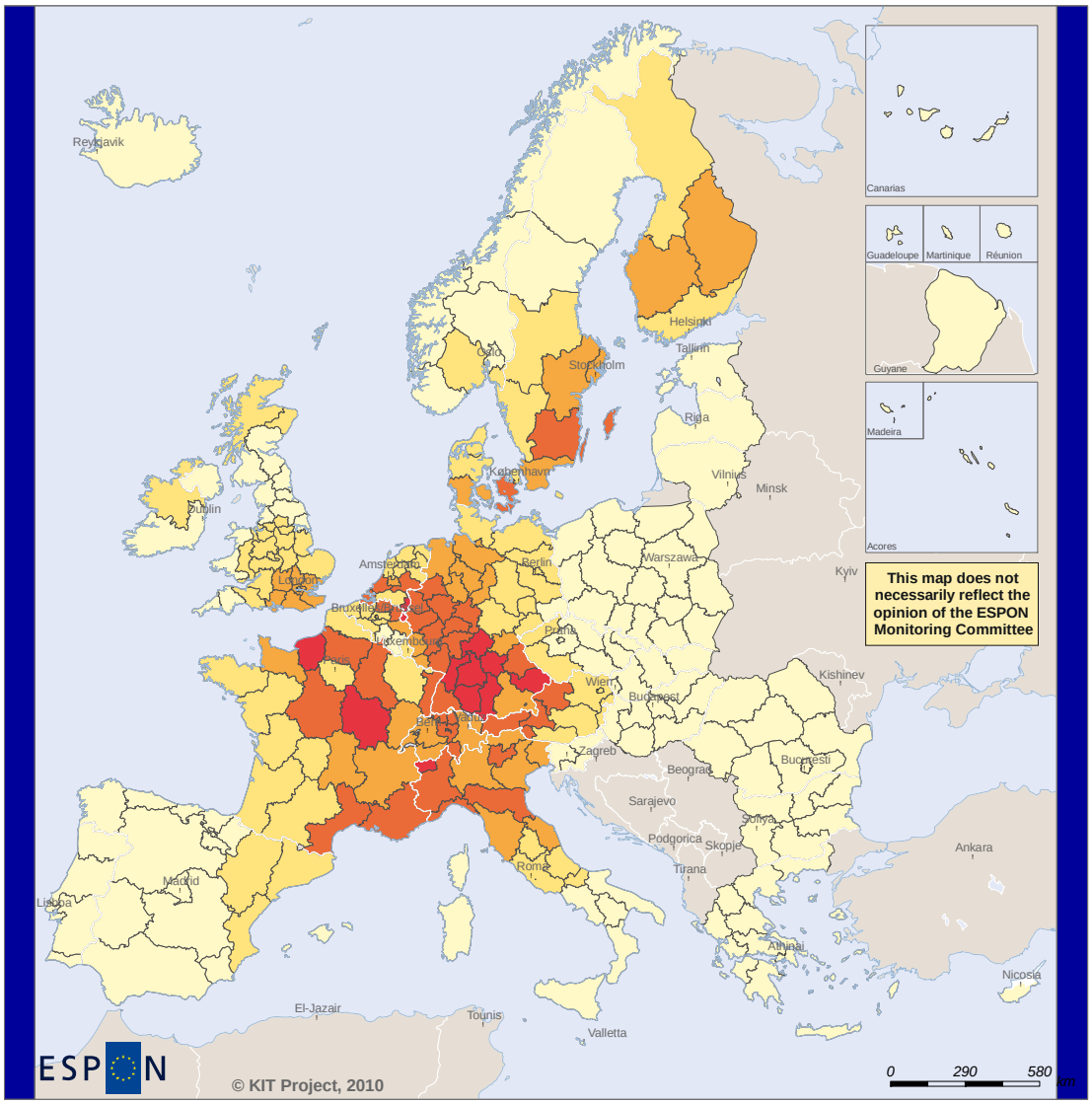
Patent activity in the neigbouring regions. Average 1995-1997

- 0 - 47
- 48 - 143
- 144 - 278
- 279 - 458
- 459 - 769

Map 38. Patent activity in the neighbouring regions. Average 1995-1997



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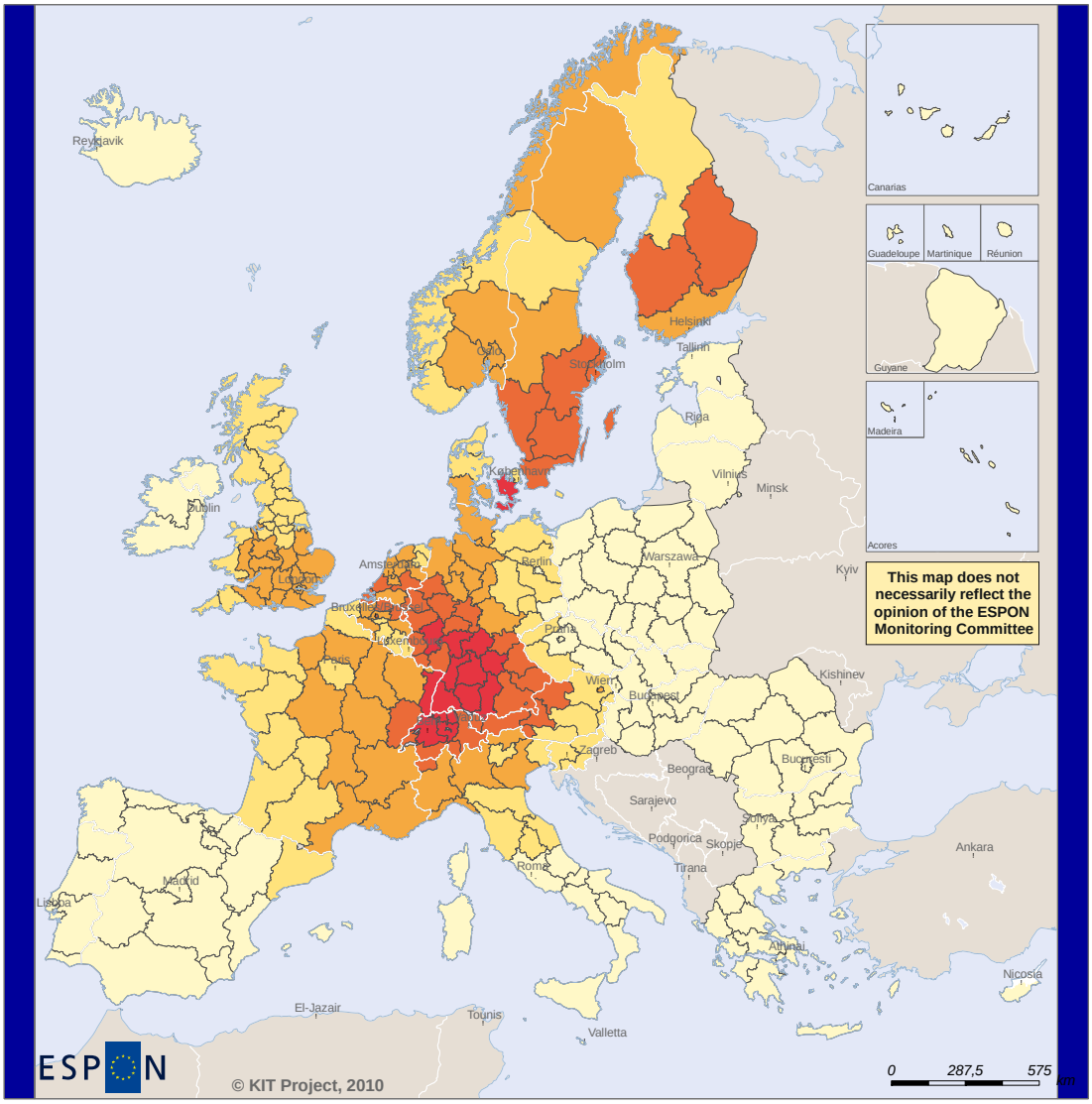
Patent activity in the neigbouring regions. Average 2005-2006

- 0 - 90
- 91 - 241
- 242 - 441
- 442 - 743
- 744 - 1409

Map 39. Patent activity in the neighbouring regions. Average 2005-2006



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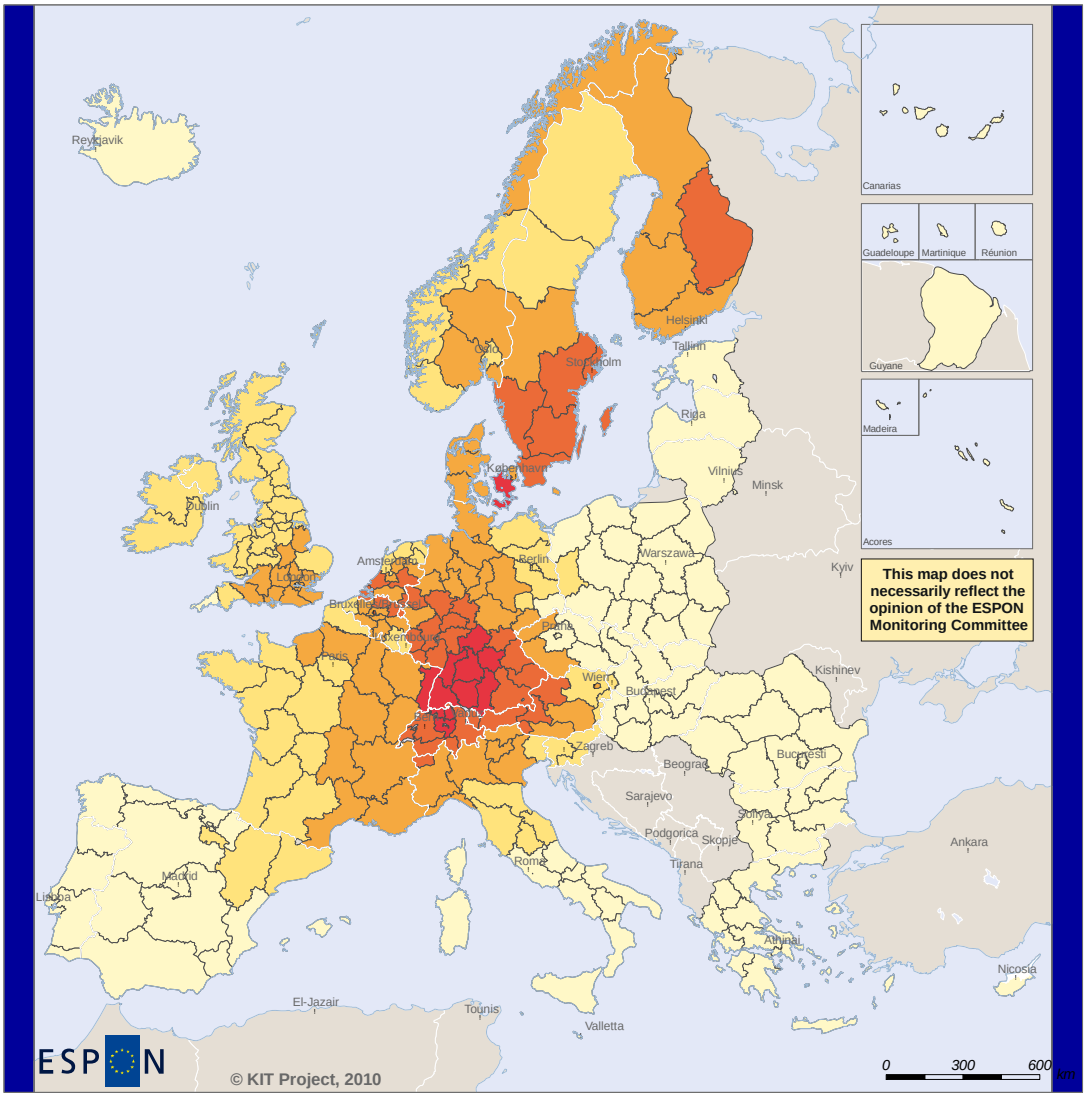
Patent activity per capita (1000 population). Average 1995-1997

- 0,0000 - 0,0257
- 0,0258 - 0,0670
- 0,0671 - 0,1118
- 0,1119 - 0,1772
- 0,1773 - 0,3002

Map 40. Patent activity per capita in the neighbouring regions. Average 1995-1997



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Patent activity per capita (1000 population) in the neighbouring regions. Average 2005-2006

- 0,0000 - 0,0431
- 0,0432 - 0,1062
- 0,1063 - 0,1860
- 0,1861 - 0,3184
- 0,3185 - 0,4945

Map 41. Patent activity per capita in the neighbouring regions. Average 2005-2006

3.2.3 Framework Program participation and funding

Table 51. FP participants and funding in neighbouring regions. Average values

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
FP participants	233.49	278.10	70.63	204.12	98.73	187.04	315.66
FP funding	36,867,406	44,305,746	9,544,148	32,546,110	13,953,522	28,098,733	50,937,025
FP funding per capita	18,961.46	21,914.58	4,914.82	28,442.15	6,603.50	14,576.96	25,315.81

Table 52. FP participants and funding in neighbouring regions. Coefficient of variation

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
FP participants	0.90	0.79	0.72	0.71	1.32	0.96	0.69
FP funding	0.96	0.83	0.72	0.72	1.48	1.01	0.72
FP funding per capita	0.86	0.75	0.86	0.51	1.20	0.99	0.63

Table 53. FP participants in neighbouring regions. Top and bottom ten regions

Position	Region code	Region name	Country	FP participants
		Top regions		
1	DK02	Sjælland	Danmark	1205.00
2	FR23	HauteNormandie	France	1176.75
3	GR25	Peloponnisos	Ellada	1002.50
4	FR26	Bourgogne	France	990.50
5	FR22	Picardie	France	958.00
6	ITC2	Valle d'Aosta/Vallée d'Aoste	Italia	828.67
7	FR81	LanguedocRoussillon	France	779.20
8	ITE2	Umbria	Italia	766.00
9	NL31	Utrecht	Nederland	746.50
10	ITC3	Liguria	Italia	737.25
		Bottom regions		
257	GR30	Attiki	Ellada	22.00
258	PL12	Mazowieckie	Polska	20.50
259	GR21	Ipeiros	Ellada	18.50
260	RO12	Centru	Romania	17.00
261	RO22	SudEst	Romania	14.60
262	BG34	Yugoiztochen	Bulgaria	10.50
263	RO41	SudVest Oltenia	Romania	9.75
264	BG33	Severoiztochen	Bulgaria	9.00
265	BG32	Severen tsentralen	Bulgaria	8.20
266	RO32	Bucuresti Ilfov	Romania	2.00

Note: Regions with 0 value are GR42, FR92, PT20, FR83, FI20, FR94, FR91, GR22, ES70, ITG2, GR43, CY00, GR41, IS00, ES53, FR93, ES63, MT00, PT30, ITG1, ES64.

Table 54. FP funding in neighbouring regions. Top and bottom ten regions

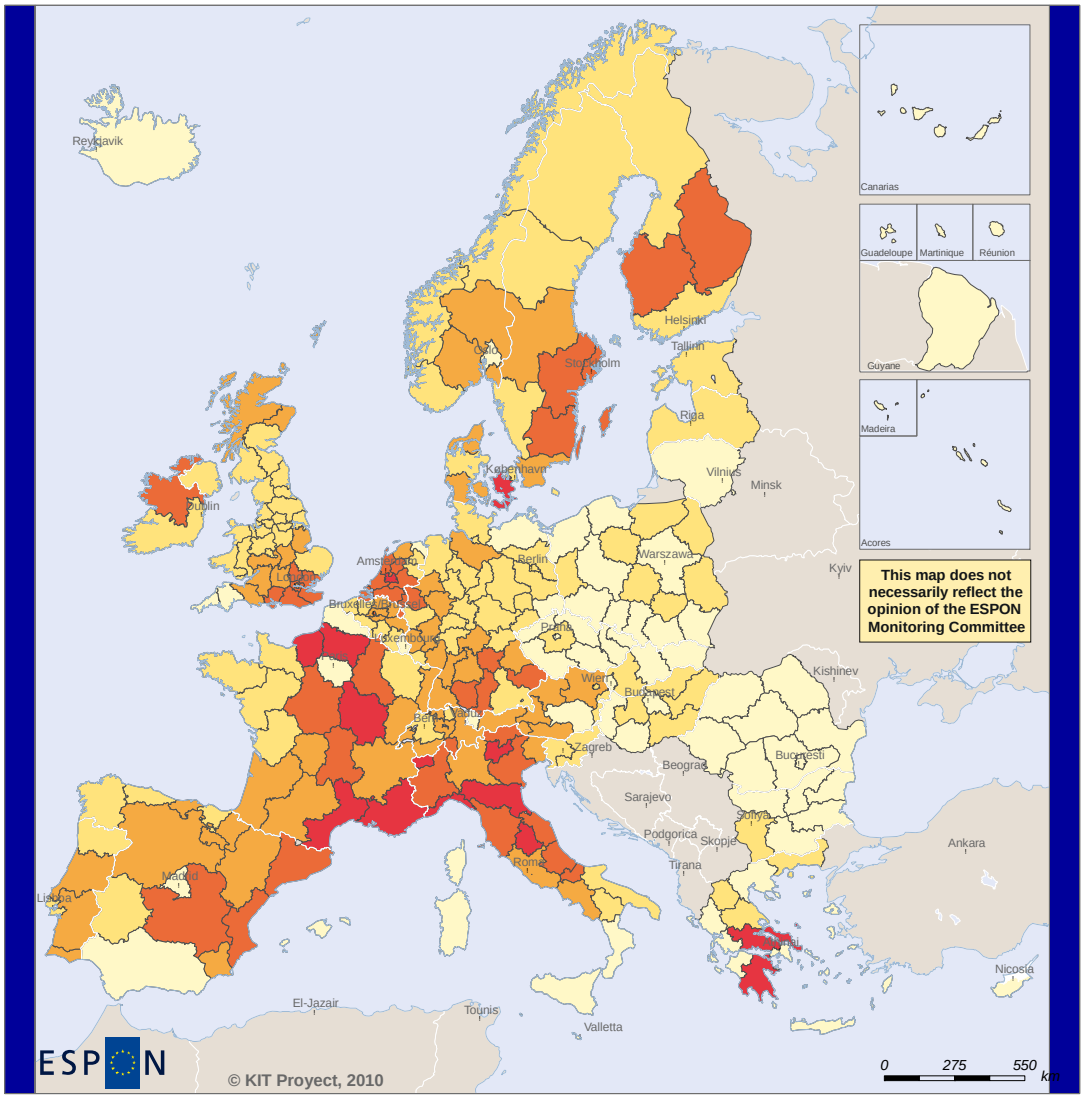
Position	Region code	Region name	Country	FP funding
		Top regions		
1	FR23	HauteNormandie	France	211,744,128
2	DK02	Sjælland	Danmark	195,147,232
3	FR26	Bourgogne	France	174,433,200
4	FR22	Picardie	France	171,745,376
5	GR25	Peloponnisos	Ellada	168,385,392
6	ITC2	Valle d'Aosta/Vallée d'Aoste	Italia	137,906,480
7	FR81	LanguedocRoussillon	France	123,853,552
8	BE10	Région de BruxellesCapitale/Brussels Hoofdstedelijk Gewest	Belgique-België	116,911,856
9	ITC3	Liguria	Italia	116,809,576
10	ITE2	Umbria	Italia	114,623,080
		Bottom regions		
257	GR30	Attiki	Ellada	3,199,826
258	RO21	NordEst	Romania	2,667,449
259	RO12	Centru	Romania	1,788,430
260	RO22	SudEst	Romania	1,741,287
261	GR21	Ipeiros	Ellada	1,663,574
262	BG34	Yugoiztochen	Bulgaria	1,417,955
263	BG32	Severen tsentralen	Bulgaria	1,215,112
264	BG33	Severoiztochen	Bulgaria	1,195,674
265	RO41	SudVest Oltenia	Romania	1,038,233
266	RO32	Bucuresti Ilfov	Romania	162,924

Note: Regions with 0 value are GR43, FR83, ES64, GR41, ES63, GR22, FR91, FR94, ES70, PT20, PT30, ITG1, FR93, ES53, CY00, FR92, MT00, ITG2, GR42, FI20, IS00.

Table 55. FP funding per capita in neighbouring regions. Top and bottom ten regions

Position	Region code	Region name	Country	FP funding per capita
		Top regions		
1	DK02	Sjælland	Danmark	121,799.70
2	BE10	Région de BruxellesCapitale/Brussels Hoofdstedelijk Gewest	Belgique-België	115,161.40
3	GR25	Peloponnisos	Ellada	62,397.20
4	BE24	Prov. Vlaams Brabant	Belgique-België	61,280.81
5	SE11	Stockholm	Sverige	57,889.52
6	NL31	Utrecht	Nederland	54,394.14
7	NO02	Hedmark og Oppland	Norge	52,578.66
8	SE21	Småland med öarna	Sverige	51,882.62
9	NO07	NordNorge	Norge	49,234.97
10	NL33	ZuidHolland	Nederland	49,085.83
		Bottom regions		
257	PL21	Malopolskie	Polska	1,756.04
258	PL12	Mazowieckie	Polska	1,538.01
259	BG34	Yugoiztochen	Bulgaria	1,220.67
260	RO22	SudEst	Romania	1,057.85
261	RO21	NordEst	Romania	973.19
262	BG32	Severen tsentralen	Bulgaria	860.87
263	BG33	Severoiztochen	Bulgaria	663.69
264	RO12	Centru	Romania	644.05
265	RO41	SudVest Oltenia	Romania	476.23
266	RO32	Bucuresti Ilfov	Romania	47.75

Note: Regions with 0 value are FI20, FR92, ITG2, FR91, ES53, ES63, ES70, GR42, FR83, FR94, FR93, CY00, GR22, MT00, GR41, ITG1, ES64, PT20, IS00, PT30, GR43.



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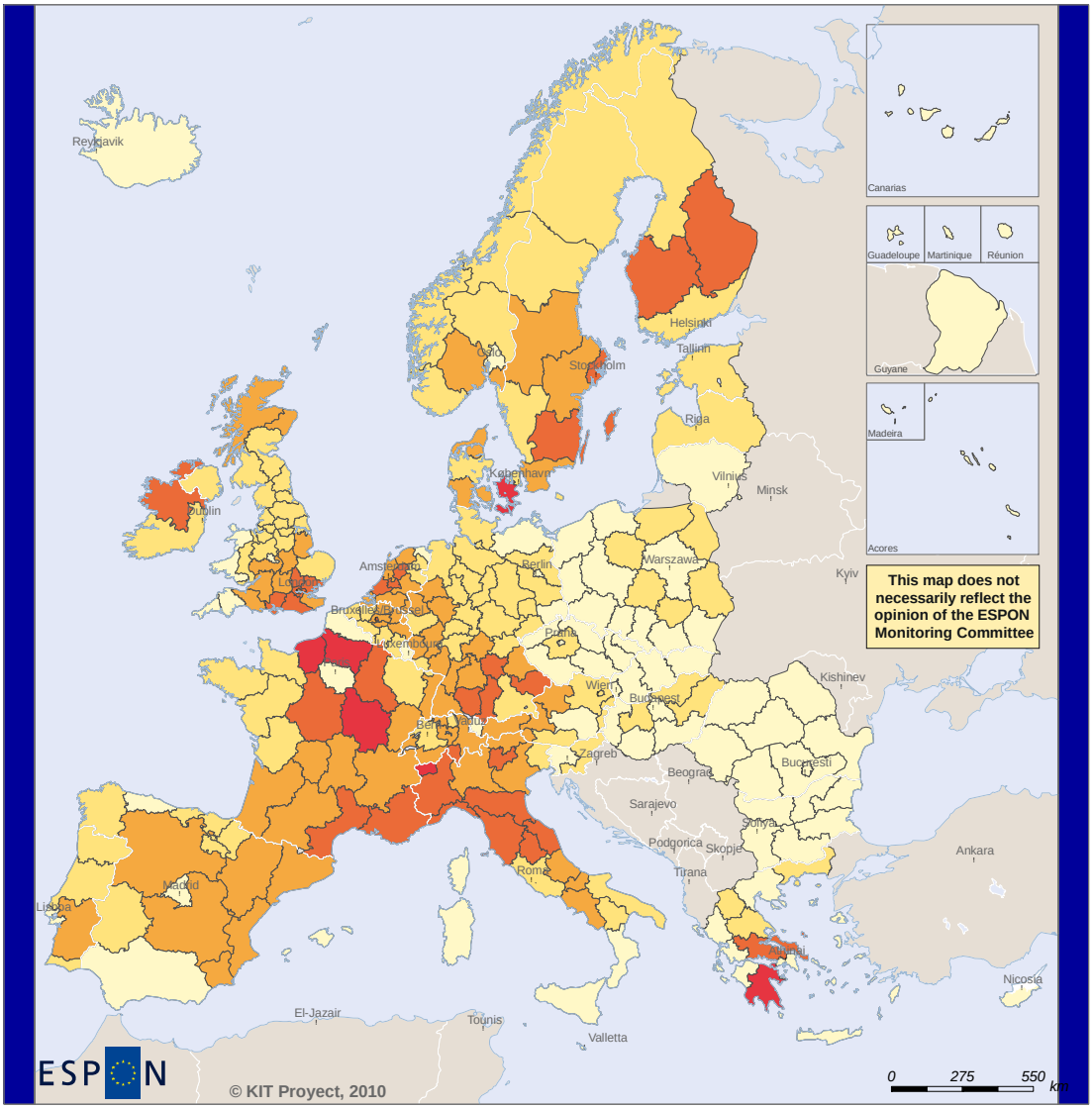
Average number of participants in FP in the neighbouring regions

- less than 93
- 93 to below 227
- 227 to below 385
- 385 to below 653
- 653 and more

Map 42. Average number of participants in FP projects in the neighbouring regions. Average 1998-2002.



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Regional level: NUTS 2
Source: Cordis, 1998-2002
Origin of data: own calculations
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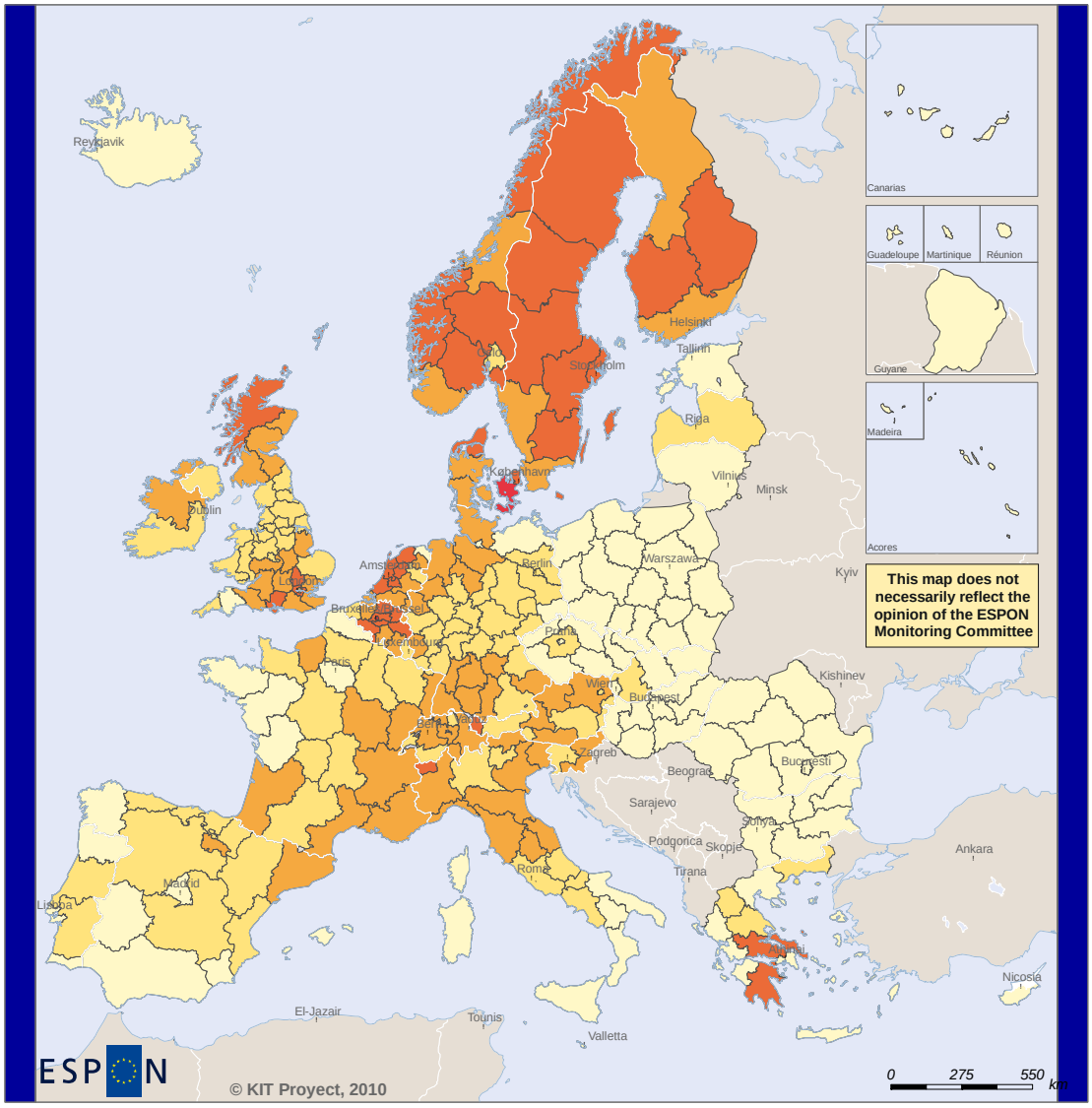
Average funding in FP in the neighbouring regions (in millions)

- less than 15.49
- 15.49 to below 38.74
- 38.74 to below 73.83
- 73.83 to below 123.85
- 123.85 and more

Map 43. Average funding in FP projects in the neighbouring regions. Average 1998-2002



Map 44. Average funding per capita in FP projects in the neighbouring regions. Average 1998-2002

3.3 Descriptive analysis of the main indicators used for the non-spatially mediated mechanism (A-spatial linkages)

In this Section of the Scientific Report we offer a descriptive analysis for each of the indicators considered for proxying the non-spatially mediated mechanism to access to external-to-the-region knowledge (a-spatial linkages). These are:

A. Co-patents with other ESPON regions: number of patents co-authored with inventors from outside the region. Absolute levels and relative to population.

B. Inflows: number of inflows of inventors coming from other regions (from where they bring knowledge, brain gain). Absolute levels and relative to population.

C. Cross-regional Patent citations: number of citations made to patents from other regions. Absolute levels and relative to population.

Additionally, and complementary to the inflows measure (which proxies the regional brain gain), it is possible to think that the dichotomy brain drain/brain gain might be overcome by the concept of brain circulation. Thus, it is perfectly possible that regions exporting talent may benefit as well from knowledge inputs from outside the region because of enduring social relationships between the left talented individual and his/her former colleagues. Thus, the flows of inventors (outflows) going to other regions might be computed as well. Although not used in the computation of the synthetic indicator for a-spatial linkages given in Section 3.5, we will offer the descriptive analysis also for this variable of outflows of inventors (D).

Specifically, for each of the indicators we present the following elaborations:

- A first Table with average values for macro areas in Europe
- A second Table with a regional index of concentration (coefficient of variation)
- A third Table with the list of top and bottom ten regions (several tables are given in case the variable is considered in absolute and in relative levels)
- Figures for the geographical distribution (absolute and in per capital levels).

3.3.1 Co-patenting activity

Table 56. Co-patenting. Average values, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	248.83	313.70	13.90	199.33	30.71	80.17	400.55
Co-patents / million POP	140.58	160.57	9.53	330.57	17.09	56.89	201.93

Table 57. Co-patenting. Coefficient of variation, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	2.28	2.04	2.12	1.20	2.89	1.72	1.80
Co-patents / million POP	1.79	1.51	1.87	1.57	2.71	1.57	1.31

Table 58. Co-patenting. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Co-patenting, 95-97
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	4393.00
2	DE12	Karlsruhe	Deutschland	4120.33
3	DE71	Darmstadt	Deutschland	3667.67
4	DEA1	Düsseldorf	Deutschland	3495.67
5	DEA2	Köln	Deutschland	3243.00
6	DE11	Stuttgart	Deutschland	2367.67
7	DE21	Oberbayern	Deutschland	2366.67
8	FR10	Île de France	France	1971.67
9	DE14	Tübingen	Deutschland	1336.33
10	DE13	Freiburg	Deutschland	1248.67
		Bottom regions		
251	BG34	Yugoiztochen	Bulgaria	1.00
252	CY00	Cyprus	Kypros / Kibris	1.00
253	FR83	Corse	France	0.67
254	LT00	Lithuania	Lietuva	0.67
255	PL62	WarminskoMazurskie	Polska	0.67
256	ES43	Extremadura	España	0.67
257	BG42	Yuzhen tsentralen	Bulgaria	0.67
258	PL32	Podkarpackie	Polska	0.33
259	ES23	La Rioja	España	0.33
260	SK04	Východné Slovensko	Slovenska Republika	0.33

Note: Regions with 0 value are FI20, PT18, BG33, RO11, GR41, ES64, RO41, ES63, PL61, PL33, MT00, PT16, GR22, GR14, GR42, RO42, PL52, PL43, RO31, PT30, PT20, PL31, BG32, PL34, BG31, GR21, GR11.

Table 59. Co-patenting over million population. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Co-patenting, 95-97
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	2215.56
2	LI00	Liechtenstein	Liechtenstein	2100.71
3	DE12	Karlsruhe	Deutschland	1555.42
4	DE71	Darmstadt	Deutschland	995.60
5	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	883.32
6	DEA2	Köln	Deutschland	774.31
7	DE14	Tübingen	Deutschland	773.84
8	DE25	Mittelfranken	Deutschland	713.61
9	DE26	Unterfranken	Deutschland	661.99
10	DE24	Oberfranken	Deutschland	661.67
		Bottom regions		
251	RO12	Centru	Romania	0.65
252	ES43	Extremadura	España	0.63
253	RO22	SudEst	Romania	0.57
254	PT11	Norte	Portugal	0.47
255	PL62	WarminskoMazurskie	Polska	0.46
256	PL51	Dolnoslaskie	Polska	0.45
257	BG42	Yuzhen tsentralen	Bulgaria	0.39
258	SK04	Východné Slovensko	Slovenska Republika	0.22
259	LT00	Lithuania	Lietuva	0.19
260	PL32	Podkarpackie	Polska	0.16

Note: Regions with 0 value are GR41, FI20, GR42, PL33, ES64, BG31, GR11, PL43, RO41, RO31, RO11, ES63, PT16, BG32, PT18, PL34, PL61, GR14, PT30, MT00, PL31, RO42, GR21, BG33, GR22, PT20, PL52.

Table 60. Co-patenting. Average values, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	371.67	467.36	22.71	307.23	53.81	141.54	588.71
Co-patents / million POP	207.06	240.00	15.93	433.28	31.39	101.74	296.12

Table 61. Co-patenting. Coefficient of variation, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	2.10	1.87	1.90	1.25	2.75	1.75	1.66
Co-patents / million POP	1.57	1.36	1.87	1.25	2.67	1.64	1.19

Table 62. Co-patenting. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Co-patenting, 98-00
		Top regions		
1	DE12	Karlsruhe	Deutschland	5446.00
2	DEB3	RheinhessenPfalz	Deutschland	5166.67
3	DE71	Darmstadt	Deutschland	5058.33
4	DEA1	Düsseldorf	Deutschland	4557.33
5	DEA2	Köln	Deutschland	4095.00
6	DE21	Oberbayern	Deutschland	3957.67
7	DE11	Stuttgart	Deutschland	3899.67
8	FR10	Île de France	France	2738.67
9	DE13	Freiburg	Deutschland	2090.33
10	DE14	Tübingen	Deutschland	1930.33
		Bottom regions		
256	FR83	Corse	France	1.00
257	FR94	Reunion (FR)	France	1.00
258	BG31	Severozapaden	Bulgaria	0.67
259	BG34	Yugoiztochen	Bulgaria	0.67
260	ES23	La Rioja	España	0.67
261	GR14	Thessalia	Ellada	0.67
262	MT00	Malta	Malta	0.67
263	PT16	Centro (PT)	Portugal	0.67
264	RO42	Vest	Romania	0.33
265	PL31	Lubelskie	Polska	0.33

Note: Regions with 0 value are GR11, RO41, PL42, PL32, PL52, GR42, RO11, PL43, GR24, GR13, ES64, PL61, RO22, PT30, PL33, GR41, PT18, GR22, PT20, ES63, PL34, BG33.

Table 63. Co-patenting over million population. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Co-patenting, 98-00
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	2580.65
2	DE12	Karlsruhe	Deutschland	2041.13
3	LI00	Liechtenstein	Liechtenstein	2009.83
4	DE71	Darmstadt	Deutschland	1364.13
5	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	1349.87
6	DE14	Tübingen	Deutschland	1103.75
7	DE24	Oberfranken	Deutschland	1020.75
8	DE11	Stuttgart	Deutschland	999.25
9	DE13	Freiburg	Deutschland	987.81
10	DE21	Oberbayern	Deutschland	987.41
		Bottom regions		
256	GR14	Thessalia	Ellada	0.90
257	RO21	NordEst	Romania	0.71
258	BG31	Severozapaden	Bulgaria	0.62
259	PL22	Slaskie	Polska	0.55
260	BG34	Yugoiztochen	Bulgaria	0.54
261	RO12	Centru	Romania	0.52
262	RO31	Sud Muntenia	Romania	0.39
263	PT16	Centro (PT)	Portugal	0.29
264	RO42	Vest	Romania	0.17
265	PL31	Lubelskie	Polska	0.15

Note: Regions with 0 value are RO22, BG33, GR24, PT18, PL32, GR11, GR41, GR22, PL43, GR13, PT20, GR42, ES63, PL33, PL34, PL52, PT30, PL61, PL42, RO11, ES64, RO41.

Table 64. Co-patenting. Average values, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	404.34	507.37	26.40	342.67	59.48	146.36	640.31
Co-patents / million POP	223.47	259.45	18.89	455.99	35.52	102.76	321.12

Table 65. Co-patenting. Coefficient of variation, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	2.08	1.86	1.95	1.28	2.60	1.77	1.65
Co-patents / million POP	1.55	1.36	2.06	1.18	2.55	1.66	1.18

Table 66. Co-patenting. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Co-patenting, 99-01
		Top regions		
1	DE12	Karlsruhe	Deutschland	5789.33
2	DEB3	RheinhessenPfalz	Deutschland	5395.67
3	DE71	Darmstadt	Deutschland	5389.67
4	DEA1	Düsseldorf	Deutschland	5011.67
5	DEA2	Köln	Deutschland	4474.00
6	DE11	Stuttgart	Deutschland	4431.33
7	DE21	Oberbayern	Deutschland	4190.67
8	FR10	Île de France	France	2849.33
9	DE14	Tübingen	Deutschland	2267.67
10	DE13	Freiburg	Deutschland	2190.33
		Bottom regions		
263	ES23	La Rioja	España	0.67
264	SK04	Východné Slovensko	Slovenska Republika	0.67
265	MT00	Malta	Malta	0.67
266	RO11	NordVest	Romania	0.67
267	FR83	Corse	France	0.67
268	GR24	Sterea Ellada	Ellada	0.67
269	PT16	Centro (PT)	Portugal	0.67
270	GR14	Thessalia	Ellada	0.33
271	BG33	Severoiztochen	Bulgaria	0.33
272	RO42	Vest	Romania	0.33

Note: Regions with 0 value are GR42, ES64, PL61, GR13, PT18, ES63, PT20, FR93, PL43, PL52, GR41, PL32, PL33, GR22, BG34.

Table 67. Co-patenting over million population. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Co-patenting, 99-01
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	2694.04
2	DE12	Karlsruhe	Deutschland	2163.45
3	LI00	Liechtenstein	Liechtenstein	1836.99
4	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	1561.83
5	DE71	Darmstadt	Deutschland	1448.49
6	DE14	Tübingen	Deutschland	1290.17
7	DE11	Stuttgart	Deutschland	1130.76
8	DE25	Mittelfranken	Deutschland	1124.56
9	DE24	Oberfranken	Deutschland	1099.93
10	BE31	Prov. Brabant Wallon	Belgique-België	1089.70
		Bottom regions		
263	RO22	SudEst	Romania	0.58
264	PL42	Zachodniopomorskie	Polska	0.58
265	RO41	SudVest Oltenia	Romania	0.56
266	PL22	Slaskie	Polska	0.48
267	GR14	Thessalia	Ellada	0.45
268	SK04	Východné Slovensko	Slovenska Republika	0.43
269	BG33	Severoiztochen	Bulgaria	0.33
270	PT16	Centro (PT)	Portugal	0.29
271	RO11	NordVest	Romania	0.24
272	RO42	Vest	Romania	0.17

Note: Regions with 0 value are PT20, PL43, GR13, ES64, PL52, PL32, BG34, GR22, PL33, FR93, GR42, PT18, ES63, GR41, PL61.

Table 68. Co-patenting. Average values, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	456.34	564.60	47.16	433.75	77.57	149.26	716.16
Co-patents / million POP	249.11	283.04	36.56	537.22	49.92	106.49	351.49

Table 69. Co-patenting. Coefficient of variation, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	2.13	1.92	2.43	1.42	2.31	1.75	1.70
Co-patents / million POP	1.62	1.43	2.99	1.23	2.49	1.55	1.26

Table 70. Co-patenting. Top and bottom ten regions, 2002-2004

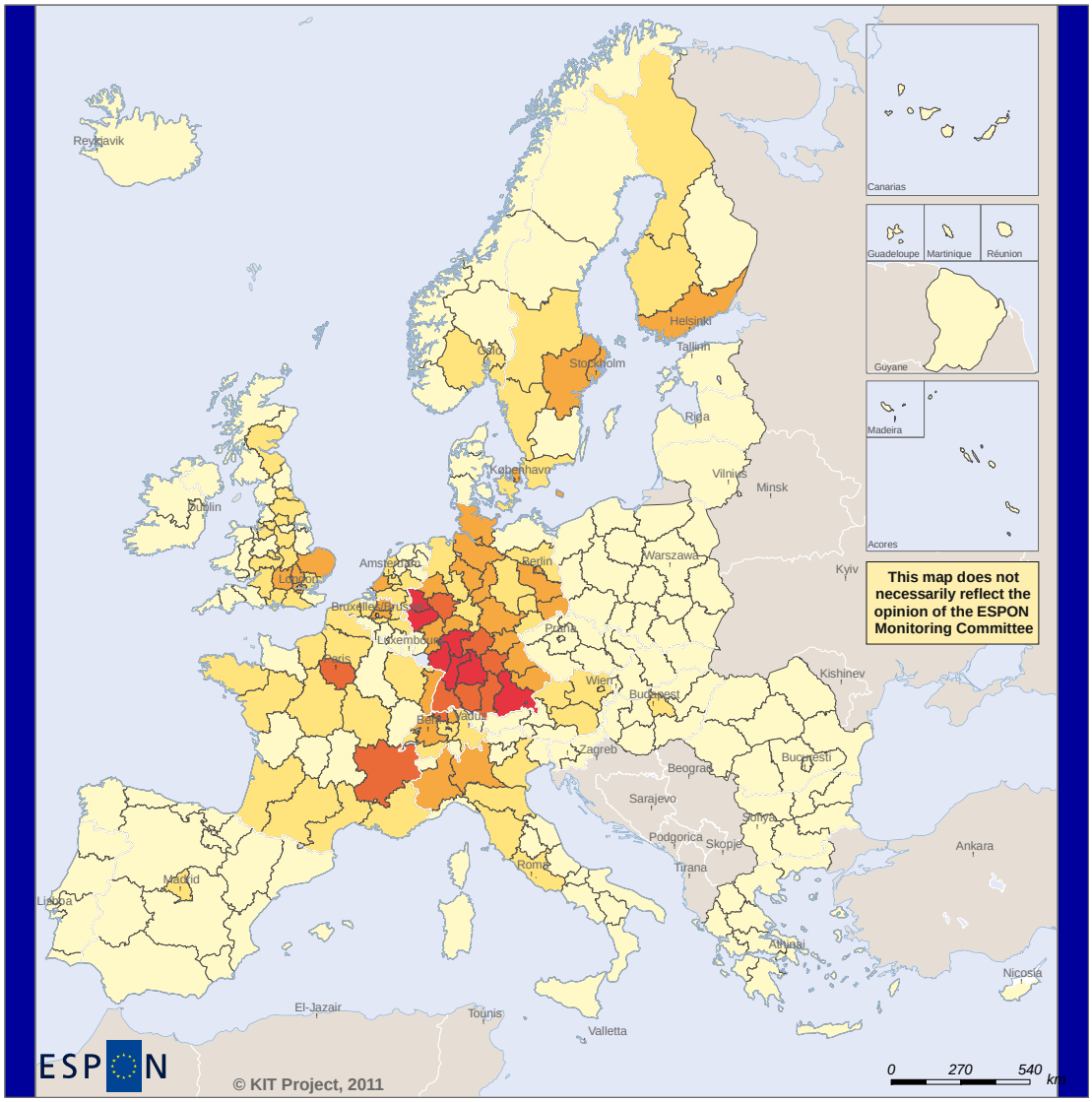
Position	Region code	Region name	Country	Co-patenting, 02-04
		Top regions		
1	DE12	Karlsruhe	Deutschland	7654.00
2	DEB3	RheinhessenPfalz	Deutschland	6677.00
3	DE71	Darmstadt	Deutschland	6012.33
4	DEA1	Düsseldorf	Deutschland	5234.67
5	DE11	Stuttgart	Deutschland	4917.67
6	DEA2	Köln	Deutschland	4606.00
7	DE21	Oberbayern	Deutschland	4390.33
8	FR10	Île de France	France	2987.00
9	DE14	Tübingen	Deutschland	2971.33
10	DE13	Freiburg	Deutschland	2756.33
		Bottom regions		
266	ES70	Canarias (ES)	España	1.67
267	PL42	Zachodniopomorskie	Polska	1.33
268	GR25	Peloponnisos	Ellada	1.00
269	PL52	Opolskie	Polska	1.00
270	PL31	Lubelskie	Polska	1.00
271	PL62	WarminskoMazurskie	Polska	1.00
272	BG31	Severozapaden	Bulgaria	1.00
273	FI20	Åland	Suomi / Finland	0.67
274	PT30	Região Autónoma da Madeira (PT)	Portugal	0.33
275	PL33	Swietokrzyskie	Polska	0.33

Note: Regions with 0 value are ES64, RO11, GR41, PT20, GR11, PL61, GR13, RO22, GR22, BG33, GR42, ES63.

Table 71. Co-patenting over million population. Top and bottom ten regions, 2002-2004

Position	Region code	Region name	Country	Co-patenting, 02-04
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	3313.68
2	DE12	Karlsruhe	Deutschland	2819.70
3	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	2309.57
4	LI00	Liechtenstein	Liechtenstein	1875.49
5	DE14	Tübingen	Deutschland	1662.24
6	DE71	Darmstadt	Deutschland	1600.32
7	DE13	Freiburg	Deutschland	1270.68
8	DE11	Stuttgart	Deutschland	1235.52
9	DE25	Mittelfranken	Deutschland	1165.89
10	DE26	Unterfranken	Deutschland	1152.02
		Bottom regions		
266	GR25	Peloponnisos	Ellada	1.67
267	PT30	Região Autónoma da Madeira (PT)	Portugal	1.39
268	RO12	Centru	Romania	1.18
269	BG31	Severozapaden	Bulgaria	1.00
270	PL52	Opolskie	Polska	0.95
271	ES70	Canarias (ES)	España	0.92
272	PL42	Zachodniopomorskie	Polska	0.79
273	PL62	WarminskoMazurskie	Polska	0.70
274	PL31	Lubelskie	Polska	0.46
275	PL33	Swietokrzyskie	Polska	0.26

Note: Regions with 0 value are ES63, GR41, GR11, GR22, PT20, ES64, RO22, PL61, GR42, RO11, BG33, GR13.



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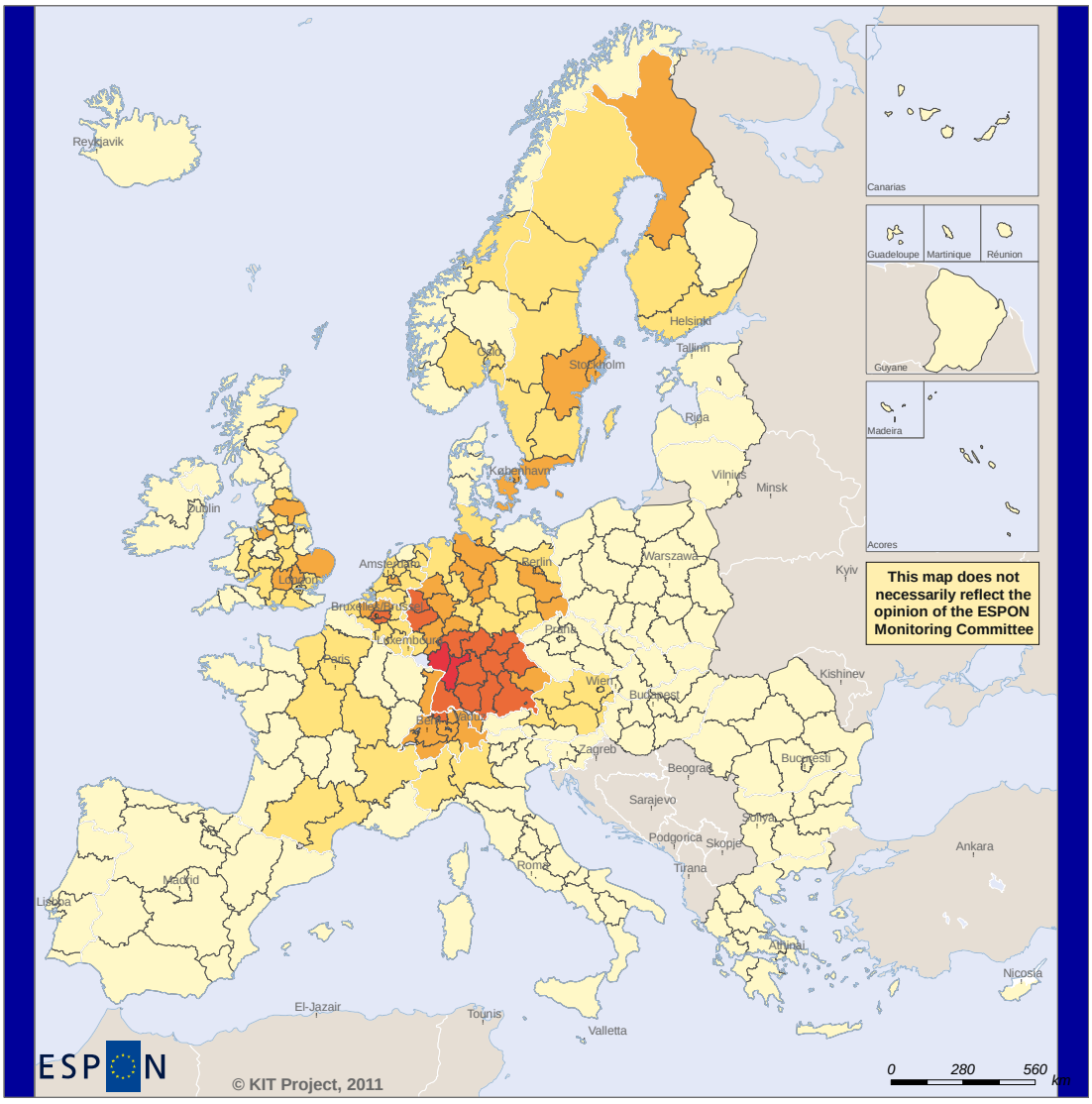
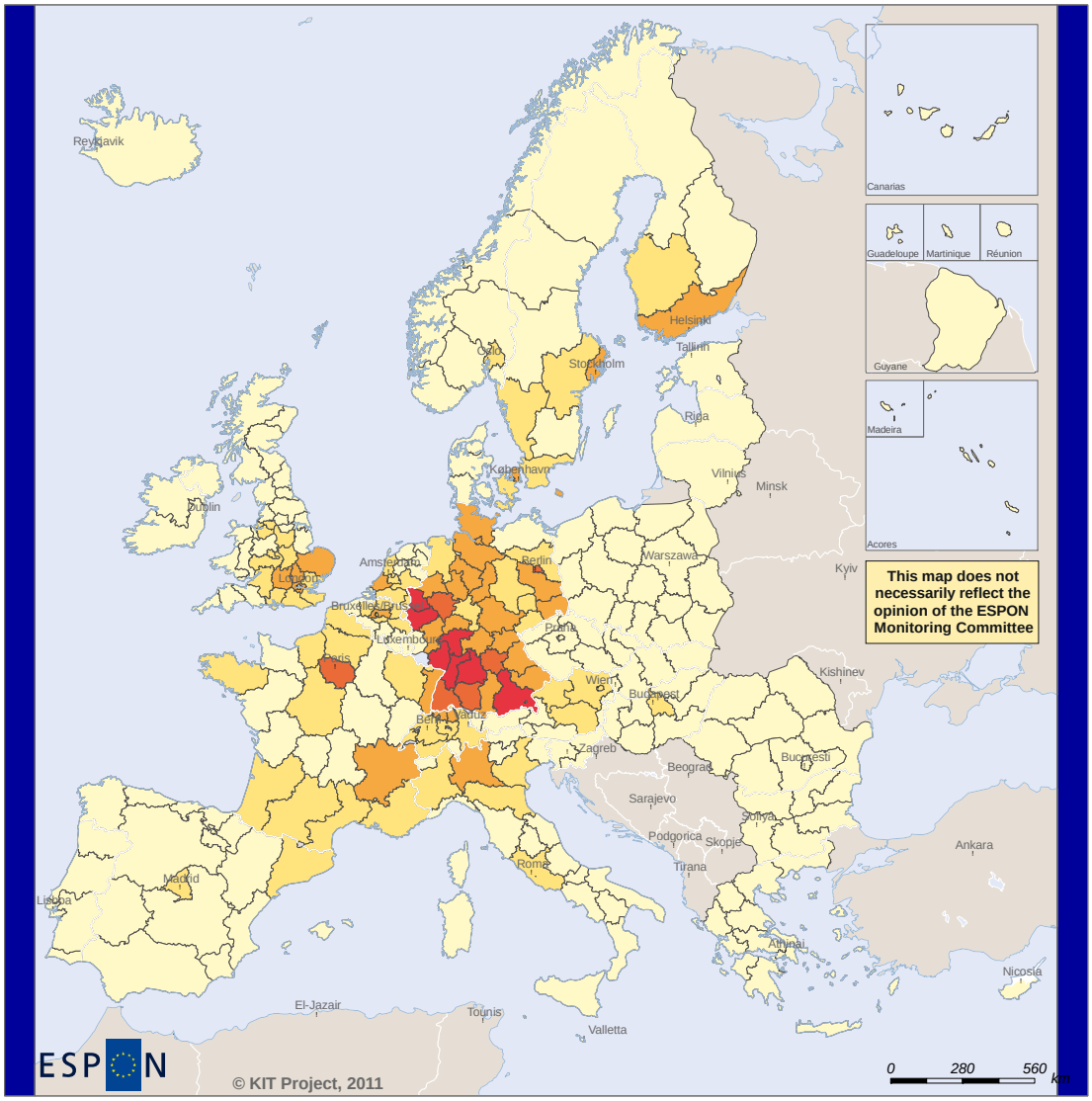
Co-patenting, average 1995-1997

- 0 - 129
- 130 - 376
- 377 - 796
- 797 - 1971
- 1972 - 4393

Map 45. Co-patents. Average 1995-1997



Map 46. Co-patents per capita. Average 1995-1997



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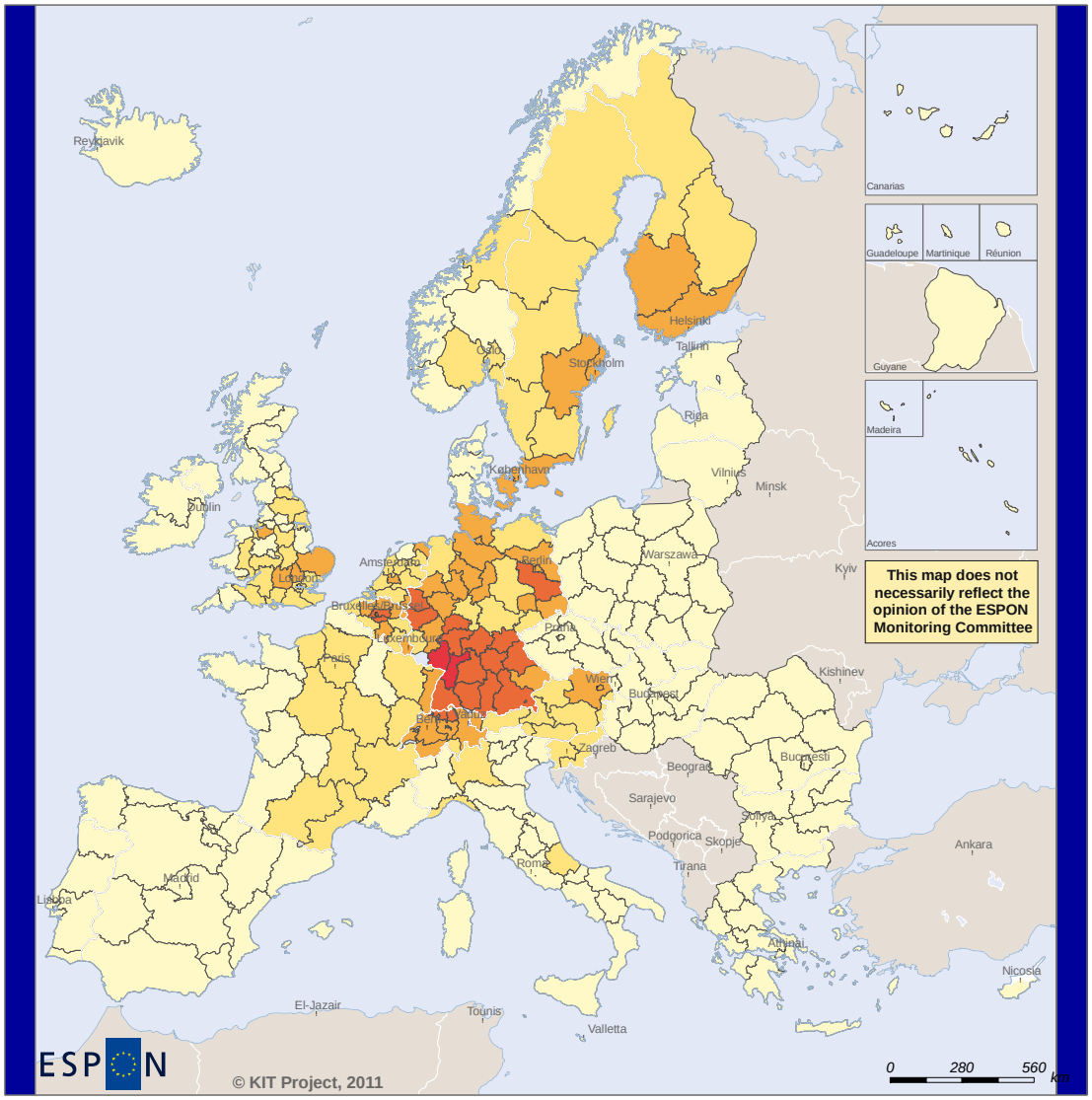
Co-patenting, average 1998-2000

- 0 - 207
- 208 - 658
- 659 - 1350
- 1351 - 2738
- 2739 - 5446

Map 47. Co-patents. Average 1998-2000



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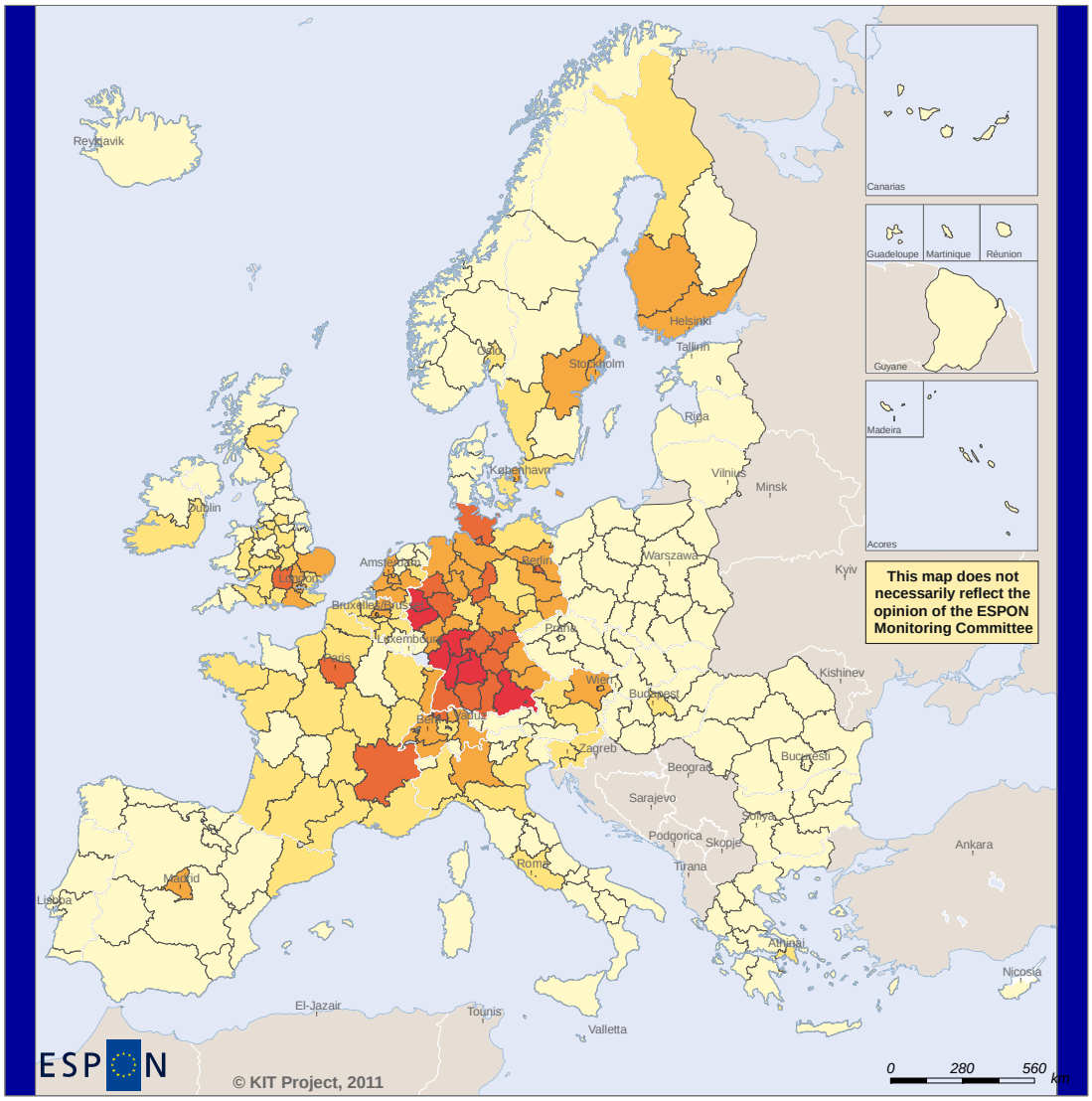
Co-patenting per capita, average 1998-2000

- 0 - 106
- 107 - 291
- 292 - 605
- 606 - 1364
- 1365 - 2580

Map 48. Co-patents per capita. Average 1998-2000



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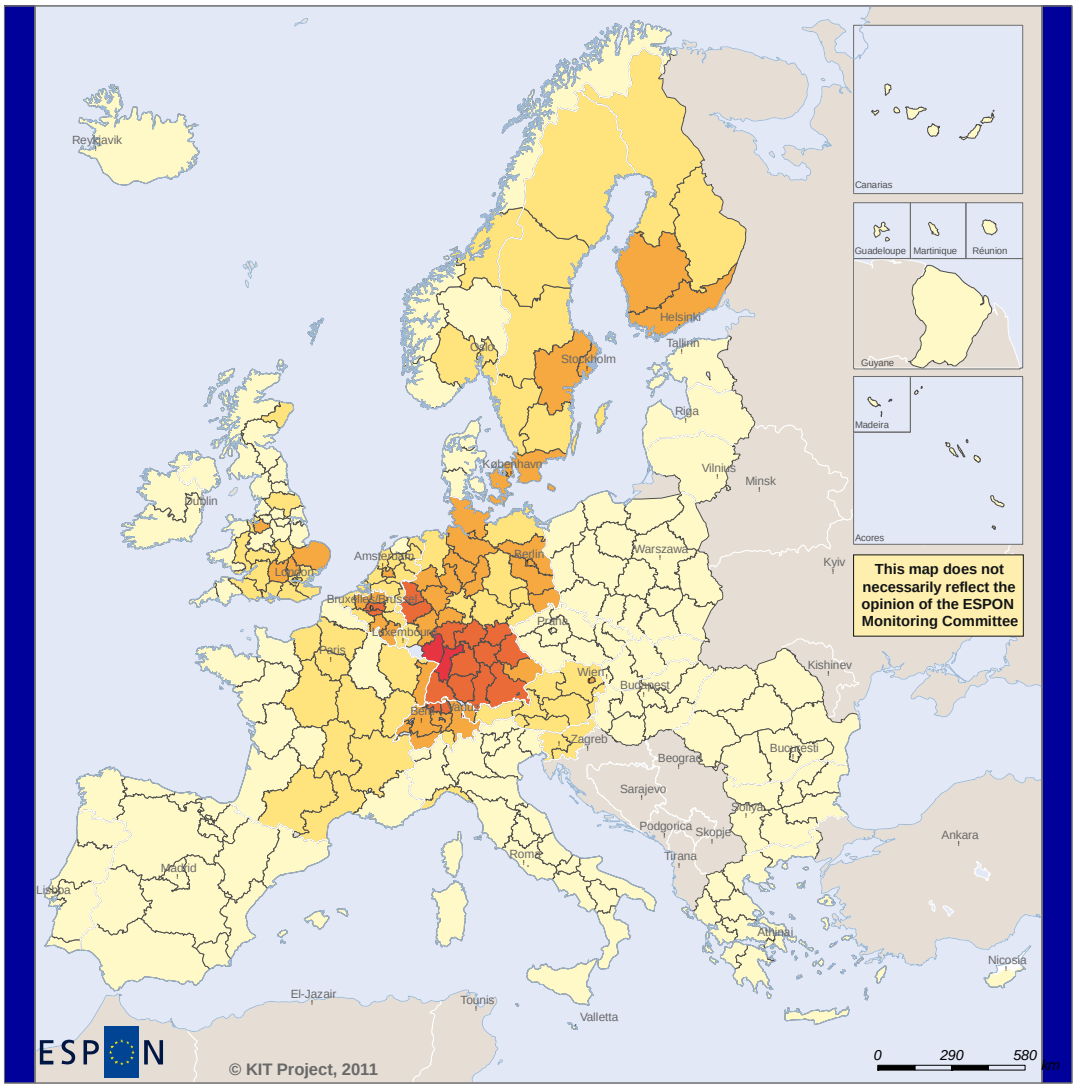
Co-patenting, average 1999-2001

- 0 - 160
- 161 - 523
- 524 - 1147
- 1148 - 2849
- 2850 - 5789

Map 49. Co-patents. Average 1999-2001



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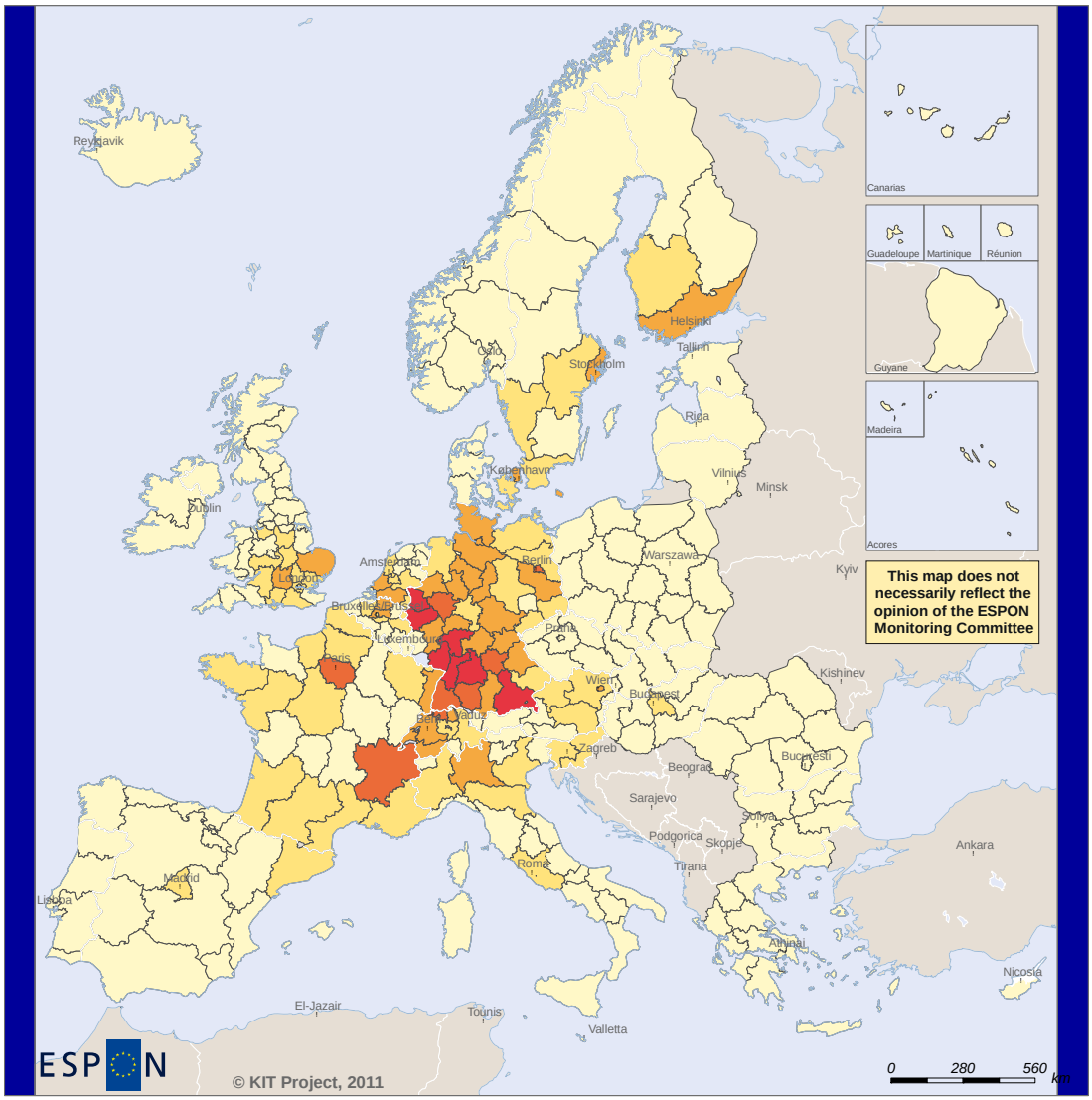
Co-patenting per capita, average 1999-2001

- 0 - 121
- 122 - 350
- 351 - 761
- 762 - 1561
- 1562 - 2694

Map 50. Co-patents per capita. Average 1999-2001



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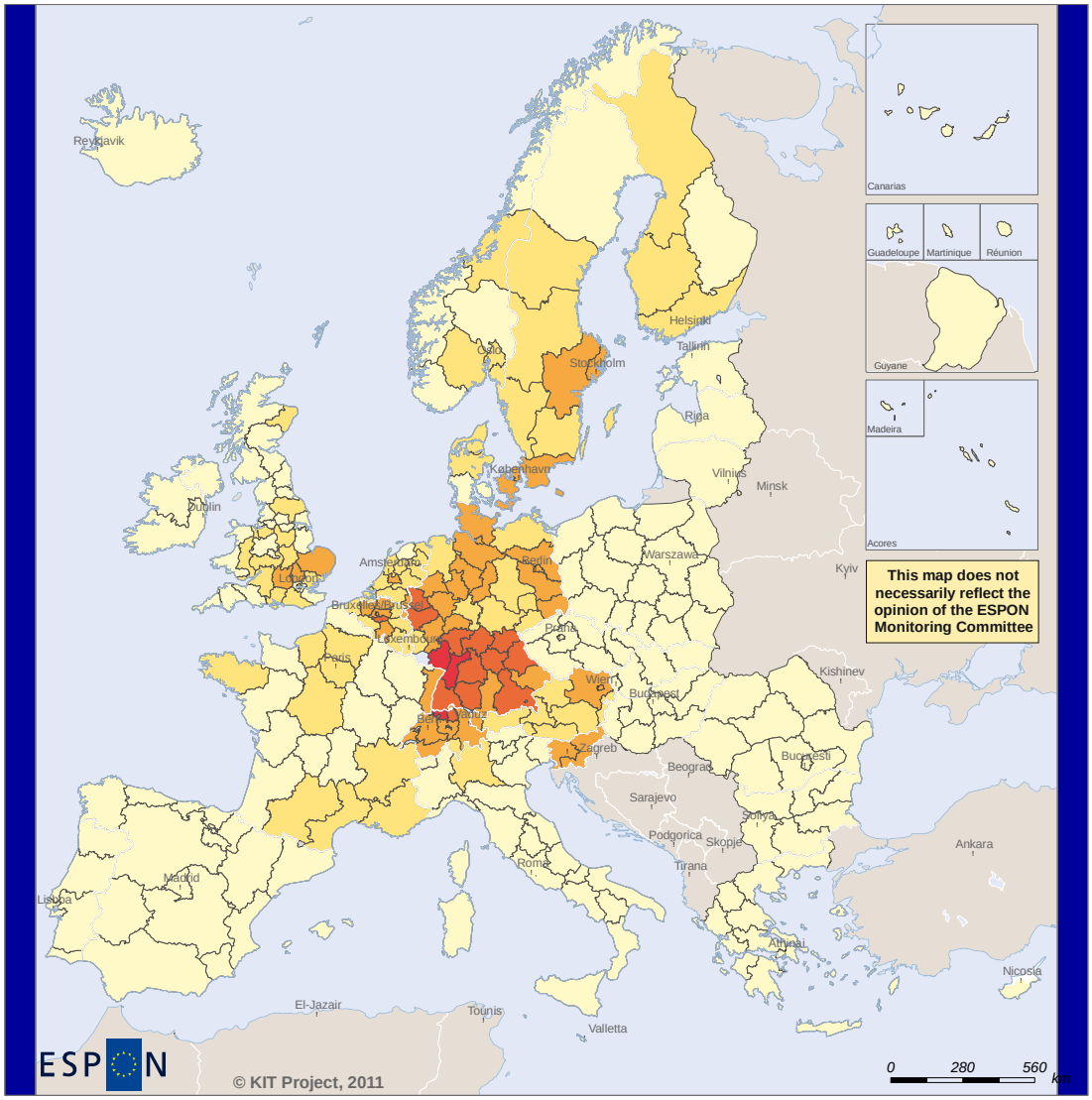
Co-patenting, average 2002-2004

- 0 - 268
- 269 - 767
- 768 - 1547
- 1548 - 2987
- 2988 - 7654

Map 51. Co-patents. Average 2002-2004



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Co-patenting per capita, average 2002-2004

- 0 - 137
- 138 - 387
- 388 - 827
- 828 - 1875
- 1876 - 3313

Map 52. Co-patents per capita. Average 2002-2004

3.3.2 Inflows of inventors

Table 72. Inventors' Inflows. Average values, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	7.67	9.64	0.18	7.31	0.94	2.39	12.22
Inflows / million POP	4.90	5.35	0.17	15.40	0.60	1.99	6.64

Table 73. Inventors' Inflows. Coefficient of variation, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	1.81	1.59	2.33	0.96	3.16	2.04	1.38
Inflows / million POP	1.84	1.16	2.65	1.83	2.96	1.80	0.98

Table 74. Inventors' Inflows. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Inflows, 95-97
		Top regions		
1	FR10	Île de France	France	97.33
2	NL41	NoordBrabant	Nederland	88.33
3	DE71	Darmstadt	Deutschland	78.00
4	DE21	Oberbayern	Deutschland	76.33
5	DEB3	RheinhessenPfalz	Deutschland	60.33
6	DE12	Karlsruhe	Deutschland	60.00
7	DE11	Stuttgart	Deutschland	54.33
8	DEA2	Köln	Deutschland	54.33
9	DEA1	Düsseldorf	Deutschland	52.00
10	DE25	Mittelfranken	Deutschland	43.00
		Bottom regions		
210	BE34	Prov. Luxembourg (B)	Belgique-België	0.33
211	FR92	Martinique (FR)	France	0.33
212	ES62	Región de Murcia	España	0.33
213	CZ08	Moravskoslezsko	Ceska Republika	0.33
214	GR23	Dytiki Ellada	Ellada	0.33
215	PT15	Algarve	Portugal	0.33
216	FR94	Reunion (FR)	France	0.33
217	ITG2	Sardegna	Italia	0.33
218	ES42	Castillala Mancha	España	0.33
219	HU22	NyugatDunántúl	Magyarorszag	0.33

Note: Regions with 0 value are PT30, PL43, FR83, PL62, PL41, PT11, FR91, CZ02, HU23, GR43, GR12, RO41, CZ04, ES11, PT20, GR22, ES63, EE00, HU33, PL32, ITF6, CZ01, PL61, GR41, GR14, CZ03, PL21, GR11, RO31, RO12, PL52, RO32, RO11, PL11, PL33, BG33, RO42, PL63, GR24, RO21, BG41, ES23, PL22, ES13, PT16, ES12, LT00, PL42, GR21, ES43, PL31, BG32, BG42, PL34, GR25, ES64, PT18, HU32, RO22, BG31, PL51, GR42, ITC2, SK04, BG34, LV00, IE01, ES70.

Table 75. Inventors' Inflows over million population. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Inflows, 95-97
		Top regions		
1	LI00	Liechtenstein	Liechtenstein	118.68
2	NL41	NoordBrabant	Nederland	38.56
3	DEB3	RheinhessenPfalz	Deutschland	30.43
4	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	26.24
5	DE25	Mittelfranken	Deutschland	25.79
6	DE23	Oberpfalz	Deutschland	23.71
7	DE14	Tübingen	Deutschland	22.97
8	DE12	Karlsruhe	Deutschland	22.65
9	DE71	Darmstadt	Deutschland	21.18
10	DE21	Oberbayern	Deutschland	19.19
		Bottom regions		
210	ES61	Andalucia	España	0.23
211	HU10	KözépMagyarország	Magyarorszag	0.23
212	CZ05	Severovýchod	Ceska Republika	0.22
213	ITG2	Sardegna	Italia	0.20
214	CZ06	Jihovýchod	Ceska Republika	0.20
215	ES42	Castillala Mancha	España	0.20
216	GR30	Attiki	Ellada	0.18
217	ES52	Comunidad Valenciana	España	0.17
218	PT17	Lisboa	Portugal	0.13
219	PL12	Mazowieckie	Polska	0.07

Note: Regions with 0 value are GR24, ITC2, BG33, PL42, ES43, GR43, PL52, BG42, PL62, PL51, PL63, BG32, PT11, HU32, PL61, CZ02, GR42, ES63, GR11, PL34, PT18, ES64, RO12, ES13, RO11, ITF6, PL21, GR14, PL32, GR21, CZ04, BG31, GR12, ES23, ES12, PL41, CZ01, FR91, FR83, EE00, PT30, RO31, RO41, LT00, GR22, PL22, HU33, RO42, LV00, RO22, IE01, RO32, PL33, GR41, BG41, PL11, HU23, PT16, BG34, GR25, ES70, SK04, PT20, CZ03, PL43, ES11, RO21, PL31.

Table 76. Inventors' Inflows. Average values, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	11.57	14.61	0.49	9.54	1.88	4.56	18.18
Inflows / million POP	6.50	7.81	0.45	10.03	1.14	3.65	9.48

Table 77. Inventors' Inflows. Coefficient of variation, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	1.84	1.61	3.56	1.12	3.16	2.11	1.42
Inflows / million POP	1.30	1.12	4.17	0.89	3.24	1.95	0.94

Table 78. Inventors' Inflows. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Inflows, 98-00
		Top regions		
1	DE21	Oberbayern	Deutschland	143.33
2	DEA2	Köln	Deutschland	140.00
3	FR10	Île de France	France	117.00
4	DE12	Karlsruhe	Deutschland	112.00
5	DE71	Darmstadt	Deutschland	105.33
6	DE11	Stuttgart	Deutschland	101.67
7	DEB3	RheinhessenPfalz	Deutschland	84.33
8	DEA1	Düsseldorf	Deutschland	81.00
9	NL41	NoordBrabant	Nederland	79.00
10	DE13	Freiburg	Deutschland	60.33
		Bottom regions		
207	ITF5	Basilicata	Italia	0.33
208	ES12	Principado de Asturias	España	0.33
209	RO32	Bucuresti Ilfov	Romania	0.33
210	ES24	Aragón	España	0.33
211	SK01	Bratislavský kraj	Slovenska Republika	0.33
212	UKE3	South Yorkshire	United Kingdom	0.33
213	HU23	DélDunántúl	Magyarorszag	0.33
214	LI00	Liechtenstein	Liechtenstein	0.33
215	CZ07	Strední Morava	Ceska Republika	0.33
216	NO07	NordNorge	Norge	0.33

Note: Regions with 0 value are PL43, RO41, HU31, FR83, FR91, PL51, MT00, GR43, ITE3, HU33, FR92, PL62, PL32, PL33, PL61, SK04, PL42, RO31, GR24, GR23, RO42, ES23, ES70, ITF2, FR93, BG33, ES62, PL31, RO21, ES64, CZ04, GR21, GR14, PL21, RO22, GR25, PT18, PL22, PL34, NO02, HU32, BG42, BG34, PT11, ES22, GR13, ES13, GR12, RO12, PT17, LT00, BG41, PT30, PT20, GR22, BG32, PL52, ES63, PT15, BG31, LV00, PL63, GR42, RO11, GR41, FR94, PL11, PT16, PL41, ES43, GR11.

Table 79. Inventors' Inflows over million population. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Inflows, 98-00
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	42.12
2	DE12	Karlsruhe	Deutschland	41.98
3	DE21	Oberbayern	Deutschland	35.78
4	NL41	NoordBrabant	Nederland	33.76
5	DEA2	Köln	Deutschland	32.93
6	DE42	Brandenburg Südwest	Deutschland	31.98
7	DE25	Mittelfranken	Deutschland	31.95
8	DE23	Oberpfalz	Deutschland	30.54
9	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	29.78
10	DE14	Tübingen	Deutschland	28.59
		Bottom regions		
207	CZ07	Strední Morava	Ceska Republika	0.27
208	UKE3	South Yorkshire	United Kingdom	0.26
209	EE00	Estonia	Eesti	0.24
210	CZ05	Severovýchod	Ceska Republika	0.22
211	ITG2	Sardegna	Italia	0.20
212	PL12	Mazowieckie	Polska	0.20
213	SK02	Západné Slovensko	Slovenska Republika	0.18
214	ITF4	Puglia	Italia	0.16
215	ES21	Pais Vasco	España	0.16
216	RO32	Bucuresti Ilfov	Romania	0.15

Note: Regions with 0 value are ITF2, PL51, HU31, PT20, PL21, GR42, PL34, RO21, PT18, NO02, ES70, PL62, FR83, ES23, RO22, PL42, PL61, BG32, GR21, FR93, GR25, BG41, GR22, ES63, ES43, ES64, HU32, FR92, MT00, BG33, SK04, GR43, GR41, PL52, PT11, PT30, FR94, GR13, RO42, BG31, RO12, ITE3, PL41, PL32, BG34, PL43, RO41, ES22, PT17, GR12, RO31, PL33, FR91, PT15, GR23, GR14, ES62, CZ04, GR11, HU33, PL22, ES13, PL31, BG42, RO11, LT00, GR24, LV00, PL63, PT16, PL11.

Table 80. Inventors' Inflows. Average values, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	12.38	15.60	0.60	10.46	2.03	4.75	19.46
Inflows / million POP	6.98	8.23	0.55	12.70	1.26	3.50	10.06

Table 81. Inventors' Inflows. Coefficient of variation, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	1.86	1.64	3.33	1.14	2.87	2.05	1.45
Inflows / million POP	1.35	1.16	3.88	0.99	2.90	1.92	0.98

Table 82. Inventors' Inflows. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Inflows, 99-01
		Top regions		
1	DEA2	Köln	Deutschland	153.67
2	DE21	Oberbayern	Deutschland	146.00
3	FR10	Île de France	France	126.00
4	DE12	Karlsruhe	Deutschland	115.33
5	DE11	Stuttgart	Deutschland	114.33
6	DE71	Darmstadt	Deutschland	113.33
7	NL41	NoordBrabant	Nederland	107.33
8	DEB3	RheinhessenPfalz	Deutschland	95.67
9	DEA1	Düsseldorf	Deutschland	90.33
10	FR71	RhôneAlpes	France	66.67
		Bottom regions		
211	SK02	Západné Slovensko	Slovenska Republika	0.33
212	ES24	Aragón	España	0.33
213	HU22	NyugatDunántúl	Magyarorszag	0.33
214	CZ07	Strední Morava	Ceska Republika	0.33
215	HU31	ÉszakMagyarország	Magyarorszag	0.33
216	GR43	Kriti	Ellada	0.33
217	HU23	DélDunántúl	Magyarorszag	0.33
218	ITF5	Basilicata	Italia	0.33
219	HU21	KözépDunántúl	Magyarorszag	0.33
220	GR23	Dytiki Ellada	Ellada	0.33

Note: Regions with 0 value are PT11, PL62, PL52, CZ04, GR21, BG32, BG31, ES13, PL32, HU32, FR94, RO22, PT20, PT30, GR12, FR93, HU33, GR42, BG33, GR41, ES53, PL11, BG42, PL22, RO42, ITF2, GR22, ES12, RO21, PL21, SK04, RO31, CY00, PL51, ES62, PL34, GR24, FR92, GR13, GR25, PL43, ITE3, ES64, FR83, GR14, PL31, MT00, RO12, ES23, BG34, BG41, PT15, NO02, PL42, PL33, PL61, PT17, ES63, IS00, LT00, RO11, NO07, PL63, PT18, RO41, PT16, LV00.

Table 83. Inventors' Inflows over million population. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Inflows, 99-01
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	47.77
2	NL41	NoordBrabant	Nederland	45.47
3	DE12	Karlsruhe	Deutschland	43.11
4	LI00	Liechtenstein	Liechtenstein	40.57
5	DE25	Mittelfranken	Deutschland	37.41
6	DE21	Oberbayern	Deutschland	36.19
7	DEA2	Köln	Deutschland	36.04
8	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	33.41
9	DE23	Oberpfalz	Deutschland	32.28
10	DE14	Tübingen	Deutschland	31.68
		Bottom regions		
211	ES24	Aragón	España	0.28
212	CZ07	Střední Morava	Ceska Republika	0.27
213	HU31	ÉszakMagyarország	Magyarorszag	0.26
214	EE00	Estonia	Eesti	0.24
215	PL12	Mazowieckie	Polska	0.20
216	ES70	Canarias (ES)	España	0.19
217	SK02	Západné Slovensko	Slovenska Republika	0.18
218	RO32	Bucuresti Ilfov	Romania	0.15
219	PL41	Wielkopolskie	Polska	0.10
220	ITF4	Puglia	Italia	0.08

Note: Regions with 0 value are MT00, PT30, LT00, PL21, FR94, RO22, GR14, PL52, PT16, FR93, PT11, GR42, PT18, ES12, ES63, GR22, RO11, RO31, PL43, PL31, GR13, PL42, BG34, GR24, PL33, ES23, RO41, CZ04, ES13, GR21, PL63, FR83, PL51, ITE3, PL32, PL11, PT20, GR12, PL22, ITF2, GR41, BG31, RO12, IS00, CY00, ES62, RO21, BG42, FR92, NO02, LV00, BG33, GR25, PT17, ES64, PL34, SK04, PL62, ES53, NO07, PT15, HU32, HU33, PL61, BG32, BG41, RO42.

Table 84. Inventors' Inflows. Average values, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	13.68	17.10	1.25	11.21	2.14	4.07	21.80
Inflows / million POP	7.39	8.56	1.18	13.38	1.63	3.23	10.58

Table 85. 30 Inventors' Inflows. Coefficient of variation, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Inflows	2.26	2.03	4.20	1.13	2.74	1.99	1.80
Inflows / million POP	1.55	1.39	4.71	0.93	3.16	1.83	1.22

Table 86. Inventors' Inflows. Top and bottom ten regions, 2002-2004

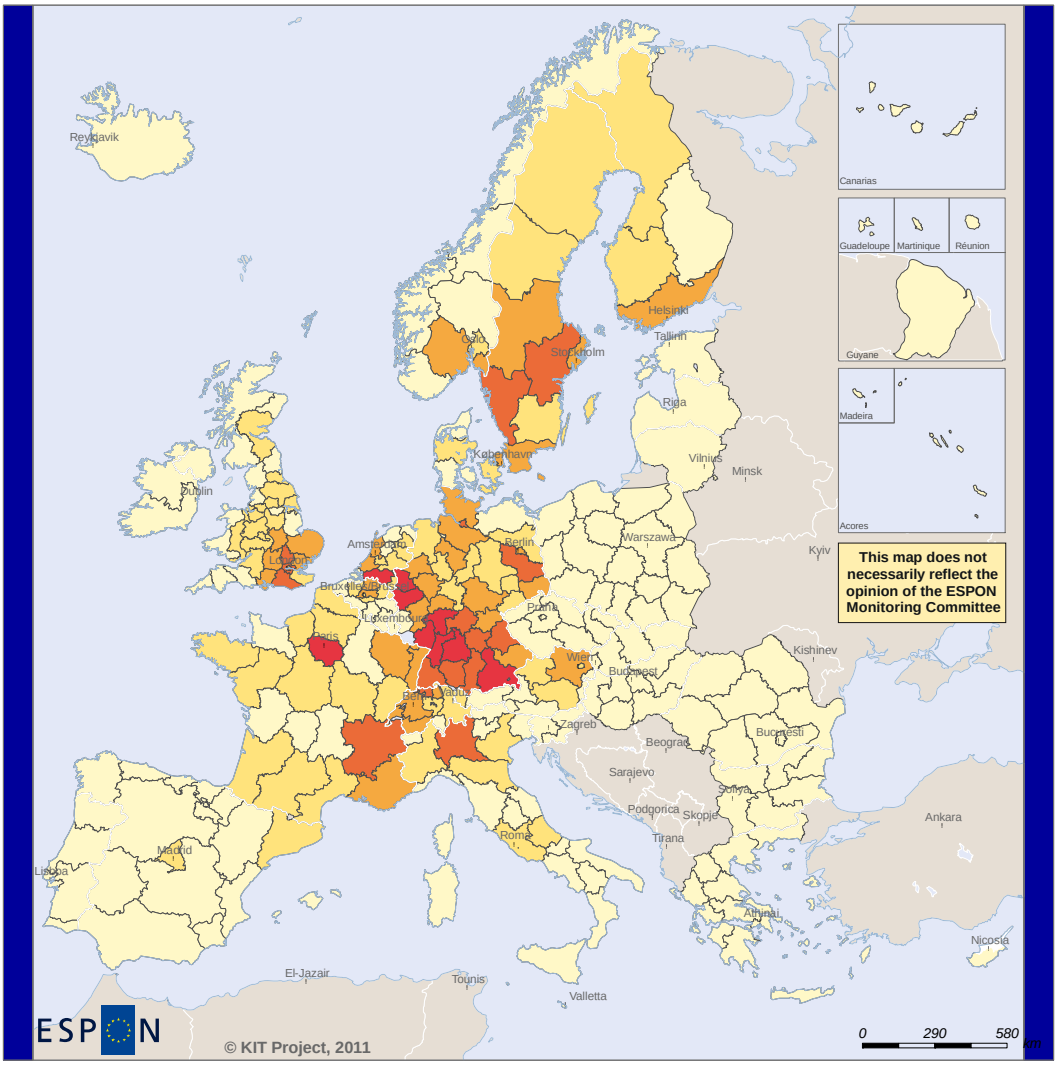
Position	Region code	Region name	Country	Inflows, 02-04
		Top regions		
1	NL41	NoordBrabant	Nederland	279.67
2	FR10	Île de France	France	259.67
3	DEA2	Köln	Deutschland	175.33
4	UKJ2	Surrey, East and West Sussex	United Kingdom	165.00
5	DE21	Oberbayern	Deutschland	123.00
6	DE12	Karlsruhe	Deutschland	115.00
7	DE11	Stuttgart	Deutschland	105.67
8	DE71	Darmstadt	Deutschland	96.67
9	DEA1	Düsseldorf	Deutschland	81.00
10	DEB3	RheinhessenPfalz	Deutschland	69.33
		Bottom regions		
226	CZ03	Jihozápad	Ceska Republika	0.33
227	PT11	Norte	Portugal	0.33
228	BG31	Severozapaden	Bulgaria	0.33
229	PL41	Wielkopolskie	Polska	0.33
230	RO41	SudVest Oltenia	Romania	0.33
231	HU23	DélDunántúl	Magyarorszag	0.33
232	LV00	Latvia	Latvija	0.33
233	CZ06	Jihovýchod	Ceska Republika	0.33
234	GR11	Anatoliki Makedonia, Thraki	Ellada	0.33
235	FR91	Guadeloupe (FR)	France	0.33

Note: Regions with 0 value are PL31, ES12, PL52, RO12, PL33, FR83, GR23, BG42, PL21, PL34, ES70, ES63, RO32, PL63, GR21, RO21, PL43, GR24, SK04, GR14, PT15, GR22, LT00, PL11, RO11, ES64, GR42, GR25, PT18, RO42, HU22, BG41, PL32, PL62, CZ04, ES11, PL61, CY00, PL22, HU31, BG32, PL42, ES43, GR13, ES13, RO22, BG34, PT20, BG33, ITF2, RO31, GR41.

Table 87. Inventors' Inflows over million population. Top and bottom ten regions, 2002-2004

Position	Region code	Region name	Country	Inflows, 02-04
		Top regions		
1	NL41	NoordBrabant	Nederland	116.46
2	UKJ2	Surrey, East and West Sussex	United Kingdom	64.23
3	DE12	Karlsruhe	Deutschland	42.40
4	DEA2	Köln	Deutschland	40.48
5	LI00	Liechtenstein	Liechtenstein	39.25
6	SI02	Zahodna Slovenija	Slovenija	38.57
7	DE25	Mittelfranken	Deutschland	37.00
8	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	36.50
9	DEB3	RheinhessenPfalz	Deutschland	34.42
10	DE24	Oberfranken	Deutschland	34.17
		Bottom regions		
226	EE00	Estonia	Eesti	0.25
227	HU33	DélAlföld	Magyarorszag	0.24
228	CZ05	Severovýchod	Ceska Republika	0.22
229	CZ06	Jihovýchod	Ceska Republika	0.20
230	PL12	Mazowieckie	Polska	0.20
231	SK02	Západné Slovensko	Slovenska Republika	0.18
232	LV00	Latvia	Latvija	0.14
233	RO41	SudVest Oltenia	Romania	0.14
234	PL41	Wielkopolskie	Polska	0.10
235	PT11	Norte	Portugal	0.09

Note: Regions with 0 value are PT18, PL31, BG33, RO42, RO12, RO21, PL21, BG34, GR41, GR13, HU22, RO22, ES13, PL52, PL61, PT15, PL43, PL11, GR22, BG41, SK04, GR21, ES63, PT20, GR23, HU31, RO31, PL32, GR14, PL33, PL62, PL42, ES11, ES43, RO11, PL34, GR42, ES64, GR24, RO32, LT00, ES12, BG32, CY00, GR25, ES70, ITF2, CZ04, PL22, BG42, PL63, FR83.



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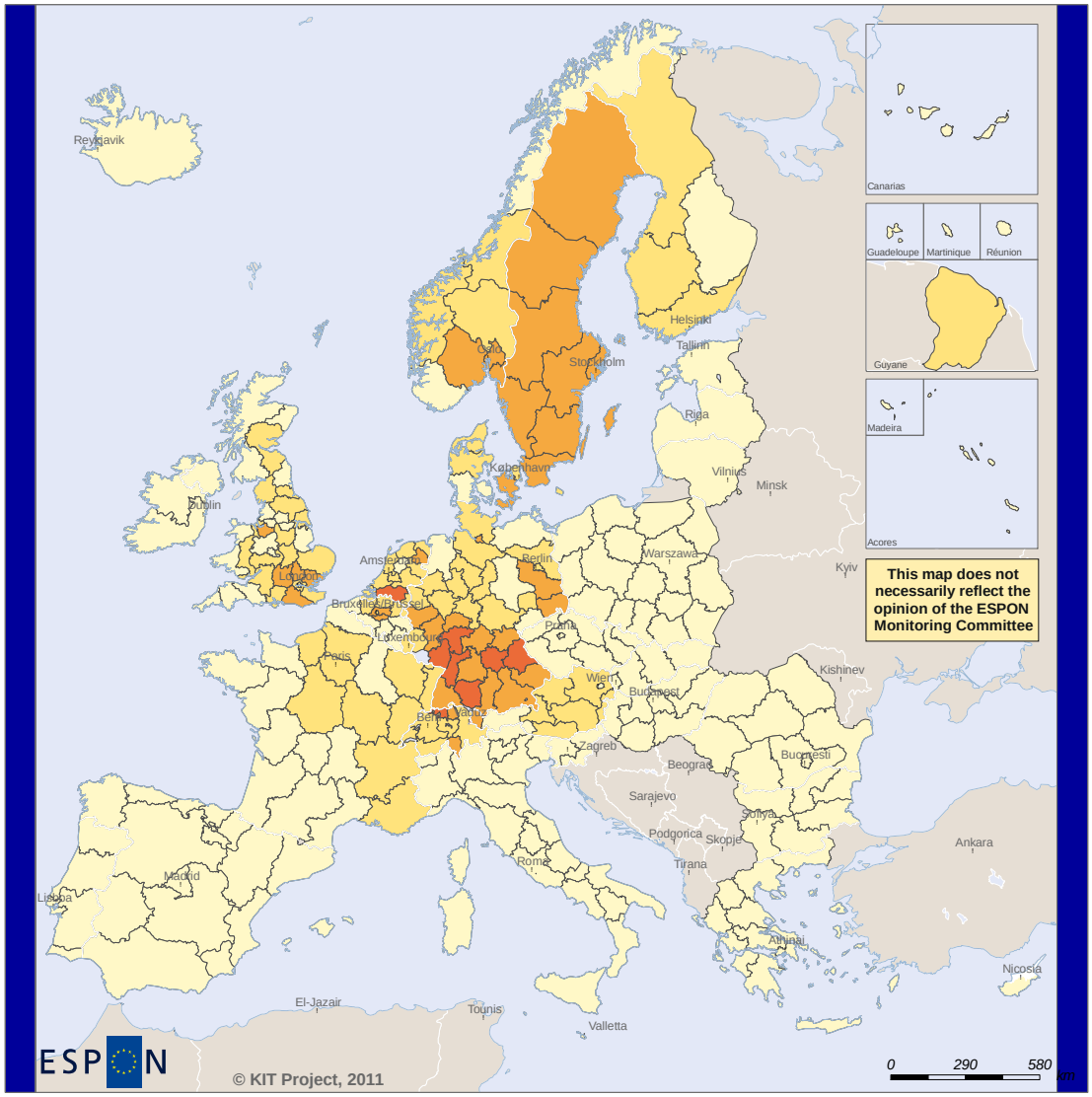
Inventors' inflows, average 1995-1997

- 0,0 - 3,6
- 3,7 - 11,0
- 11,1 - 21,6
- 21,7 - 43,0
- 43,1 - 97,3

Map 53. Inventors' inflows. Average 1995-1997



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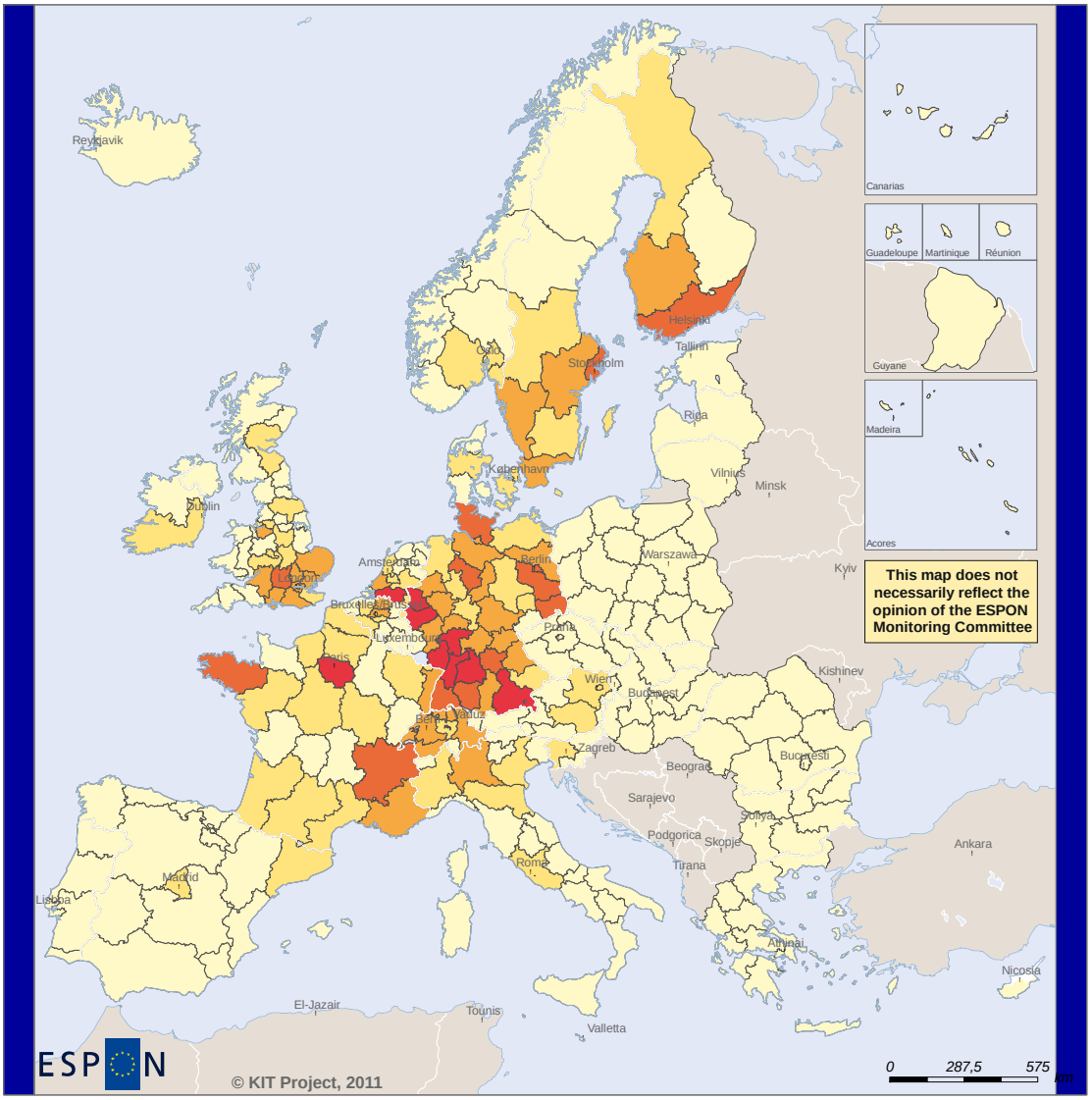
Inventors' inflows over million population, average 1995-1997

- 0,0 - 3,2
- 3,3 - 9,8
- 9,9 - 19,1
- 19,2 - 38,5
- 38,6 - 118,6

Map 54. Inventors' inflows per capita. Average 1995-1997



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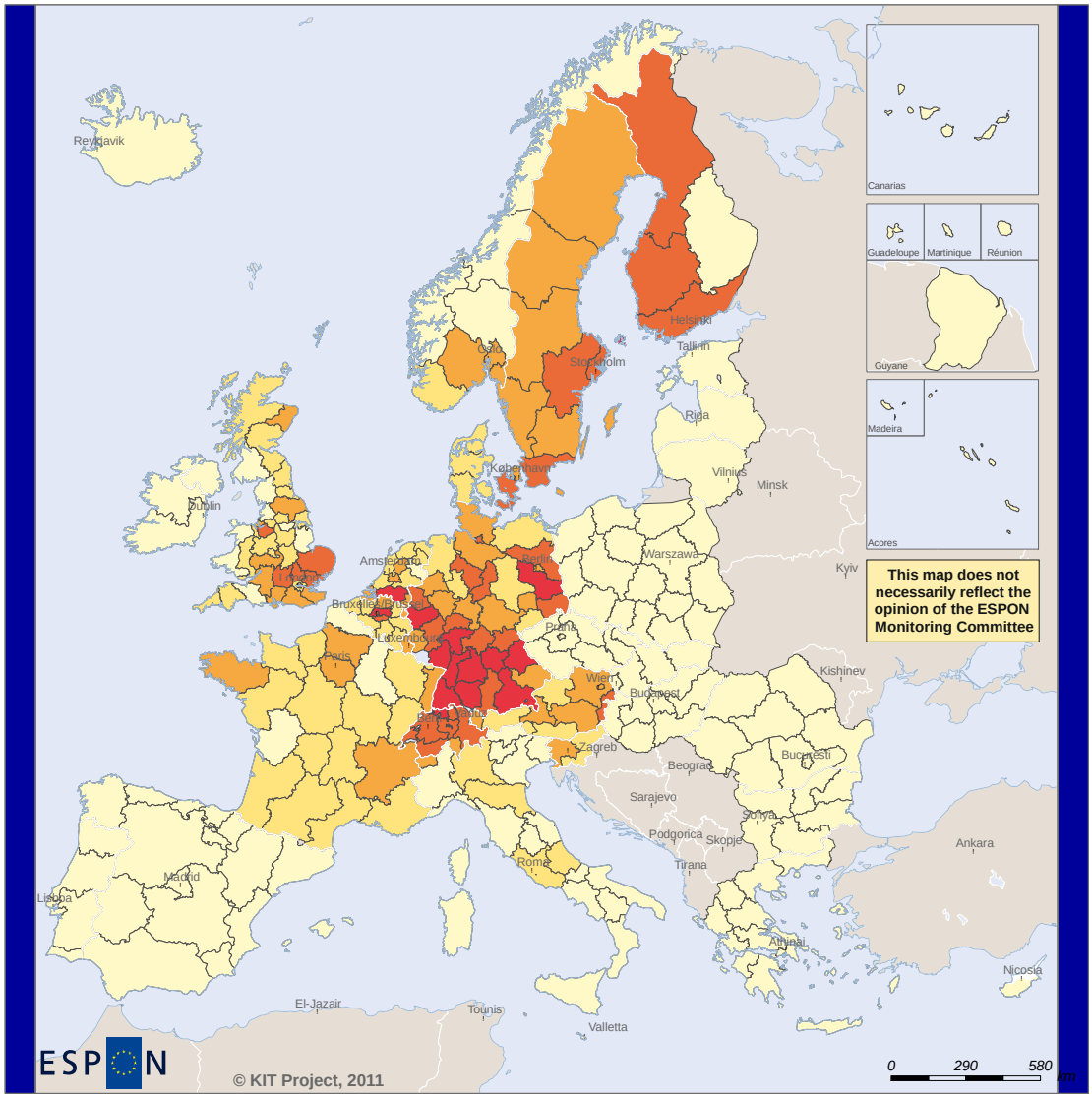
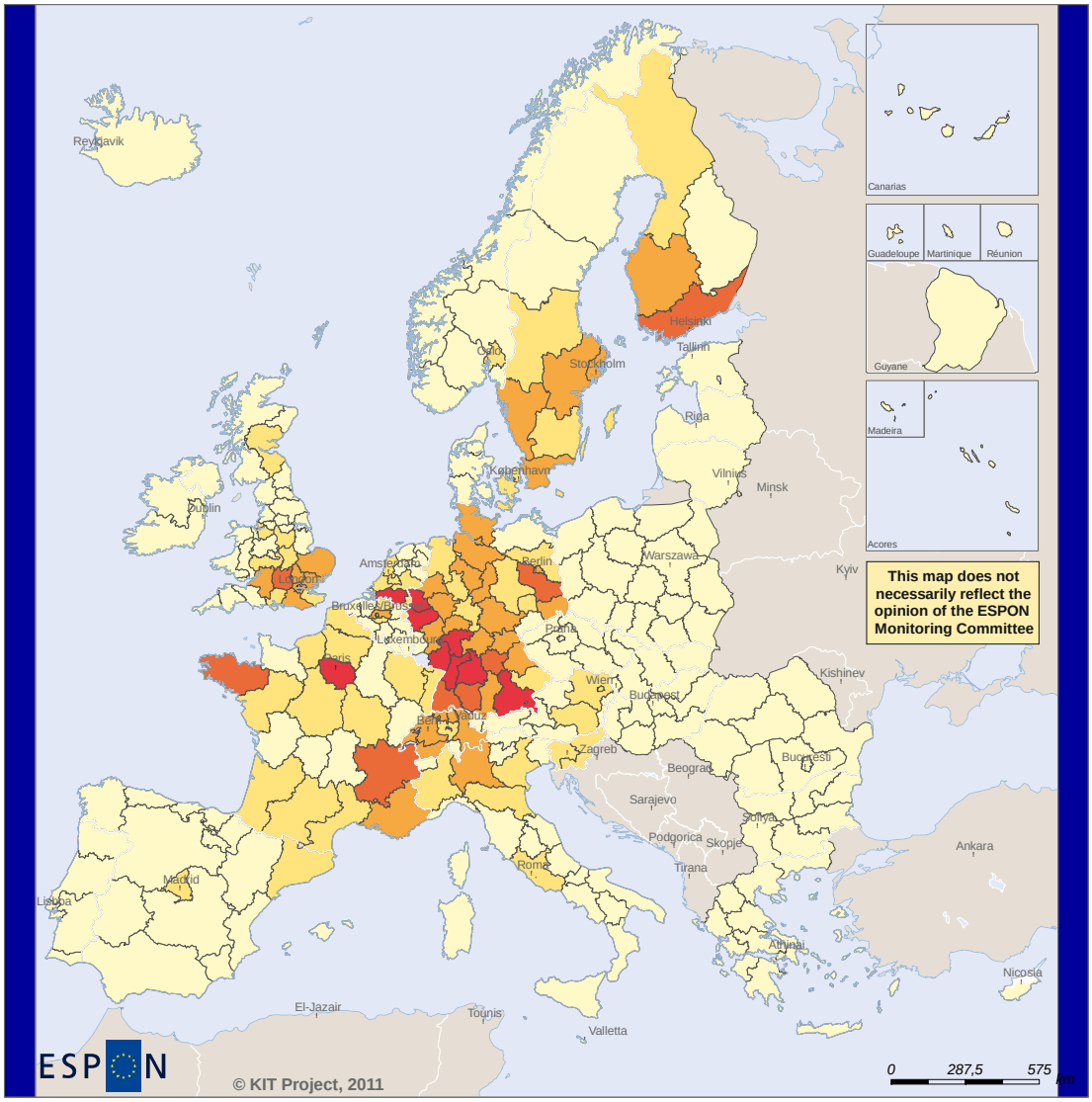
Inventors' inflows, average 1998-2000

- 0,0 - 6,0
- 6,1 - 15,6
- 15,7 - 34,3
- 34,4 - 60,3
- 60,4 - 143,3

Map 55. Inventors' inflows. Average 1998-2000.



Map 56. Inventors' inflows per capita. Average 1998-2000



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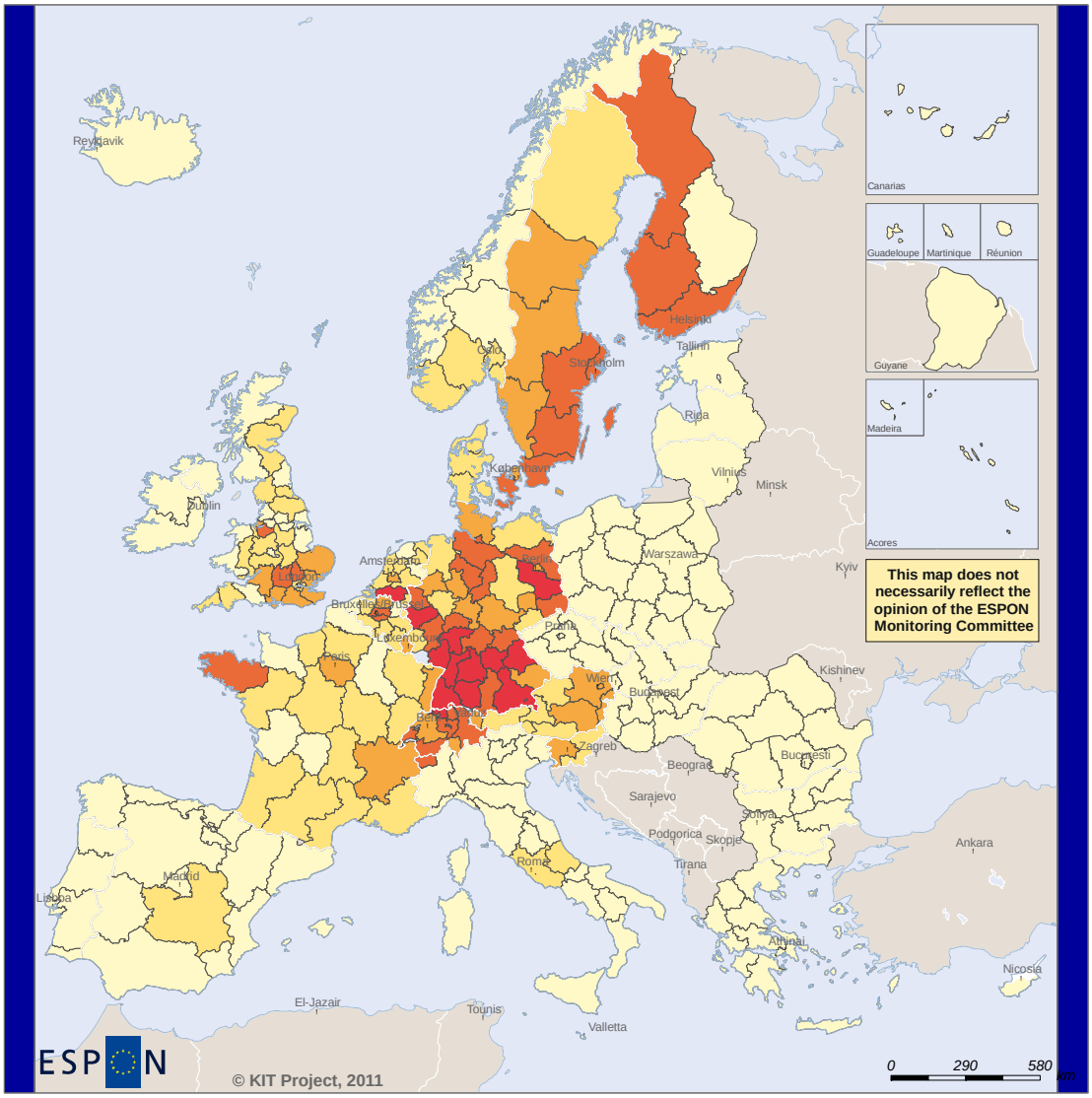
Inventors' inflows, average 1999-2001

- 0,0 - 7,3
- 7,4 - 20,6
- 20,7 - 40,0
- 40,1 - 66,6
- 66,7 - 153,6

Map 57. Inventors' inflows. Average 1999-2001



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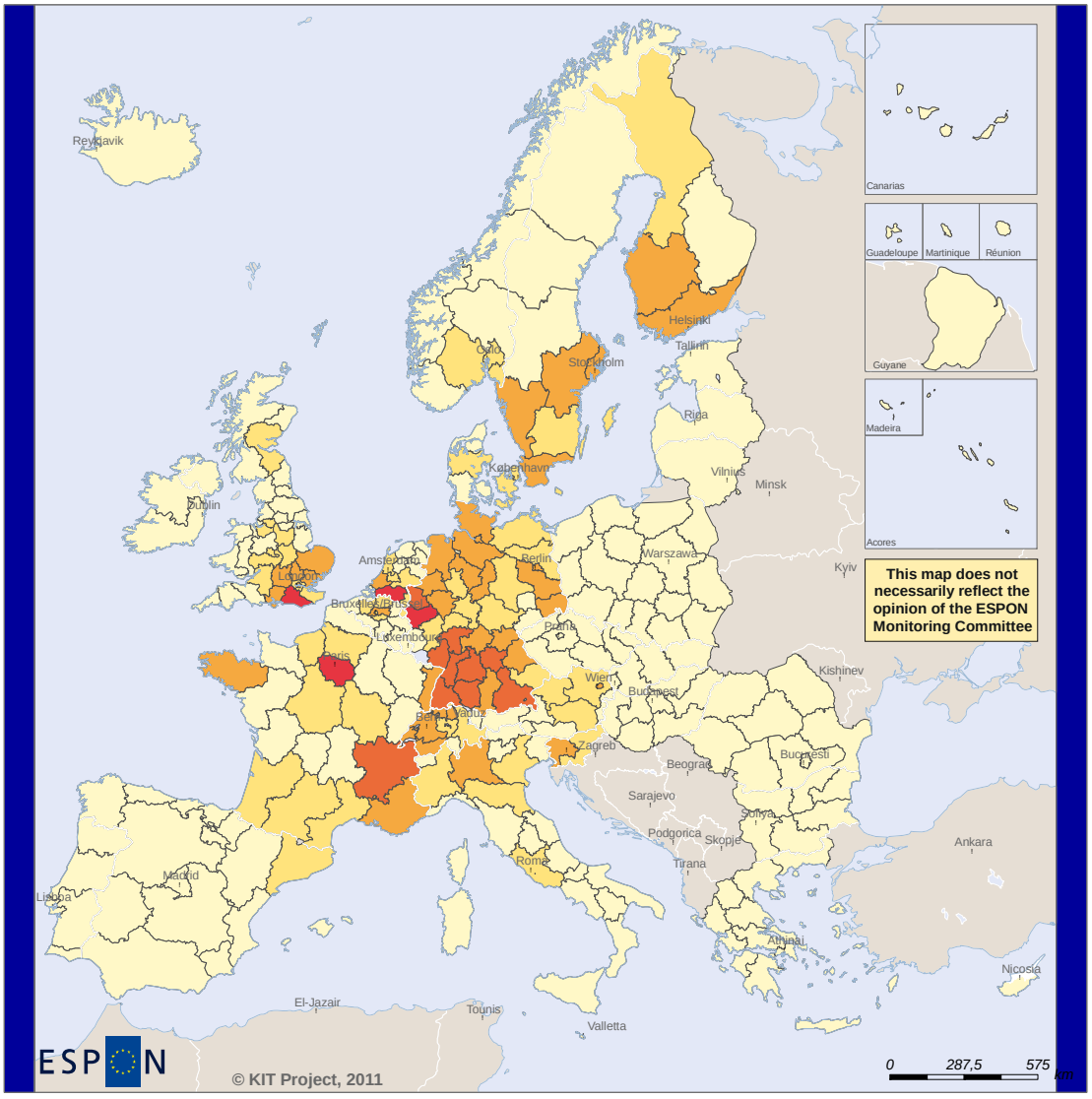
Inventors' inflows over million population, average 1999-2001

- 0,0 - 3,0
- 3,1 - 8,4
- 8,5 - 15,6
- 15,7 - 26,0
- 26,1 - 47,7

Map 58. Inventors' inflows per capita. Average 1999-2001



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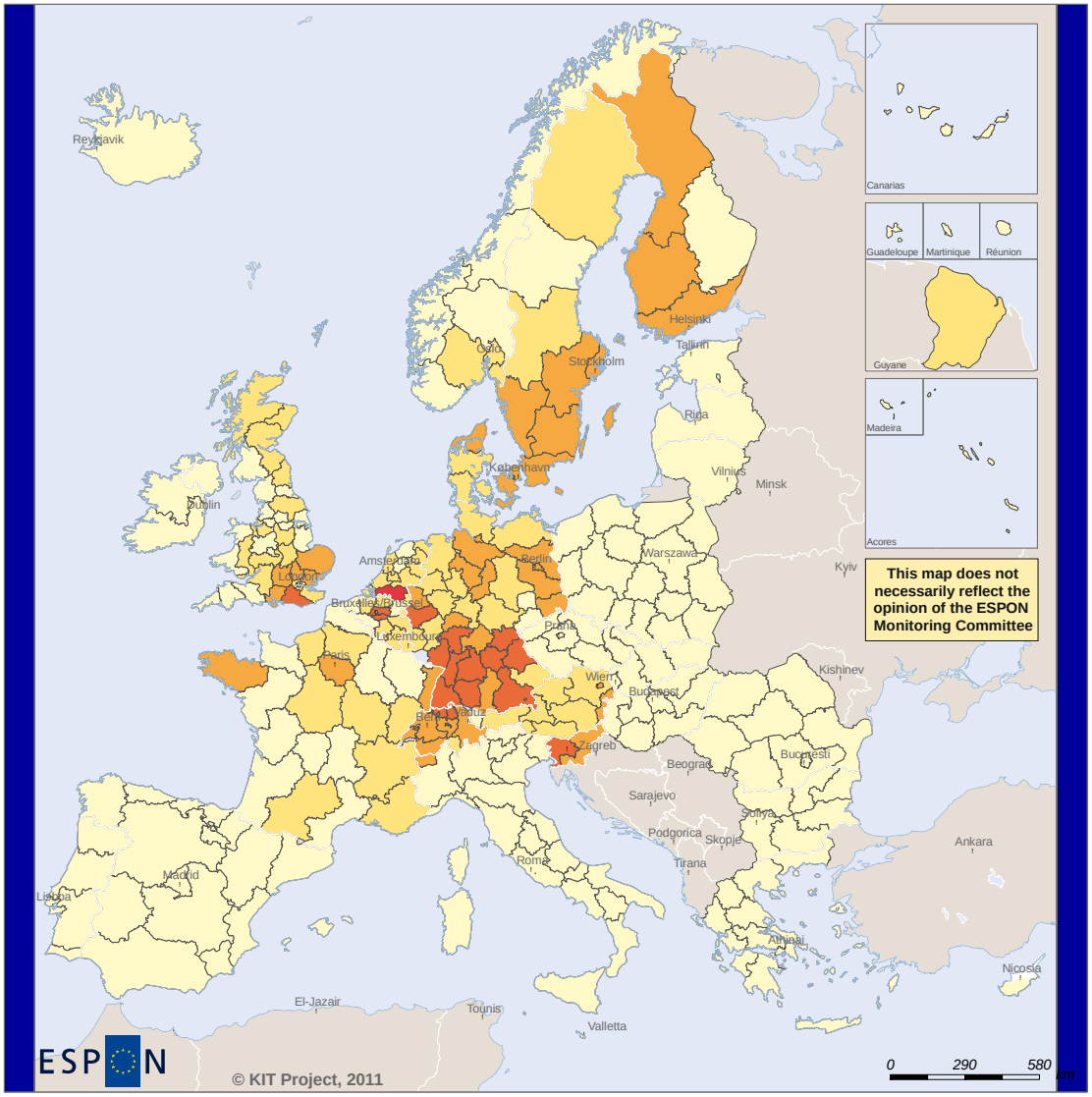
Inventors' inflows, average 2002-2004

- 0,0 - 7,3
- 7,4 - 21,3
- 21,4 - 50,0
- 50,1 - 123,0
- 123,1 - 279,6

Map 59. Inventors' inflows. Average 2002-2004



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Inventors' inflows over million population, average 2002-2004

- 0,0 - 4,2
- 4,3 - 12,0
- 12,1 - 25,0
- 25,1 - 64,2
- 64,3 - 116,4

Map 60. Inventors' inflows per capita. Average 2002-2004

3.3.3 Cross-regional citations

Table 88. Cross-regional citations. Average values, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	95.34	118.70	1.97	108.25	5.98	18.03	155.04
Citations / million POP	50.01	58.27	1.46	108.87	3.40	12.80	75.28

Table 89. Cross-regional citations. Coefficient of variation, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	1.91	1.69	1.96	1.19	2.51	1.63	1.43
Citations / million POP	1.28	1.03	1.83	1.06	2.40	1.50	0.81

Table 90. Cross-regional citations. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Citations, 95-97
		Top regions		
1	FR10	Île de France	France	1465.51
2	DE71	Darmstadt	Deutschland	1069.50
3	DE21	Oberbayern	Deutschland	1016.40
4	DE11	Stuttgart	Deutschland	981.22
5	DEA1	Düsseldorf	Deutschland	964.99
6	DEA2	Köln	Deutschland	775.49
7	DEB3	RheinhessenPfalz	Deutschland	702.95
8	ITC4	Lombardia	Italia	658.68
9	FR71	RhôneAlpes	France	652.47
10	DE12	Karlsruhe	Deutschland	633.17
		Bottom regions		
253	FR94	Reunion (FR)	France	0.25
254	FR92	Martinique (FR)	France	0.23
255	PL62	WarminskoMazurskie	Polska	0.22
256	FR91	Guadeloupe (FR)	France	0.19
257	GR23	Dytiki Ellada	Ellada	0.17
258	PL32	Podkarpackie	Polska	0.17
259	FR83	Corse	France	0.11
260	ITC2	Valle d'Aosta/Vallée d'Aoste	Italia	0.11
261	BG34	Yugoiztochen	Bulgaria	0.08
262	GR13	Dytiki Makedonia	Ellada	0.08

Note: Regions with 0 value are PL52, LI00, PL33, PT18, RO42, ES64, PT15, RO31, PT16, RO11, RO21, PL31, PL34, PL43, IS00, GR14, ES63, PL61, RO22, GR22, PT20, PT30, GR24, GR41, GR11.

Table 91. Cross-regional citations over million population. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Citations, 95-97
		Top regions		
1	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	364.91
2	DEB3	RheinhessenPfalz	Deutschland	354.49
3	DE71	Darmstadt	Deutschland	290.39
4	CH04	Zürich	Schweiz/Suisse/Svizzera	278.95
5	DE21	Oberbayern	Deutschland	255.52
6	DE11	Stuttgart	Deutschland	253.89
7	DE12	Karlsruhe	Deutschland	239.03
8	DE13	Freiburg	Deutschland	236.69
9	CH06	Zentralschweiz	Schweiz/Suisse/Svizzera	234.97
10	CH05	Ostschweiz	Schweiz/Suisse/Svizzera	210.27
		Bottom regions		
253	PL42	Zachodniopomorskie	Polska	0.19
254	PT17	Lisboa	Portugal	0.19
255	PL22	Slaskie	Polska	0.19
256	LT00	Lithuania	Lietuva	0.19
257	PL62	WarminskoMazurskie	Polska	0.15
258	RO41	SudVest Oltenia	Romania	0.14
259	PT11	Norte	Portugal	0.12
260	RO12	Centru	Romania	0.11
261	PL32	Podkarpackie	Polska	0.08
262	BG34	Yugoiztochen	Bulgaria	0.07

Note: Regions with 0 value are PT20, PT15, RO31, PL33, PL34, PL52, PL61, PT30, RO42, LI00, IS00, PT18, ES63, GR24, RO21, ES64, PL31, GR41, RO11, GR14, GR11, RO22, PL43, GR22, PT16.

Table 92. Cross-regional citations. Average values, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	135.17	168.34	3.48	150.41	10.84	30.73	218.07
Citations / million POP	72.23	84.41	2.40	152.85	5.99	21.56	108.10

Table 93. Cross-regional citations. Coefficient of variation, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	1.85	1.64	2.19	1.16	2.61	1.58	1.40
Citations / million POP	1.25	1.02	1.70	0.97	2.49	1.43	0.81

Table 94. Cross-regional citations. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Citations, 98-00
		Top regions		
1	FR10	Île de France	France	1870.49
2	DE21	Oberbayern	Deutschland	1678.16
3	DE11	Stuttgart	Deutschland	1582.61
4	DEA1	Düsseldorf	Deutschland	1262.01
5	DE71	Darmstadt	Deutschland	1244.45
6	DEA2	Köln	Deutschland	1026.07
7	DE12	Karlsruhe	Deutschland	887.00
8	ITC4	Lombardia	Italia	881.60
9	FR71	RhôneAlpes	France	822.24
10	DEB3	RheinhessenPfalz	Deutschland	727.48
		Bottom regions		
257	GR24	Sterea Ellada	Ellada	0.33
258	GR11	Anatoliki Makedonia, Thraki	Ellada	0.33
259	BG34	Yugoiztochen	Bulgaria	0.33
260	FR94	Reunion (FR)	France	0.33
261	GR21	Ipeiros	Ellada	0.32
262	FR92	Martinique (FR)	France	0.26
263	GR43	Kriti	Ellada	0.22
264	PL31	Lubelskie	Polska	0.17
265	PT15	Algarve	Portugal	0.16
266	BG42	Yuzhen tsentralen	Bulgaria	0.11

Note: Regions with 0 value are PL61, PT18, PL42, RO42, RO11, PL33, GR14, PT20, GR25, RO41, ES64, BG31, PL52, PL32, PL43, GR22, GR41, ES63, GR13, IS00, GR42.

Table 95. Cross-regional citations over million population. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Citations, 98-00
		Top regions		
1	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	462.82
2	DE21	Oberbayern	Deutschland	418.69
3	CH04	Zürich	Schweiz/Suisse/Svizzera	409.46
4	DE11	Stuttgart	Deutschland	405.61
5	DEB3	RheinhessenPfalz	Deutschland	363.37
6	DE71	Darmstadt	Deutschland	335.70
7	DE12	Karlsruhe	Deutschland	332.48
8	BE31	Prov. Brabant Wallon	Belgique-België	331.29
9	DE14	Tübingen	Deutschland	318.42
10	SE11	Stockholm	Sverige	317.39
		Bottom regions		
257	PL62	WarminskoMazurskie	Polska	0.37
258	BG34	Yugoiztochen	Bulgaria	0.27
259	RO12	Centru	Romania	0.26
260	PL22	Slaskie	Polska	0.25
261	RO22	SudEst	Romania	0.23
262	PL21	Malopolskie	Polska	0.22
263	PL41	Wielkopolskie	Polska	0.13
264	RO31	Sud Muntenia	Romania	0.10
265	PL31	Lubelskie	Polska	0.08
266	BG42	Yuzhen tsentralen	Bulgaria	0.07

Note: Regions with 0 value are GR42, ES64, IS00, GR41, RO11, RO42, ES63, PL32, PL33, PL42, GR14, PL52, RO41, GR25, PL61, GR22, PL43, PT18, PT20, BG31, GR13.

Table 96. Cross-regional citations. Average values, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	145.02	180.51	3.98	161.87	11.83	34.68	233.49
Citations / million POP	77.42	90.52	2.77	162.64	6.58	24.53	115.65

Table 97. Cross-regional citations. Coefficient of variation, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Co-patents	1.86	1.65	2.09	1.17	2.57	1.58	1.41
Co-patents / million POP	1.25	1.02	1.61	0.98	2.46	1.42	0.81

Table 98. Cross-regional citations. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Citations, 99-01
		Top regions		
1	FR10	Île de France	France	1982.45
2	DE21	Oberbayern	Deutschland	1856.23
3	DE11	Stuttgart	Deutschland	1690.10
4	DE71	Darmstadt	Deutschland	1366.36
5	DEA1	Düsseldorf	Deutschland	1337.74
6	DEA2	Köln	Deutschland	1156.53
7	ITC4	Lombardia	Italia	944.36
8	DE12	Karlsruhe	Deutschland	942.21
9	FR71	RhôneAlpes	France	829.96
10	DEB3	RheinhessenPfalz	Deutschland	797.52
		Bottom regions		
256	GR11	Anatoliki Makedonia, Thraki	Ellada	0.33
257	RO31	Sud Muntenia	Romania	0.33
258	GR42	Notio Aigaio	Ellada	0.33
259	FR94	Reunion (FR)	France	0.33
260	FR92	Martinique (FR)	France	0.26
261	PL31	Lubelskie	Polska	0.17
262	GR21	Ipeiros	Ellada	0.15
263	RO41	SudVest Oltenia	Romania	0.11
264	LI00	Liechtenstein	Liechtenstein	0.11
265	PT15	Algarve	Portugal	0.08

Note: Regions with 0 value are PT20, GR13, GR22, PT18, IS00, PL61, PL33, ES63, RO12, GR24, BG34, RO42, PL42, PL43, GR41, ES64, PL52, GR14, BG31, GR25, RO11, PL32.

Table 99. Cross-regional citations over million population. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Citations, 99-01
		Top regions		
1	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	505.88
2	DE21	Oberbayern	Deutschland	459.53
3	CH04	Zürich	Schweiz/Suisse/Svizzera	444.02
4	DE11	Stuttgart	Deutschland	431.34
5	DEB3	RheinhessenPfalz	Deutschland	398.19
6	BE31	Prov. Brabant Wallon	Belgique-België	373.20
7	DE71	Darmstadt	Deutschland	367.22
8	DE12	Karlsruhe	Deutschland	352.11
9	DE14	Tübingen	Deutschland	322.16
10	DE25	Mittelfranken	Deutschland	316.84
		Bottom regions		
256	BG32	Severen tsentralen	Bulgaria	0.41
257	PL62	WarminskoMazurskie	Polska	0.29
258	PL51	Dolnoslaskie	Polska	0.28
259	PL22	Slaskie	Polska	0.27
260	RO22	SudEst	Romania	0.23
261	PT15	Algarve	Portugal	0.23
262	BG42	Yuzhen tsentralen	Bulgaria	0.22
263	RO31	Sud Muntenia	Romania	0.10
264	PL31	Lubelskie	Polska	0.08
265	RO41	SudVest Oltenia	Romania	0.05

Note: Regions with 0 value are GR22, ES64, PT18, GR13, PL52, GR24, PL43, ES63, RO11, PT20, PL42, IS00, BG34, GR41, PL61, BG31, RO42, GR25, GR14, RO12, PL32, PL33.

Table 100. Cross-regional citations. Average values, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	134.41	167.50	5.23	141.84	12.66	31.43	216.51
Citations / million POP	69.35	81.11	3.81	140.75	7.23	22.57	103.31

Table 101. Cross-regional citations. Coefficient of variation, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Citations	1.86	1.65	1.83	1.13	2.43	1.42	1.41
Citations / million POP	1.26	1.05	1.78	0.95	2.31	1.26	0.84

Table 102. Cross-regional citations. Top and bottom ten regions, 2002-2004

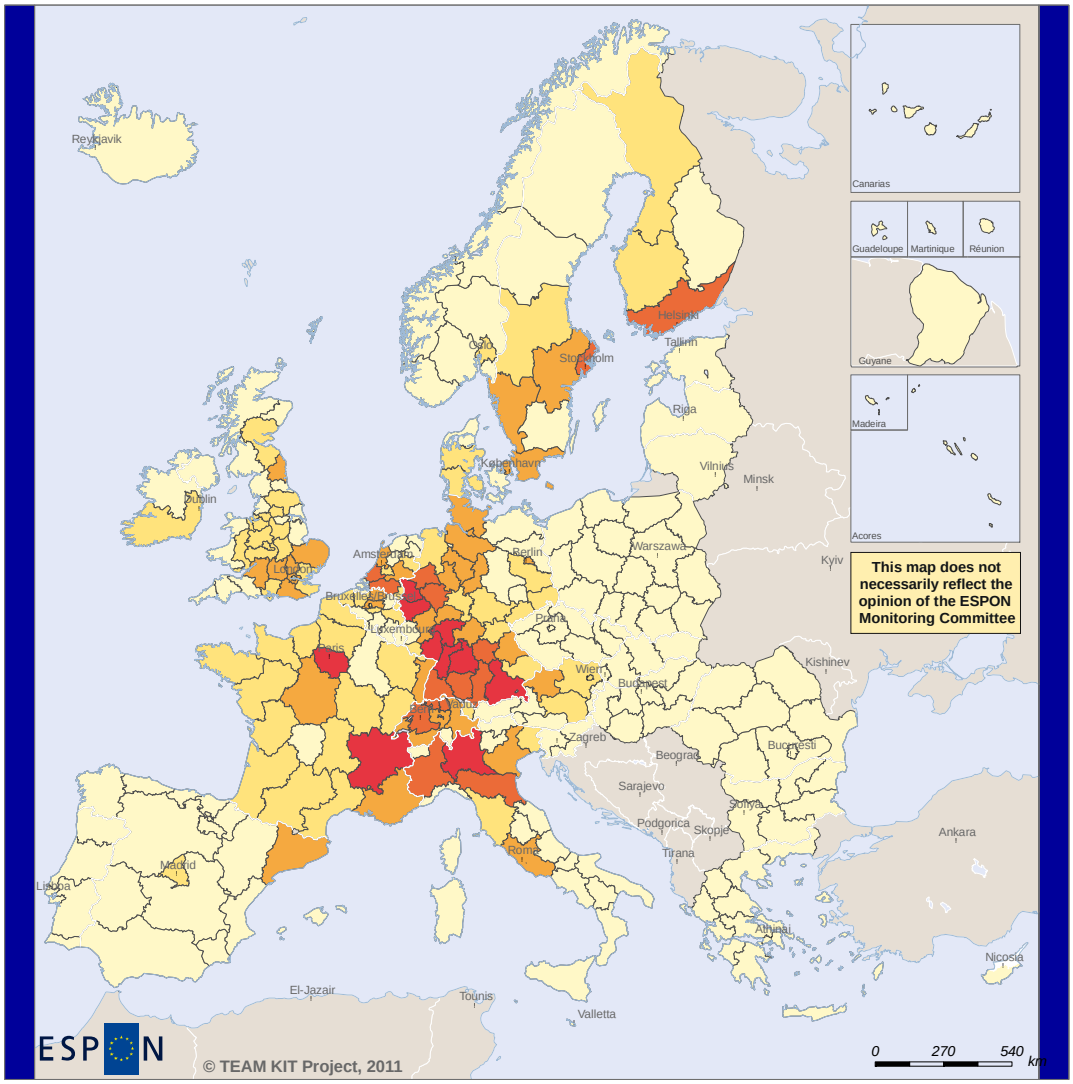
Position	Region code	Region name	Country	Citations, 02-04
		Top regions		
1	FR10	Île de France	France	1838.81
2	DE11	Stuttgart	Deutschland	1752.25
3	DE21	Oberbayern	Deutschland	1564.87
4	DE71	Darmstadt	Deutschland	1153.40
5	DEA1	Düsseldorf	Deutschland	1125.22
6	DEA2	Köln	Deutschland	1039.20
7	DE12	Karlsruhe	Deutschland	957.49
8	FR71	RhôneAlpes	France	861.41
9	ITC4	Lombardia	Italia	860.85
10	NL41	NoordBrabant	Nederland	796.37
		Bottom regions		
265	GR41	Voreio Aigaio	Ellada	0.33
266	GR42	Notio Aigaio	Ellada	0.33
267	FR93	Guyane (FR)	France	0.33
268	PL32	Podkarpackie	Polska	0.33
269	RO21	NordEst	Romania	0.11
270	FI20	Åland	Suomi / Finland	0.11
271	FR91	Guadeloupe (FR)	France	0.08
272	RO11	NordVest	Romania	0.04
273	RO41	SudVest Oltenia	Romania	0.04
274	RO31	Sud Muntenia	Romania	0.02

Note: Regions with 0 value are ES63, PT18, RO22, PL42, GR11, PT20, PL52, IS00, PL62, ES64, GR13, PL61, GR22.

Table 103. Cross-regional citations over million population. Top and bottom ten regions, 2002-2004

Position	Region code	Region name	Country	Citations, 02-04
		Top regions		
1	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	445.64
2	DE11	Stuttgart	Deutschland	440.39
3	DEB3	RheinhessenPfalz	Deutschland	387.79
4	DE21	Oberbayern	Deutschland	375.86
5	DE14	Tübingen	Deutschland	357.94
6	DE12	Karlsruhe	Deutschland	353.02
7	DE13	Freiburg	Deutschland	336.97
8	NL41	NoordBrabant	Nederland	332.16
9	CH04	Zürich	Schweiz/Suisse/Svizzera	327.80
10	DE71	Darmstadt	Deutschland	307.07
		Bottom regions		
265	PL31	Lubelskie	Polska	0.53
266	HU22	NyugatDunántúl	Magyarorszag	0.44
267	RO42	Vest	Romania	0.21
268	FR91	Guadeloupe (FR)	France	0.19
269	PL32	Podkarpackie	Polska	0.16
270	RO12	Centru	Romania	0.14
271	RO21	NordEst	Romania	0.03
272	RO41	SudVest Oltenia	Romania	0.02
273	RO11	NordVest	Romania	0.02
274	RO31	Sud Muntenia	Romania	0.01

Note: Regions with 0 value are GR13, IS00, PL61, ES64, GR22, PL52, PT20, ES63, PL62, PT18, RO22, GR11, PL42.



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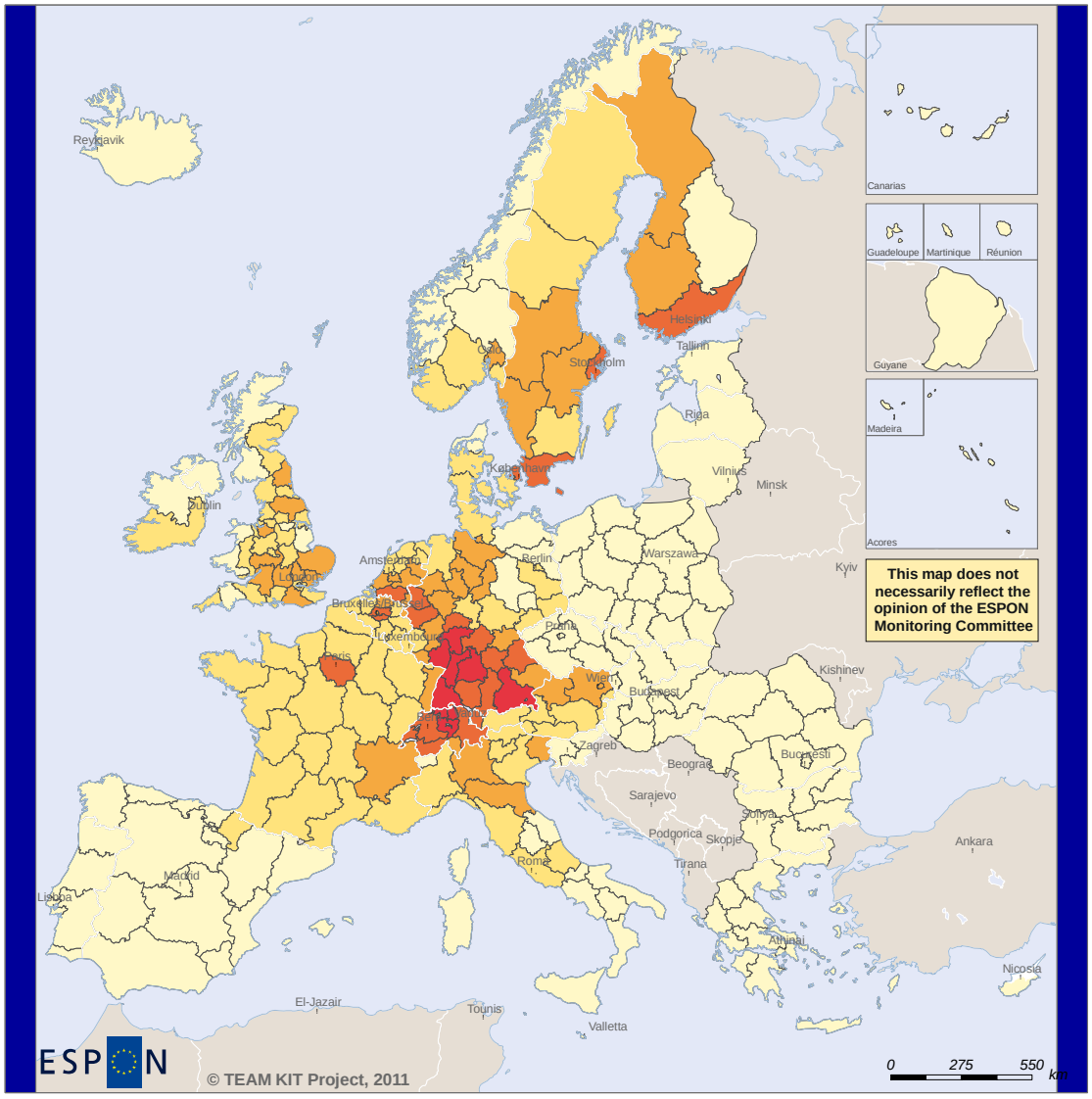
Cross-regional citations made. Average 1995-1997

- 0 - 46
- 47 - 127
- 128 - 256
- 257 - 493
- 494 - 1465

Map 61.Cross-regional citations. Average 1995-1997



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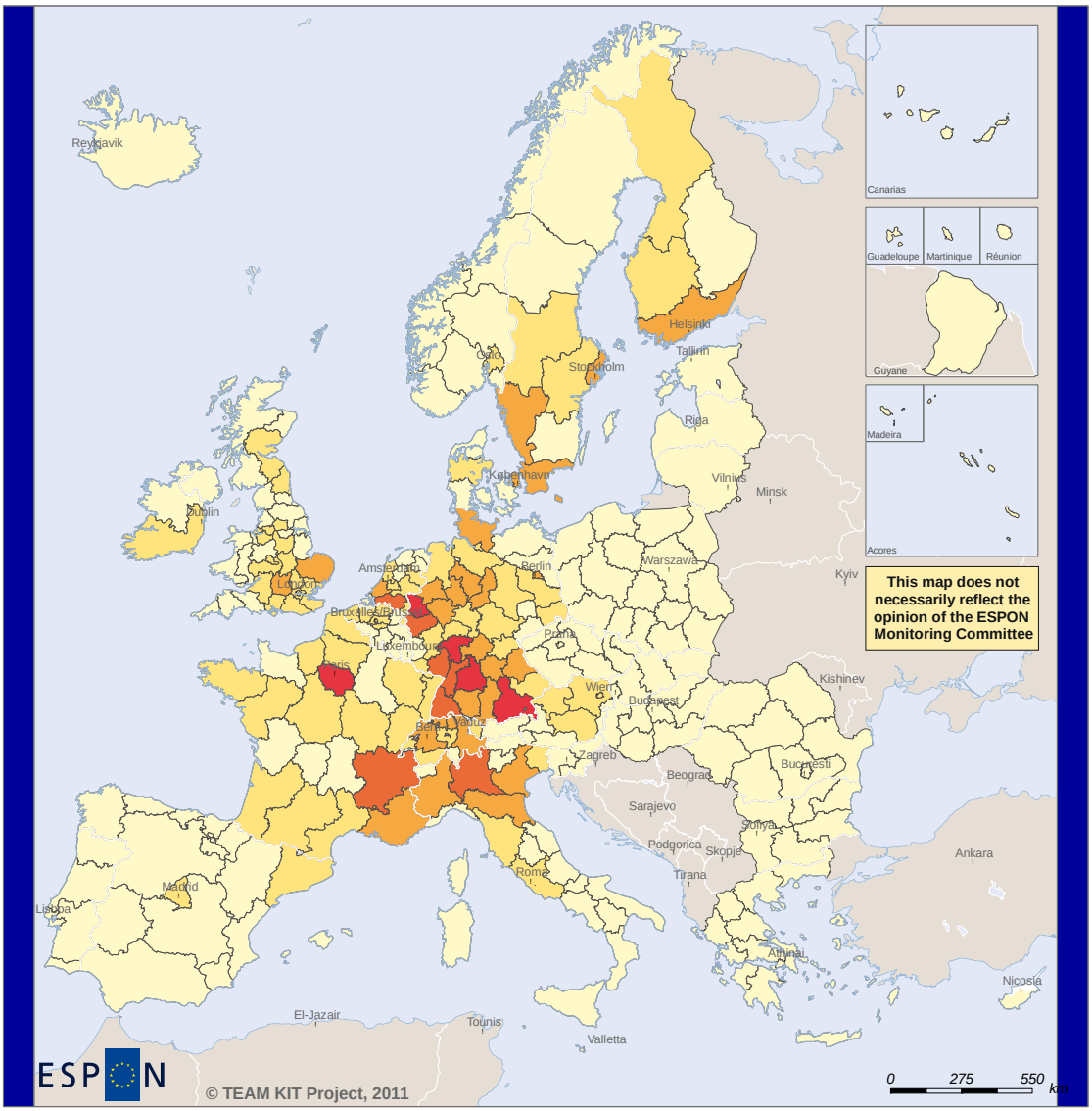
Cross-regional citations made per capita (1 milion population). Average 1995-1997

- 0 - 23
- 24 - 68
- 69 - 128
- 129 - 210
- 211 - 364

Map 62.Cross-regional citations per capita. Average 1995-1997



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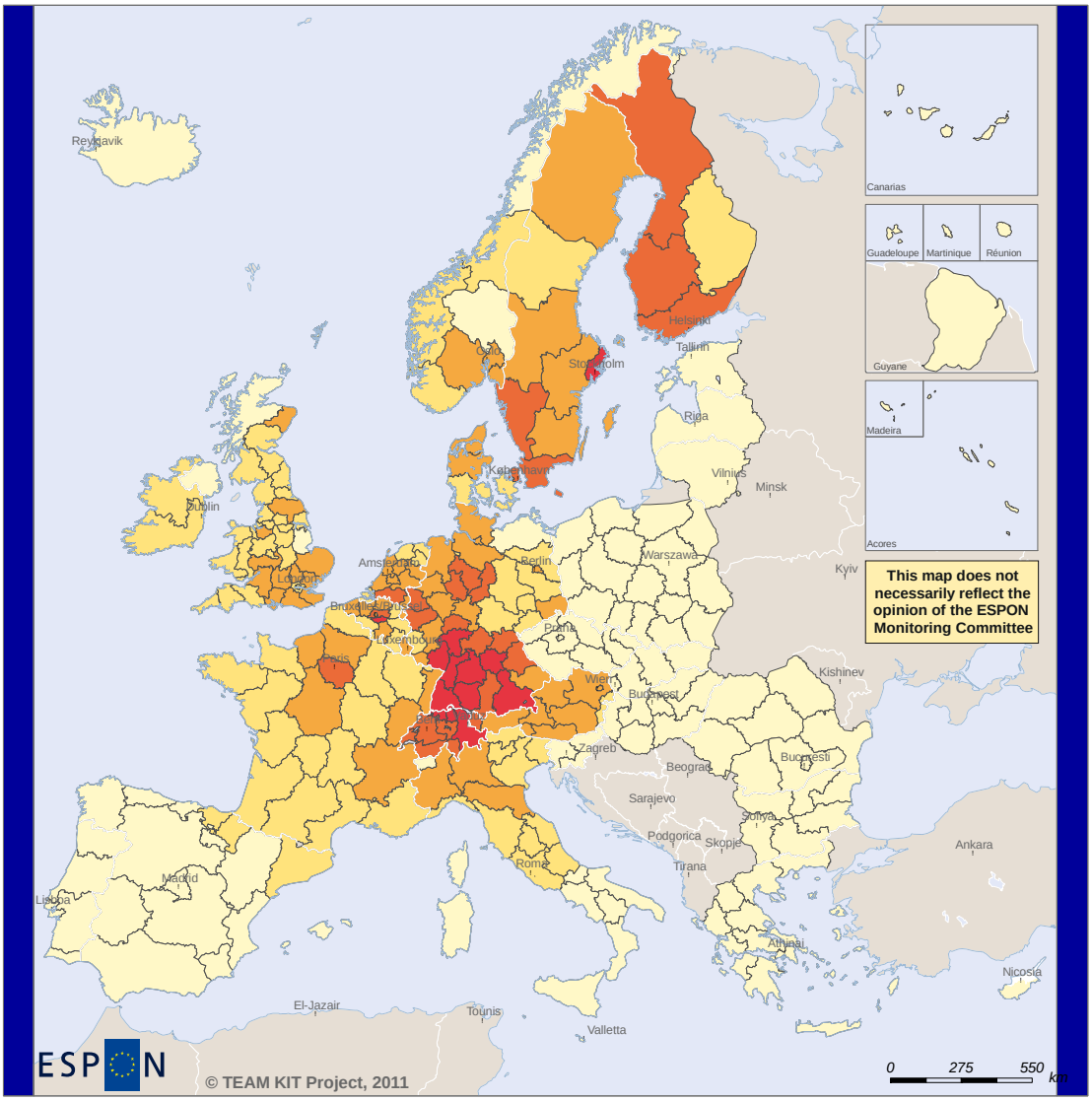
Cross-regional citations made. Average 1998-2000

- 0 - 73
- 74 - 269
- 270 - 588
- 589 - 1026
- 1027 - 1870

Map 63.Cross-regional citations. Average 1998-2000



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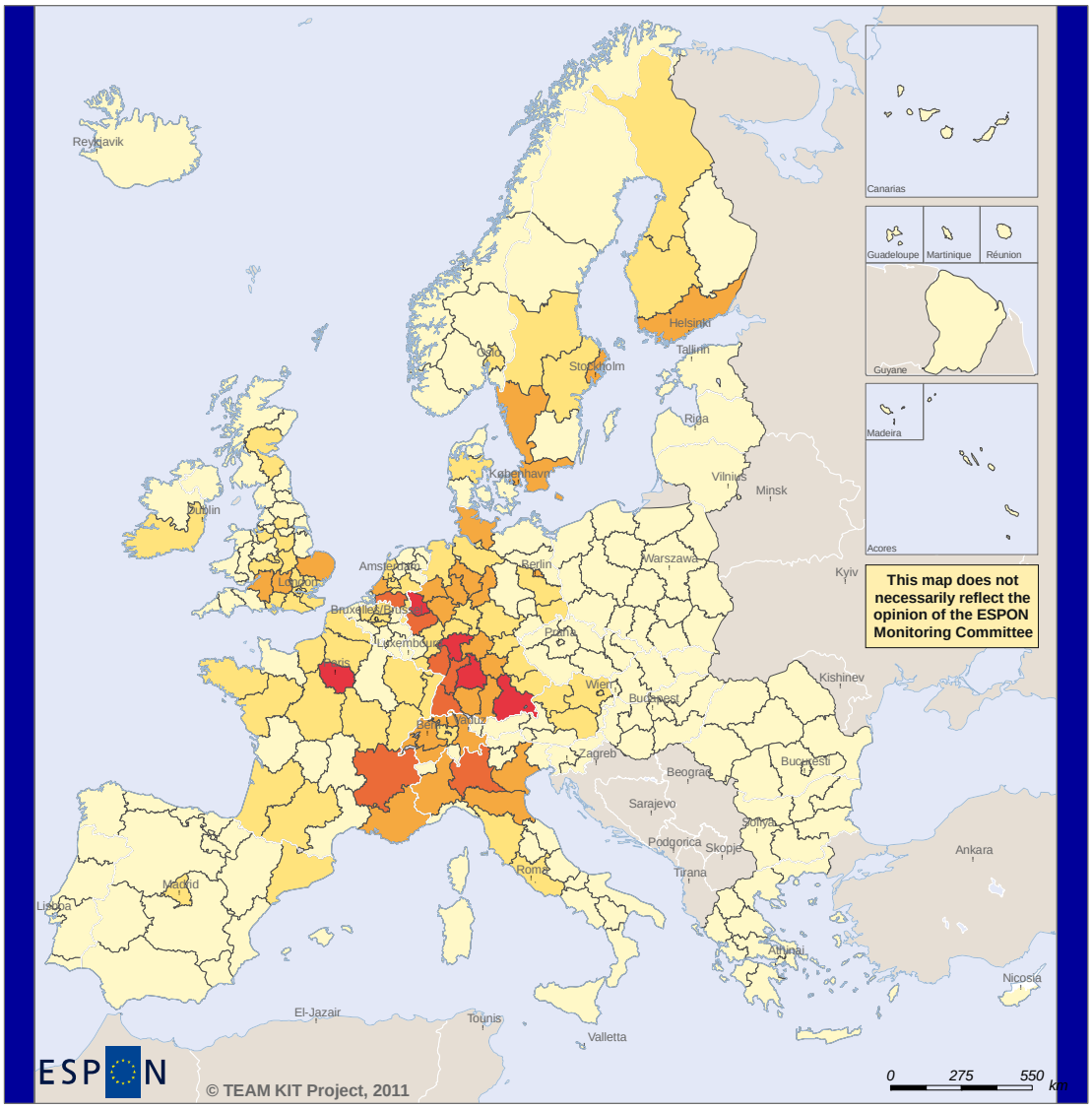
Cross-regional citations made per capita (1 milion population). Average 1998-2000

- 0 - 25
- 26 - 78
- 79 - 159
- 160 - 283
- 284 - 462

Map 64.Cross-regional citations per capita. Average 1998-2000



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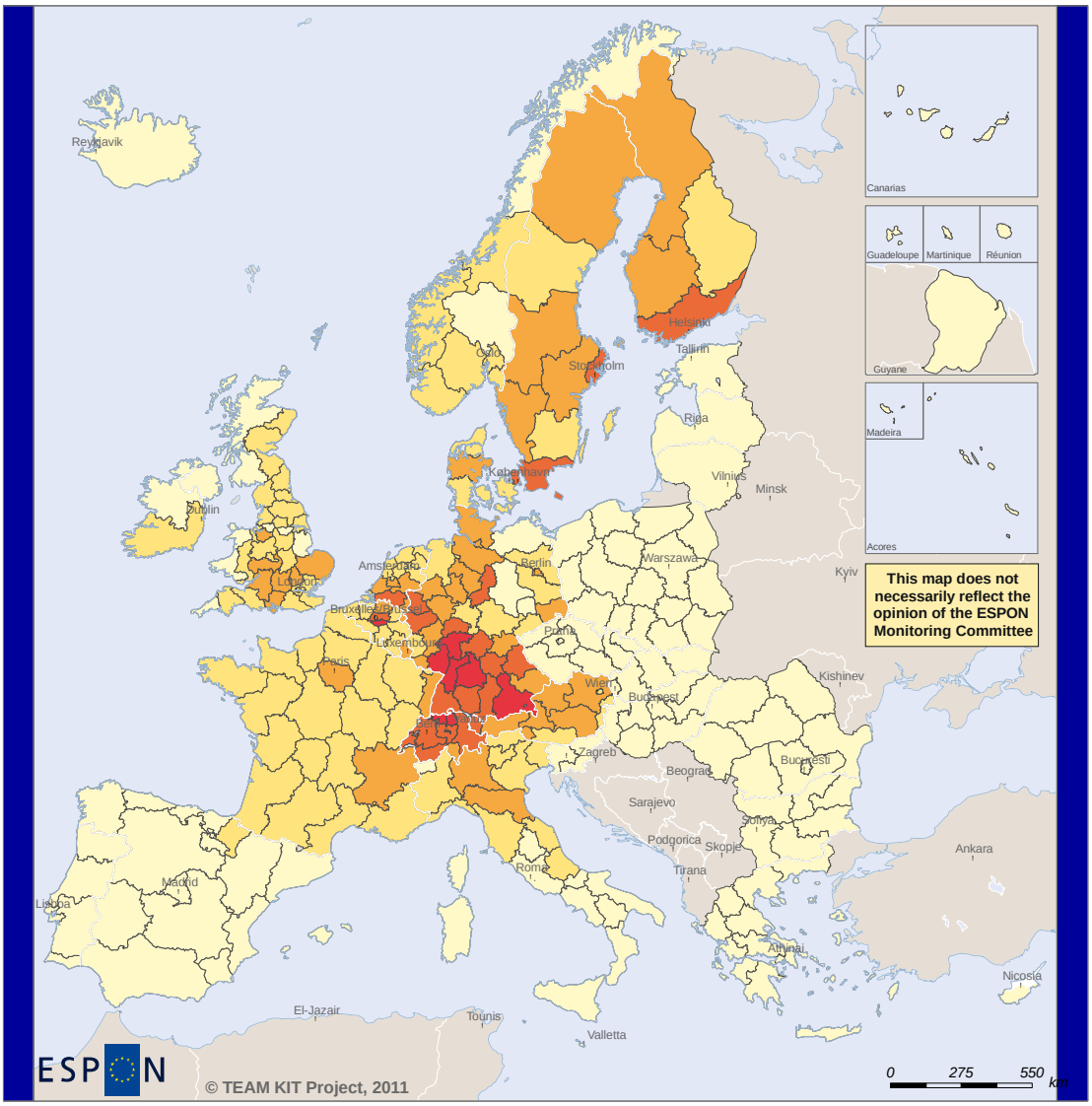
Cross-regional citations made. Average 1999-2001

- 0 - 93
- 94 - 275
- 276 - 616
- 617 - 1156
- 1157 - 1982

Map 65.Cross-regional citations. Average 1999-2001



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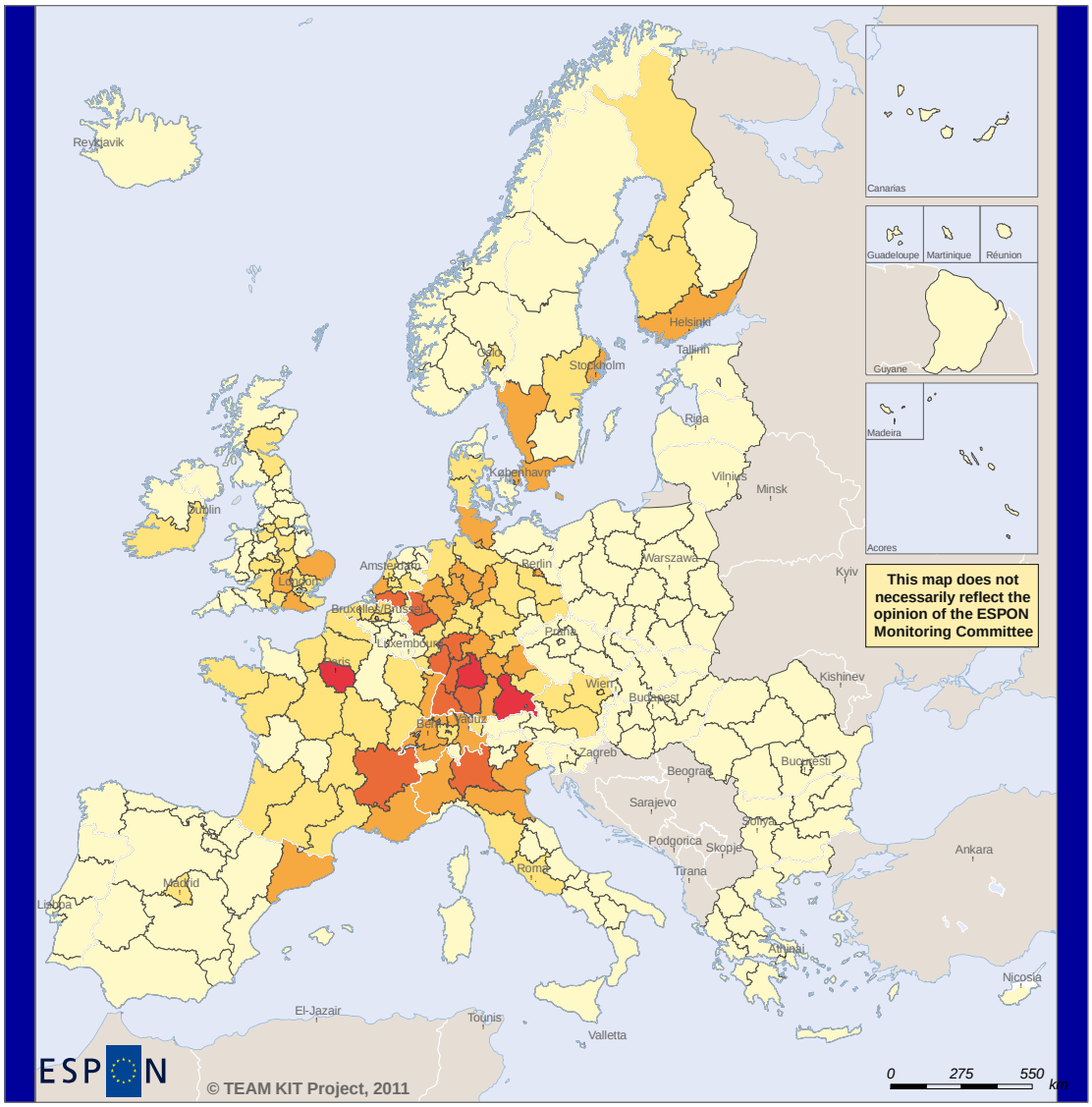
Cross-regional citations made per capita (1 milion population). Average 1999-2001

- 0 - 35
- 36 - 101
- 102 - 200
- 201 - 322
- 323 - 505

Map 66.Cross-regional citations per capita. Average 1999-2001



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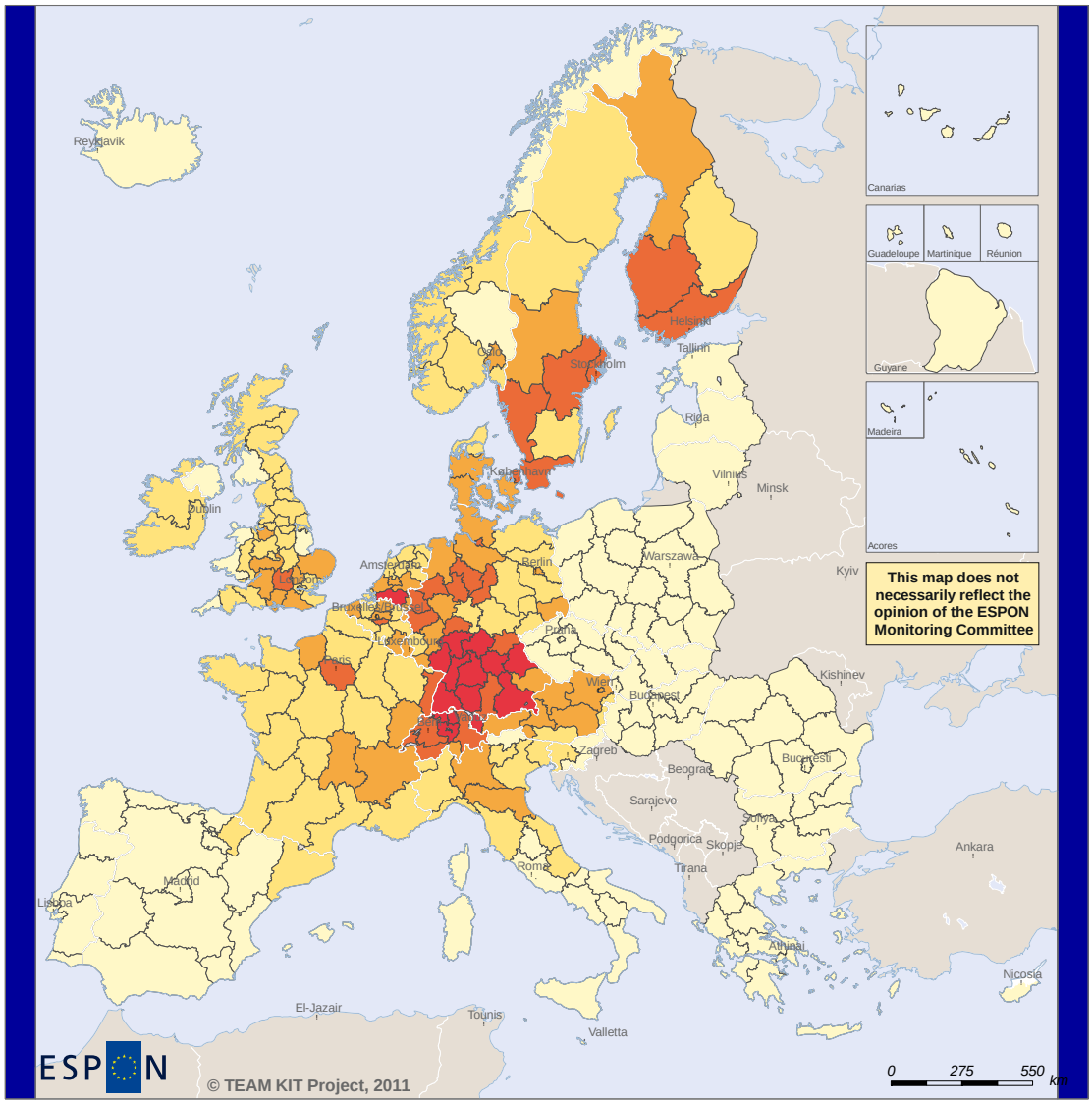
Cross-regional citations made. Average 2002-2004

- 0 - 80
- 81 - 249
- 250 - 511
- 512 - 1153
- 1154 - 1838

Map 67.Cross-regional citations. Average 2002-2004



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Cross-regional citations made per capita (1 milion population). Average 2002-2004

- 0 - 27
- 28 - 81
- 82 - 151
- 152 - 254
- 255 - 445

Map 68.Cross-regional citations per capita. Average 2002-2004

3.3.4 Outflows of inventors

Table 104. Inventors' Outflows. Average values, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	7.67	9.64	0.16	7.40	0.90	2.34	12.26
Outflows / million POP	4.54	5.16	0.14	11.64	0.55	1.99	6.40

Table 105. Inventors' Outflows. Coefficient of variation, 1995-1997

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	1.87	1.64	2.56	1.01	3.09	2.10	1.43
Outflows / million POP	1.52	1.19	2.80	1.33	2.86	2.12	1.00

Table 106. Inventors' Outflows. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Outflows, 95-97
		Top regions		
1	FR10	Île de France	France	110.67
2	DE71	Darmstadt	Deutschland	88.00
3	DE21	Oberbayern	Deutschland	81.33
4	DE12	Karlsruhe	Deutschland	75.00
5	DEA2	Köln	Deutschland	64.00
6	DE11	Stuttgart	Deutschland	59.33
7	DEB3	RheinhessenPfalz	Deutschland	59.33
8	DEA1	Düsseldorf	Deutschland	50.00
9	NL41	NoordBrabant	Nederland	45.33
10	UKJ2	Surrey, East and West Sussex	United Kingdom	44.67
		Bottom regions		
197	SK03	Stredné Slovensko	Slovenska Republika	0.33
198	CZ06	Jihovýchod	Ceska Republika	0.33
199	FR93	Guyane (FR)	France	0.33
200	ES53	Illes Balears	España	0.33
201	CZ02	Strední Cechy	Ceska Republika	0.33
202	ITF2	Molise	Italia	0.33
203	ITF5	Basilicata	Italia	0.33
204	PL42	Zachodniopomorskie	Polska	0.33
205	NO07	NordNorge	Norge	0.33
206	CZ05	Severovýchod	Ceska Republika	0.33

Note: Regions with 0 value are RO41, HU31, CZ01, GR25, BE34, BG42, ES70, FR83, BG32, ITF6, ES64, PT18, GR21, BG31, PL33, PL52, MT00, PL31, ES21, HU33, ES63, RO11, GR41, ES23, PL34, PL11, PL51, PL32, RO12, GR43, SK04, PL63, PL41, ES11, CZ03, PL43, GR14, GR23, ITD1, GR42, LV00, FI20, PT16, CZ04, HU23, CZ07, PT30, PT11, BG41, ES12, BG34, PL61, RO32, FR94, PL62, HU32, PT20, LT00, HU21, PL12, PT17, GR13, PT15, ES62, RO31, GR11, ES13, ES22, IE01, GR12, GR24, RO42, RO21, NL23, GR22, EE00, RO22, BG33, PL21, UKM6, ITC2.

Table 107. Inventors' Outflows over million population. Top and bottom ten regions, 1995-1997

Position	Region code	Region name	Country	Outflows, 95-97
		Top regions		
1	LI00	Liechtenstein	Liechtenstein	64.81
2	DEB3	RheinhessenPfalz	Deutschland	29.93
3	DE12	Karlsruhe	Deutschland	28.31
4	DE71	Darmstadt	Deutschland	23.89
5	DE60	Hamburg	Deutschland	23.04
6	DE24	Oberfranken	Deutschland	22.82
7	DE25	Mittelfranken	Deutschland	22.18
8	DE14	Tübingen	Deutschland	21.03
9	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	20.82
10	DE21	Oberbayern	Deutschland	20.45
		Bottom regions		
197	SK03	Stredné Slovensko	Slovenska Republika	0.25
198	HU10	KözépMagyarország	Magyarorszag	0.23
199	CZ05	Severovýchod	Ceska Republika	0.22
200	ITG2	Sardegna	Italia	0.20
201	CZ06	Jihovýchod	Ceska Republika	0.20
202	PL42	Zachodniopomorskie	Polska	0.19
203	ITF4	Puglia	Italia	0.16
204	ES61	Andalucia	España	0.14
205	GR30	Attiki	Ellada	0.09
206	PL22	Slaskie	Polska	0.07

Note: Regions with 0 value are BE34, ES23, BG41, ITF6, PL31, GR25, PL52, PT17, GR24, ITD1, PL63, HU31, HU23, RO41, ES21, PL21, ES62, ITC2, CZ07, BG33, GR22, HU21, IE01, ES13, FI20, RO32, PL34, PT20, MT00, PL61, PL41, ES22, ES64, GR14, FR83, BG42, EE00, GR13, RO12, GR11, GR12, PT18, GR23, ES12, PL33, LV00, RO31, RO21, HU32, CZ03, RO22, RO11, GR41, BG34, PT16, CZ01, LT00, PL11, RO42, FR94, PL43, GR42, CZ04, PT30, ES70, PL62, BG32, GR21, HU33, PT15, PT11, UKM6, NL23, PL32, BG31, GR43, PL51, SK04, ES63, PL12, ES11.

Table 108. Inventors' Outflows. Average values, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	11.57	14.61	0.49	9.54	1.64	4.39	18.33
Outflows / million POP	6.29	7.61	0.43	9.16	1.02	3.63	9.26

Table 109. Inventors' Outflows. Coefficient of variation, 1998-2000

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	1.95	1.72	3.62	1.22	2.94	2.03	1.52
Outflows / million POP	1.39	1.20	3.90	1.09	3.07	1.94	1.02

Table 110. Inventors' Outflows. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Outflows, 98-00
		Top regions		
1	FR10	Île de France	France	170.00
2	DE21	Oberbayern	Deutschland	141.00
3	DE71	Darmstadt	Deutschland	121.67
4	DE12	Karlsruhe	Deutschland	117.00
5	DE11	Stuttgart	Deutschland	115.67
6	DEA2	Köln	Deutschland	108.00
7	DEB3	RheinhessenPfalz	Deutschland	95.00
8	DEA1	Düsseldorf	Deutschland	91.00
9	NL41	NoordBrabant	Nederland	84.00
10	DE60	Hamburg	Deutschland	67.33
		Bottom regions		
209	PT11	Norte	Portugal	0.33
210	PT15	Algarve	Portugal	0.33
211	BE34	Prov. Luxembourg (B)	Belgique-België	0.33
212	PL12	Mazowieckie	Polska	0.33
213	IS00	Iceland	Ísland	0.33
214	HU32	ÉszakAlföld	Magyarorszag	0.33
215	ES53	Illes Balears	España	0.33
216	ES70	Canarias (ES)	España	0.33
217	ITD1	Provincia Autonoma BolzanoBozen	Italia	0.33
218	SK02	Západné Slovensko	Slovenska Republika	0.33

Note: Regions with 0 value are NO07, PT17, CZ02, ITG2, MT00, CZ06, CY00, RO41, BG32, GR14, PL61, EE00, PL51, GR42, BG41, PT20, PL42, GR23, PL22, RO22, GR41, PL34, PL41, NO02, PT16, SK04, RO11, HU21, PT18, RO32, ITD2, ES23, RO31, ES62, RO21, GR24, PL43, LV00, BG31, BG33, GR22, PT30, HU31, PL32, ITF2, FR91, PL33, FR93, FR92, LI00, PL31, GR11, ES64, PL62, ES13, ES43, GR25, PL52, FR83, CZ04, RO42, ES63, GR13, LT00, BG42, RO12, SK03, GR21, HU33.

Table 111. Inventors' Outflows over million population. Top and bottom ten regions, 1998-2000

Position	Region code	Region name	Country	Outflows, 98-00
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	47.45
2	DE12	Karlsruhe	Deutschland	43.85
3	DE60	Hamburg	Deutschland	39.54
4	NL41	NoordBrabant	Nederland	35.88
5	DE21	Oberbayern	Deutschland	35.18
6	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	33.51
7	DE71	Darmstadt	Deutschland	32.82
8	DE25	Mittelfranken	Deutschland	30.36
9	DE23	Oberpfalz	Deutschland	29.88
10	DE42	Brandenburg Südwest	Deutschland	29.88
		Bottom regions		
209	ITF4	Puglia	Italia	0.25
210	HU32	ÉszakAlföld	Magyarorszag	0.21
211	ES70	Canarias (ES)	España	0.20
212	GR12	Kentriki Makedonia	Ellada	0.18
213	SK02	Západné Slovensko	Slovenska Republika	0.18
214	PL63	Pomorskie	Polska	0.15
215	PL11	Lódzkie	Polska	0.13
216	PL21	Malopolskie	Polska	0.10
217	PT11	Norte	Portugal	0.09
218	PL12	Mazowieckie	Polska	0.07

Note: Regions with 0 value are GR14, PT30, BG33, PL43, RO12, NO02, RO41, HU31, RO22, ES64, PL33, PT17, GR13, PL52, ES62, BG42, GR25, FR92, ES13, CY00, ES43, CZ04, RO11, PT16, RO32, PL41, HU21, HU33, RO31, ITD2, FR83, PL31, LT00, GR22, RO21, ES63, PL42, PL62, PL34, BG41, GR24, PL51, LV00, PT18, CZ02, LI00, GR21, GR23, ITF2, FR93, ES23, SK03, PT20, CZ06, FR91, GR41, BG31, MT00, GR42, BG32, RO42, ITG2, GR11, SK04, PL61, PL22, NO07, EE00, PL32.

Table 112. Inventors' Outflows. Average values, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	12.38	15.62	0.56	10.25	1.72	4.55	19.68
Outflows / million POP	6.69	8.03	0.49	10.43	1.06	3.60	9.85

Table 113. Inventors' Outflows. Coefficient of variation, 1999-2001

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	2.02	1.79	3.76	1.21	2.82	2.01	1.58
Outflows / million POP	1.40	1.22	4.11	0.97	2.95	1.88	1.05

Table 114. Inventors' Outflows. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Outflows, 99-01
		Top regions		
1	FR10	Île de France	France	191.67
2	DE21	Oberbayern	Deutschland	152.00
3	DEA2	Köln	Deutschland	143.67
4	DE71	Darmstadt	Deutschland	127.00
5	DE12	Karlsruhe	Deutschland	124.00
6	DE11	Stuttgart	Deutschland	123.33
7	NL41	NoordBrabant	Nederland	121.00
8	DEB3	RheinhessenPfalz	Deutschland	104.33
9	DEA1	Düsseldorf	Deutschland	99.67
10	DE25	Mittelfranken	Deutschland	56.67
		Bottom regions		
213	ES70	Canarias (ES)	España	0.33
214	ES22	Comunidad Foral de Navarra	España	0.33
215	PL12	Mazowieckie	Polska	0.33
216	RO32	Bucuresti Ilfov	Romania	0.33
217	ITD2	Provincia Autonoma Trento	Italia	0.33
218	PL63	Pomorskie	Polska	0.33
219	PL11	Lódzkie	Polska	0.33
220	SK01	Bratislavský kraj	Slovenska Republika	0.33
221	NL34	Zeeland	Nederland	0.33
222	ITE2	Umbria	Italia	0.33

Note: Regions with 0 value are LT00, FR93, PL34, GR14, RO12, GR24, CZ06, GR13, ES23, GR21, PL51, MT00, FR83, GR22, GR42, SK04, RO21, NO07, PT11, ES13, BG42, BG34, FR92, PL61, PL41, ES63, BG33, PL62, PT18, ES62, HU21, RO41, RO11, BG32, PT15, RO22, PL52, PL21, PT16, PT30, GR41, RO42, PL32, PL31, NO02, PT17, GR25, PL42, FR91, CY00, ES64, PL43, CZ04, PL33, GR11, RO31, CZ02, BG41, LV00, EE00, PT20, ES43, BG31, GR23, ITF2.

Table 115. Inventors' Outflows over million population. Top and bottom ten regions, 1999-2001

Position	Region code	Region name	Country	Outflows, 99-01
		Top regions		
1	DEB3	RheinhessenPfalz	Deutschland	52.09
2	NL41	NoordBrabant	Nederland	51.26
3	DE12	Karlsruhe	Deutschland	46.34
4	DE21	Oberbayern	Deutschland	37.63
5	DE71	Darmstadt	Deutschland	34.14
6	DE23	Oberpfalz	Deutschland	34.13
7	DEA2	Köln	Deutschland	33.67
8	DE25	Mittelfranken	Deutschland	33.65
9	DE60	Hamburg	Deutschland	32.44
10	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	32.07
		Bottom regions		
211	HU33	DélAlföld	Magyarorszag	0.24
212	HU32	ÉszakAlföld	Magyarorszag	0.21
213	ITG2	Sardegna	Italia	0.20
214	ES70	Canarias (ES)	España	0.20
215	GR12	Kentriki Makedonia	Ellada	0.18
216	SK02	Západné Slovensko	Slovenska Republika	0.18
217	ITF4	Puglia	Italia	0.17
218	PL63	Pomorskie	Polska	0.15
219	RO32	Bucuresti Ilfov	Romania	0.15
220	PL11	Lódzkie	Polska	0.13

Note: Regions with 0 value are PL22, PL12, PT18, CZ02, RO21, EE00, ES13, FR83, ES23, RO11, PL32, BG33, GR24, BG31, ITF2, PT15, GR23, ES43, GR21, CZ04, PL43, GR25, GR41, PL52, LT00, ES62, ES63, PT11, GR13, PL42, RO12, PL21, BG32, PT17, PL31, PT20, RO31, PL33, PL61, RO42, CY00, NO02, BG34, RO22, GR42, BG41, HU21, NO07, PL34, FR91, FR93, PL51, GR22, CZ06, PT30, FR92, PL41, RO41, PL62, LV00, BG42, ES64, SK04, MT00, GR11, GR14, PT16.

Table 116. Inventors' Outflows. Average values, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	13.68	17.18	1.25	10.10	1.98	3.47	22.09
Outflows / million POP	7.26	8.61	1.12	10.61	1.46	2.99	10.76

Table 117. Inventors' Outflows. Coefficient of variation, 2002-2004

	ESPON whole sample	Countries			EU Regions		
		EU 15	EU 12, new entrants	EFTA 4	Convergence	Transition	Competitive
Outflows	2.46	2.21	4.10	1.13	2.70	1.89	1.95
Outflows / million POP	1.73	1.58	4.39	0.90	3.08	1.91	1.40

Table 118. Inventors' Outflows. Top and bottom ten regions, 2002-2004

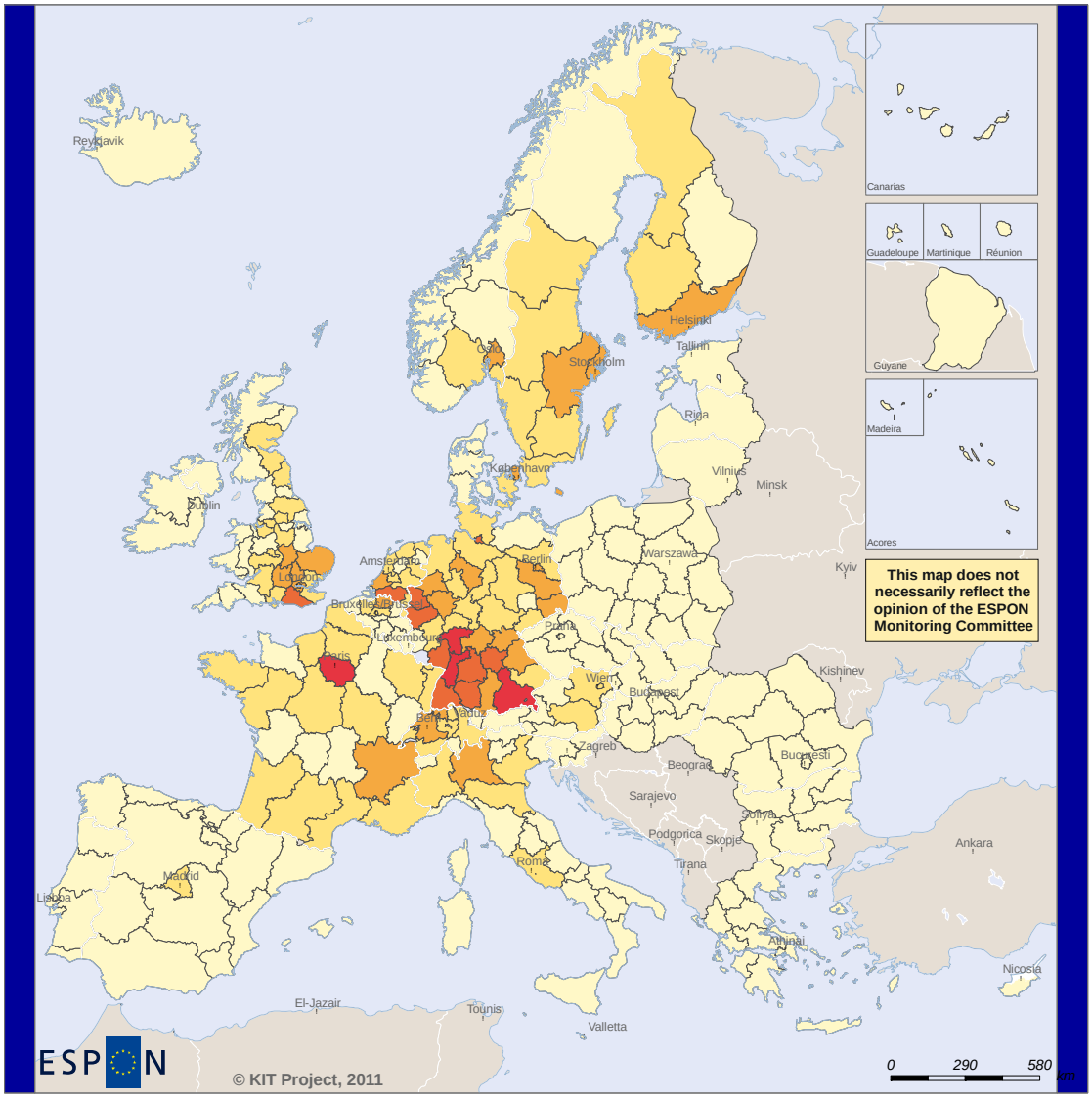
Position	Region code	Region name	Country	Outflows, 02-04
		Top regions		
1	NL41	NoordBrabant	Nederland	377.00
2	FR10	Île de France	France	256.67
3	DEA2	Köln	Deutschland	175.67
4	DE21	Oberbayern	Deutschland	123.67
5	DE12	Karlsruhe	Deutschland	117.67
6	UKJ2	Surrey, East and West Sussex	United Kingdom	115.33
7	DE11	Stuttgart	Deutschland	111.00
8	DE71	Darmstadt	Deutschland	106.33
9	DEA1	Düsseldorf	Deutschland	79.33
10	DEB3	RheinhessenPfalz	Deutschland	76.00
		Bottom regions		
227	SK02	Západné Slovensko	Slovenska Republika	0.33
228	HU22	NyugatDunántúl	Magyarorszag	0.33
229	PT17	Lisboa	Portugal	0.33
230	ES43	Extremadura	España	0.33
231	HU33	DélAlföld	Magyarorszag	0.33
232	PL22	Slaskie	Polska	0.33
233	LI00	Liechtenstein	Liechtenstein	0.33
234	IS00	Iceland	Ísland	0.33
235	CZ03	Jihozápad	Ceska Republika	0.33
236	ES13	Cantabria	España	0.33

Note: Regions with 0 value are BG33, PT15, HU31, GR14, BG34, PL62, PL11, RO11, GR42, ES63, GR23, GR11, PL33, LT00, GR25, RO22, MT00, SK04, RO31, PL43, PL63, GR22, PL42, BG32, PL21, PL31, RO21, PT30, ITF2, RO12, GR13, GR24, ES64, GR43, PL32, EE00, FR83, CZ05, ES12, RO32, CZ04, ES53, ES70, PT20, PT18, PL52, BG31, PL61, GR41, GR21, PL34.

Table 119. Inventors' Outflows over million population. Top and bottom ten regions, 2002-2004

Position	Region code	Region name	Country	Outflows, 02-04
1	NL41	NoordBrabant	Nederland	157.13
2	UKJ2	Surrey, East and West Sussex	United Kingdom	44.85
3	DE12	Karlsruhe	Deutschland	43.37
4	DEA2	Köln	Deutschland	40.53
5	DEB3	RheinhessenPfalz	Deutschland	37.73
6	DE24	Oberfranken	Deutschland	37.16
7	DE25	Mittelfranken	Deutschland	35.43
8	DE23	Oberpfalz	Deutschland	34.31
9	CH03	Nordwestschweiz	Schweiz/Suisse/Svizzera	34.18
10	SI01	Vzhodna Slovenija	Slovenija	32.12
		Bottom regions		
227	BG42	Yuzhen tsentralen	Bulgaria	0.21
228	PL41	Wielkopolskie	Polska	0.20
229	SK02	Západné Slovensko	Slovenska Republika	0.18
230	RO42	Vest	Romania	0.17
231	BG41	Yugozapaden	Bulgaria	0.16
232	LV00	Latvia	Latvija	0.14
233	RO41	SudVest Oltenia	Romania	0.14
234	PT17	Lisboa	Portugal	0.12
235	PT11	Norte	Portugal	0.09
236	PL22	Slaskie	Polska	0.07

Note: Regions with 0 value are BG33, GR21, EE00, ES53, ES12, GR24, RO11, GR22, PT18, FR83, PL43, BG31, RO12, PT30, RO21, GR14, PL33, GR43, GR41, RO31, ES64, SK04, PL63, PL52, PL42, PL31, HU31, PT20, CZ04, BG34, RO32, PL11, GR13, PL62, PL61, CZ05, BG32, MT00, ES63, ES70, PL32, LT00, PL34, GR42, PL21, ITF2, PT15, GR25, RO22, GR11, GR23.



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Regional level: NUTS 2
Source: OECD REGPAT
Origin of data: own calculations
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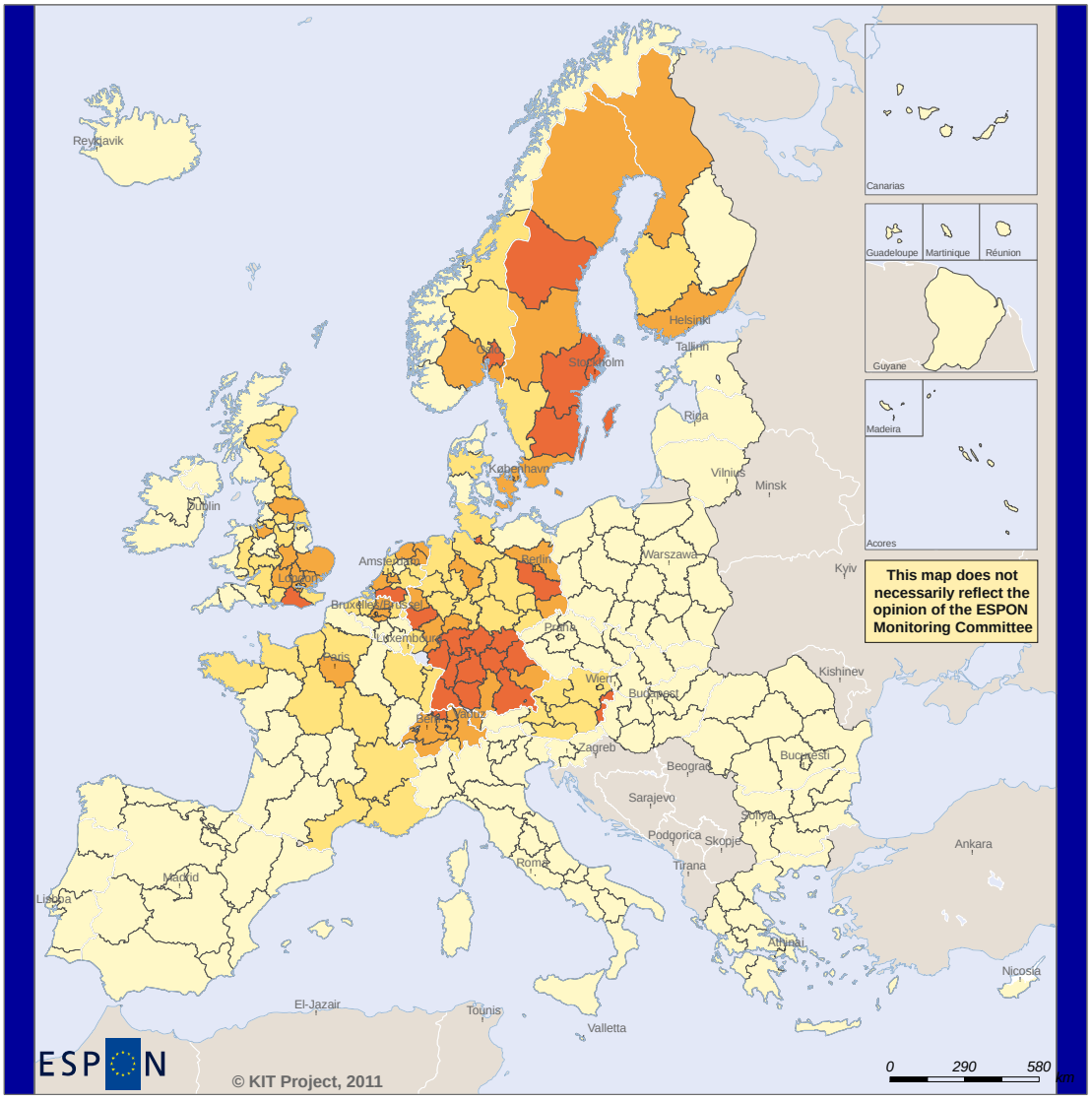
Inventors' outflows, average 1995-1997

- 0 - 4
- 5 - 14
- 15 - 32
- 33 - 64
- 65 - 110

Map 69. Inventors' outflows. Average 1995-1997



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Regional level: NUTS 2
Source: OECD REGPAT
Origin of data: own calculations
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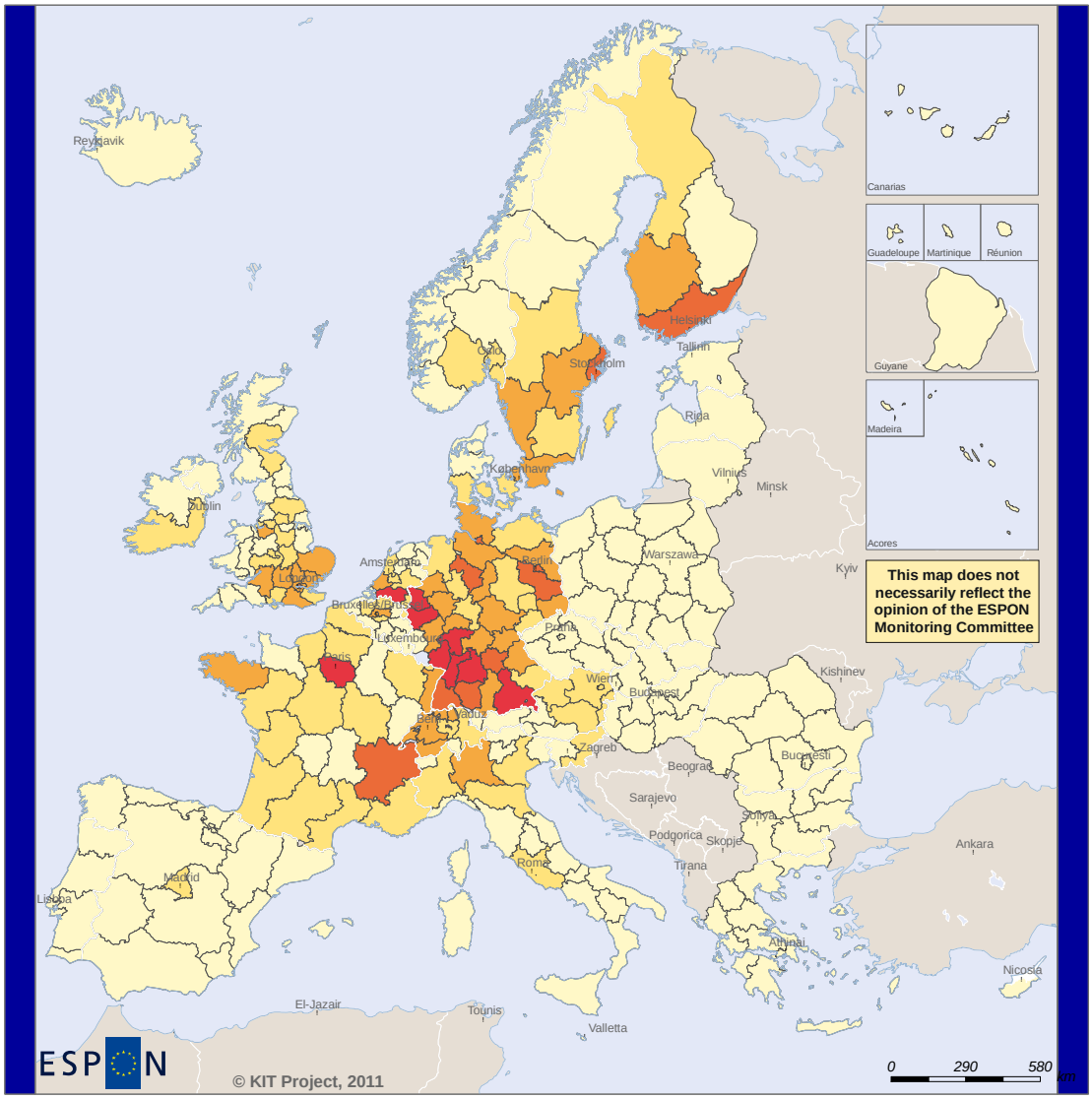
Inventors' outflows over million population, average 1995-1997

- 0,0 - 2,4
- 2,5 - 7,0
- 7,1 - 14,6
- 14,7 - 29,9
- 30,0 - 64,8

Map 70. Inventors' outflows per capita. Average 1995-1997



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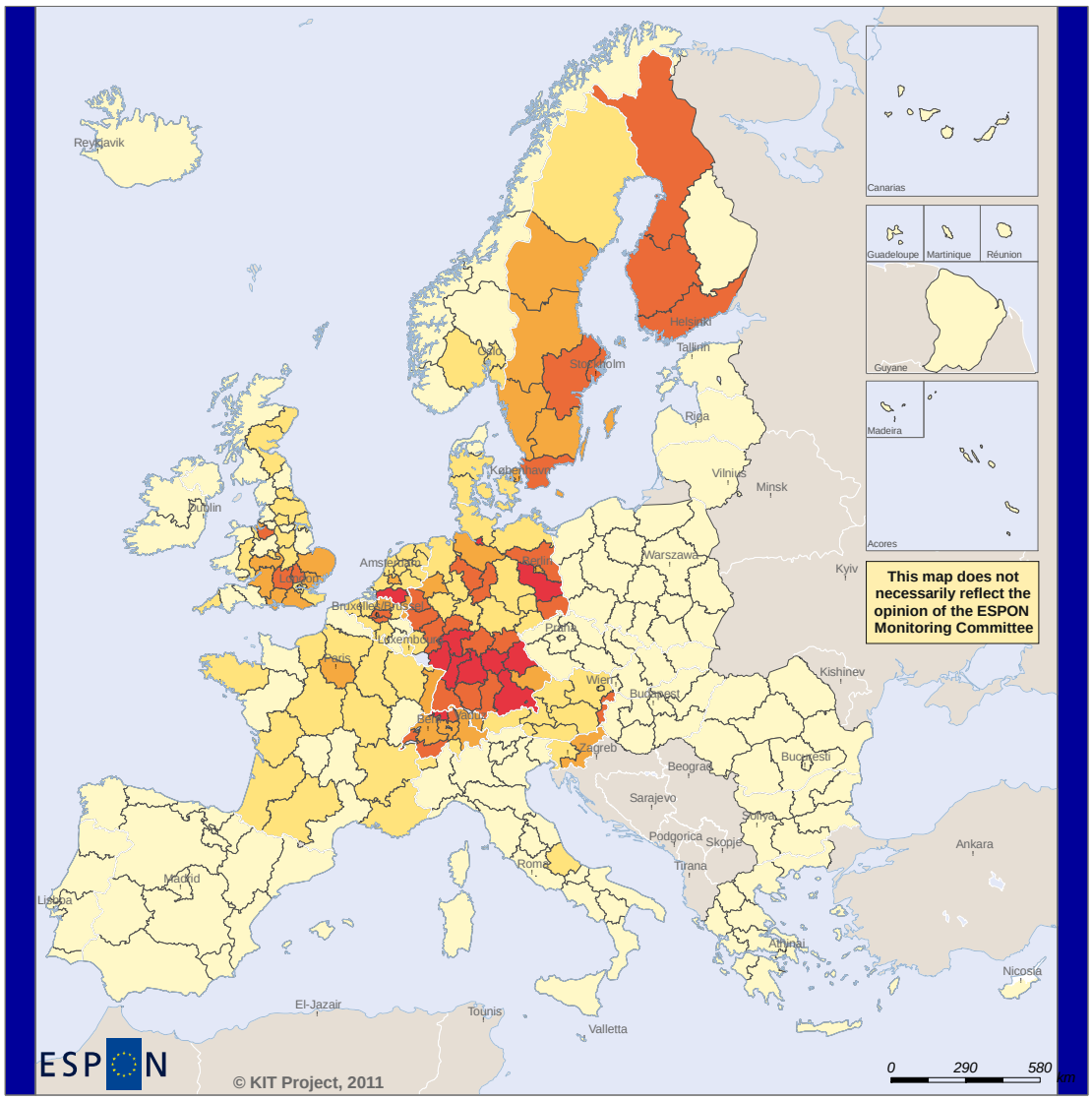
Inventors' outflows, average 1998-2000

- 0,0 - 5,3
- 5,4 - 17,6
- 17,7 - 36,0
- 36,1 - 67,3
- 67,4 - 170,0

Map 71. Inventors' outflows. Average 1998-2000



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Regional level: NUTS 2
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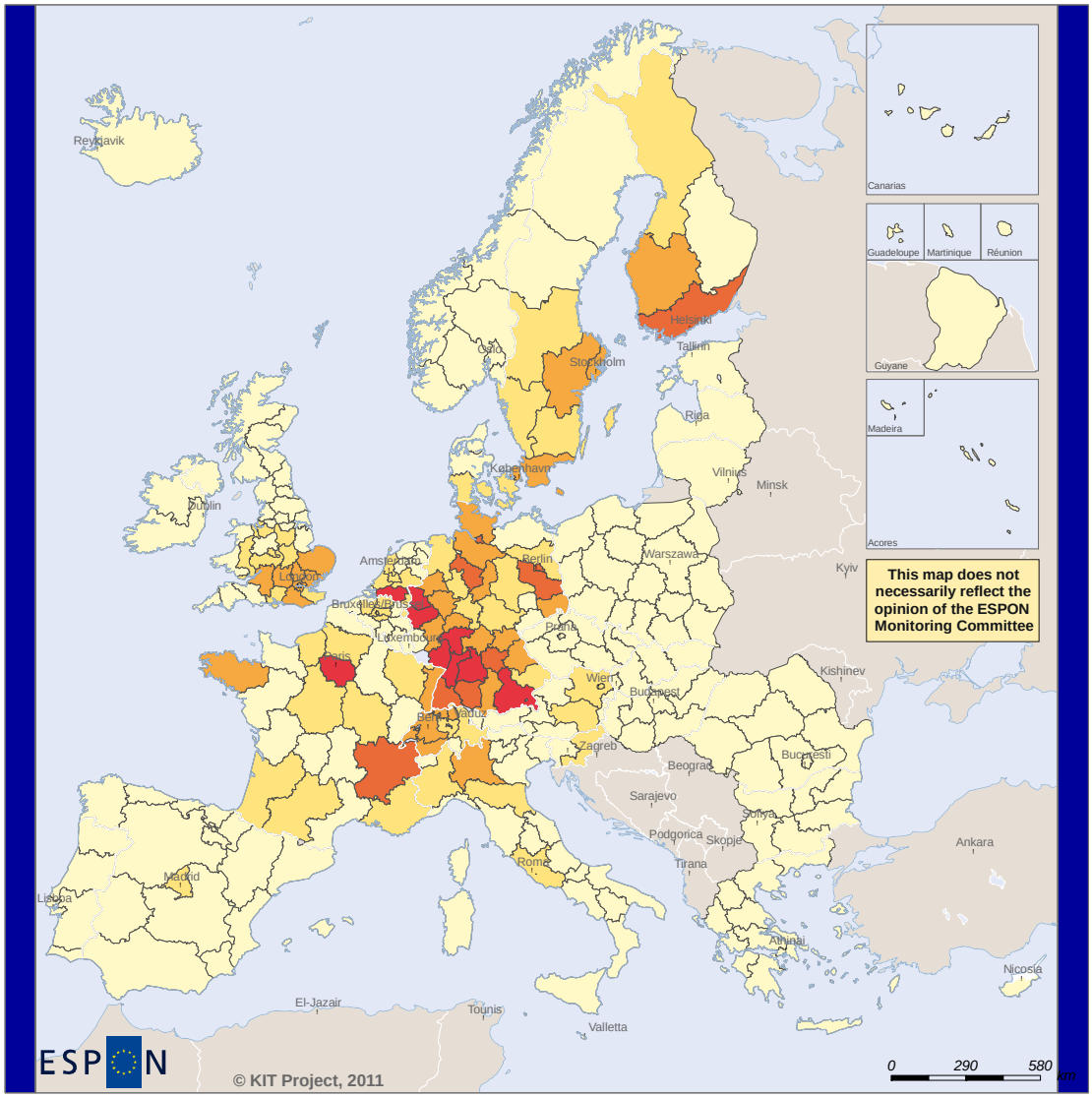
Inventors' outflows over million population, average 1998-2000

- 0,0 - 2,9
- 3,0 - 8,3
- 8,4 - 15,4
- 15,5 - 26,8
- 26,9 - 47,4

Map 72. Inventors' outflows per capita. Average 1998-2000



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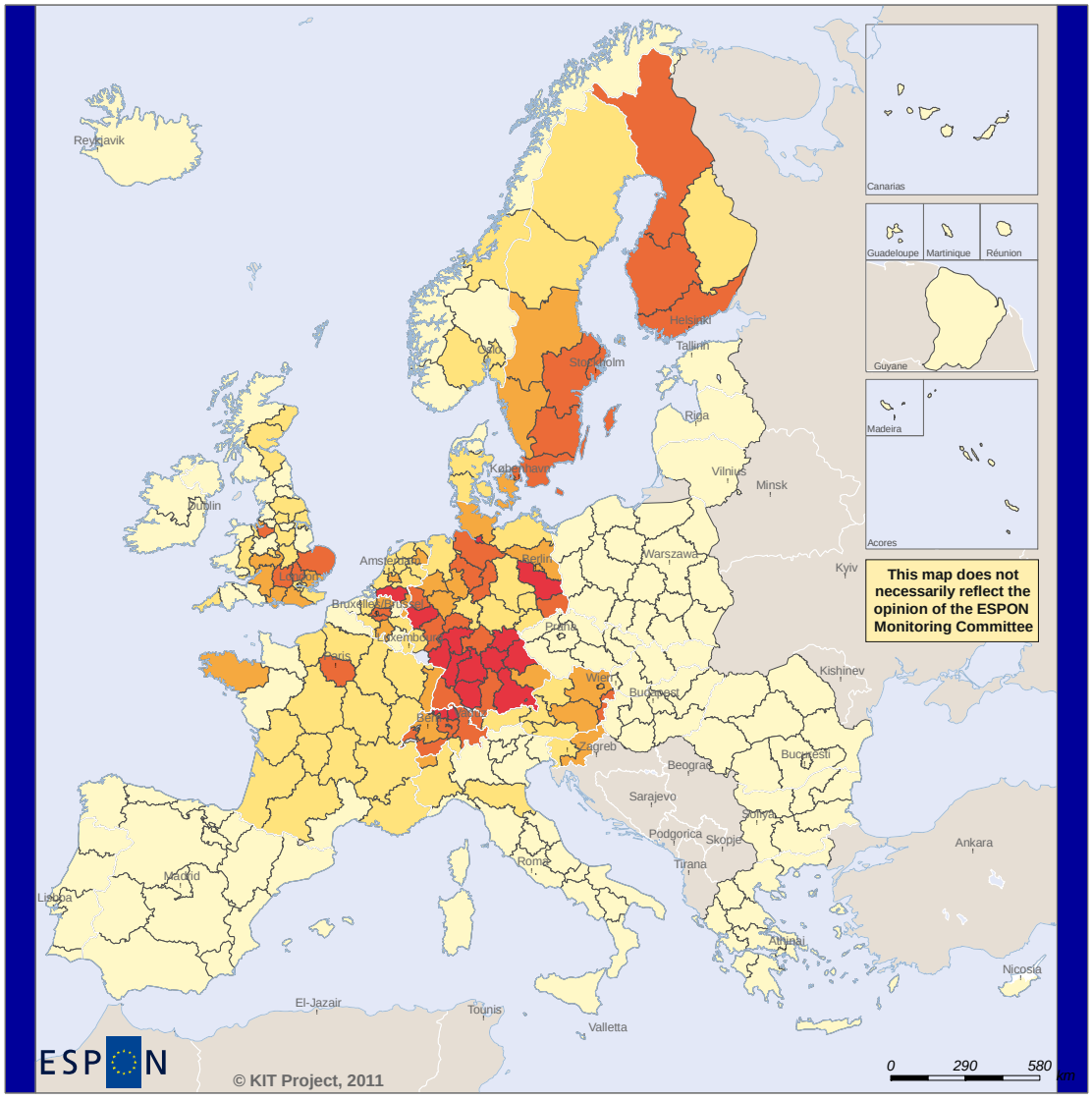
Inventors' outflows, average 1999-2001

- 0,0 - 7,3
- 7,4 - 20,6
- 20,7 - 38,3
- 38,4 - 56,6
- 56,7 - 191,6

Map 73. Inventors' outflows. Average 1999-2001



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Regional level: NUTS 2
Source: OECD REGPAT
Origin of data: own calculations
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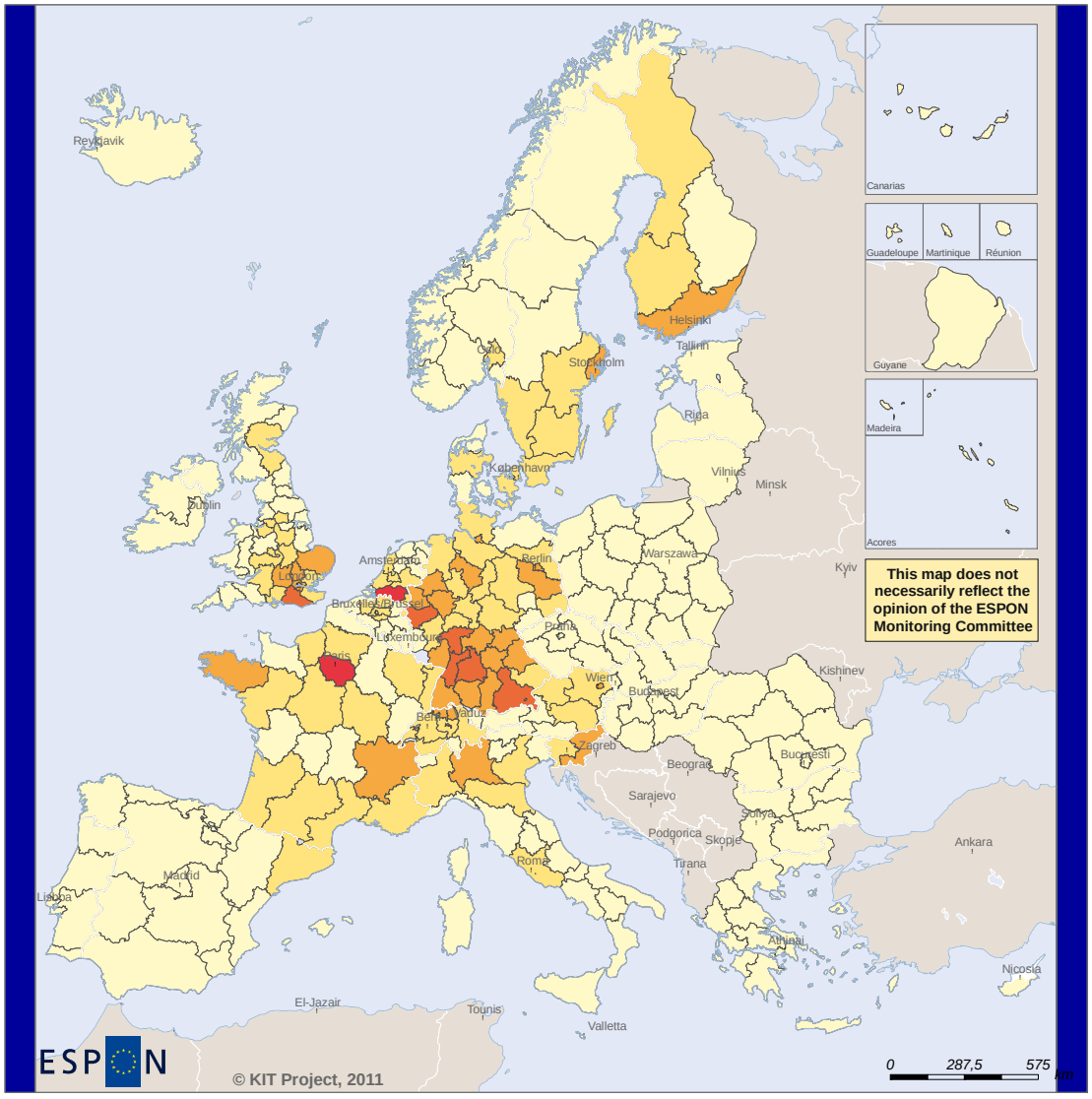
Inventors' outflows over million population, average 1999-2001

- 0,0 - 2,9
- 3,0 - 7,8
- 7,9 - 15,0
- 15,1 - 26,0
- 26,1 - 52,0

Map 74. Inventors' outflows per capita. Average 1999-2001



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Regional level: NUTS 2
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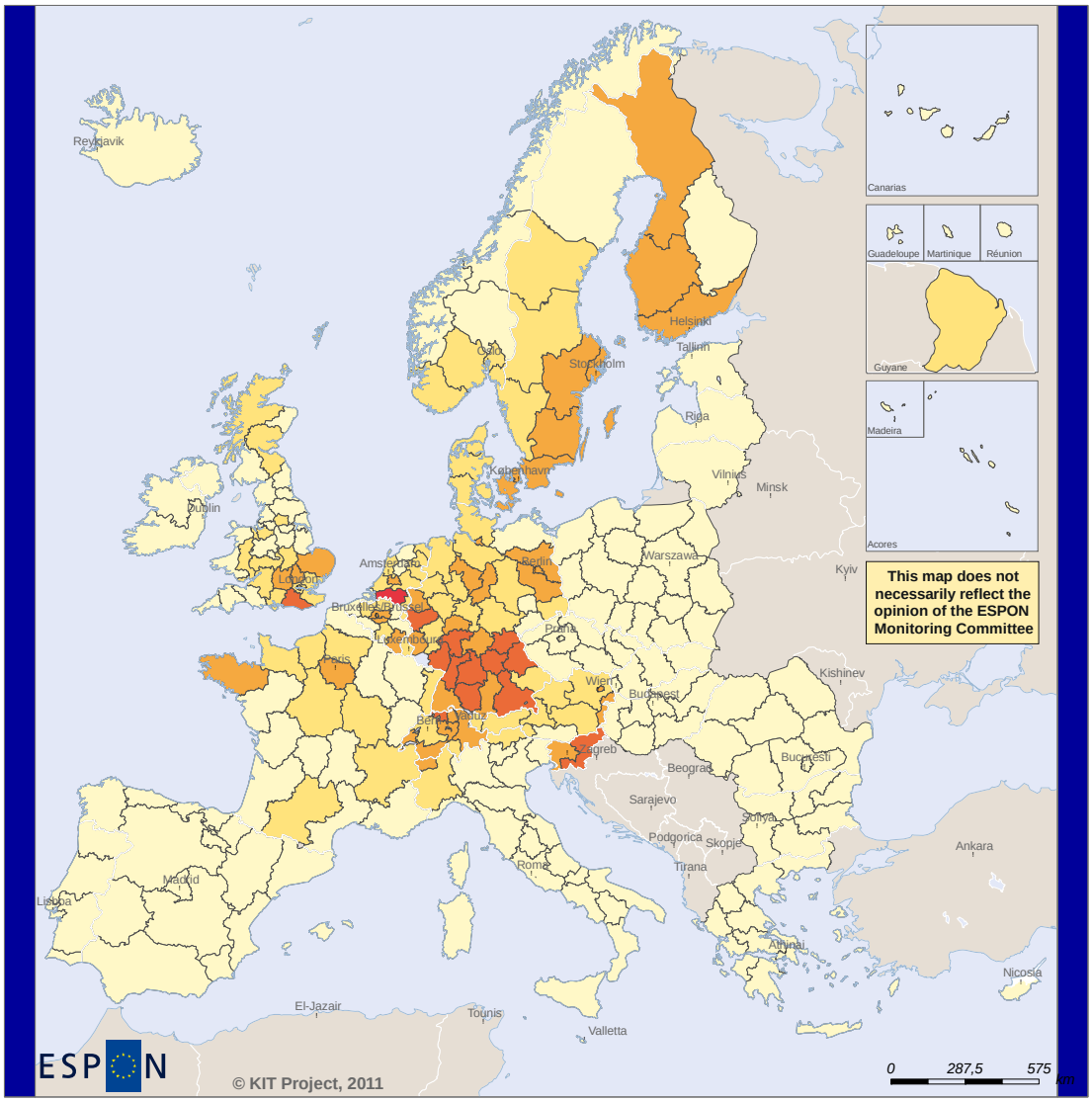
Inventors' outflows, average 2002-2004

- 0,0 - 7,6
- 7,7 - 27,0
- 27,1 - 79,3
- 79,4 - 175,6
- 175,7 - 377,0

Map 75. Inventors' outflows. Average 2002-2004



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Regional level: NUTS 2
Source: OECD REGPAT
Origin of data: own calculations

Inventors' outflows over million population, average 2002-2004

- 0,0 - 4,5
- 4,6 - 12,7
- 12,8 - 25,3
- 25,4 - 44,8
- 44,9 - 157,1

Map 76. Inventors' outflows per capita. Average 2002-2004

3.4 A social network descriptive approach for the a-spatial linkages

This Section of the Scientific Report tries to go one step further in the description of what we mean by 'Knowledge Networking Regions' by applying Social Network Analysis (SNA hereafter) tools to a subset of our variables of interest. While spatial statistics and spatial econometrics give the opportunity to study the geographical distribution of knowledge variables and their spatial interactions (see 'The functional approach to the knowledge economy' within this report), SNA provides a specific methodological framework to investigate non-geographically mediated variables at the regional scale. In particular, the a-spatial branch of the 'Networking Regions' – cross-regional co-patents, spatial mobility of highly skilled individuals, and cross-regional patent citations made - is going to be analysed here. To do so, we take 287 European NUTS2 regions as being nodes, or points or actors, of a whole network of regions. These nodes may or may not be linked through edges, or ties, to one another, make up by either co-patents or inventors' spatial mobility or patent citations.

For each of these variables and time-spans under consideration, we build a binary matrix (called socio-matrix in SNA) where each of the cells are valued 1 if there exist a relationship between regions i and j, and 0 otherwise. Put differently, when at least one co-patent is observed between regions i and j, the ij and ji cells of the co-patenting socio-matrix will be valued 1, and 0 otherwise. Similarly, when at least one inventors' movement is observed between regions i and j, the ij cell of the mobility socio-matrix will be valued 1, and 0 otherwise. Additionally, when at least one citation is originated in region i, the citing region, to region j, the cited region, the ij cell of the citations socio-matrix will be valued 1, and 0 otherwise.[4] In the co-patenting socio-matrix relations are undirected by definition (both actors in the relationship benefit from knowledge flows), so the matrix is symmetric. On the contrary, the mobility socio-matrix is directed, since the movement is from region i to region j, and not the other way around, so the matrix is asymmetric. In the same vein, the citations socio-matrix is also asymmetric. Socio-matrices are the basic tool from which we will get a number of network measures.

The set of structural measures derived from the socio-matrices will help us to assess the connectivity, cohesion and inclusiveness of the network of regions for each of the variables and time spans considered. Doing so we will be able to say something about the processes by which knowledge is diffused across regions through non-spatially mediated mechanisms.

The structural measures that are going to be considered are as follows:

1. **Density:** it measures how *cohesive* is the network as a whole, describing the general level of linkages among the network. The higher the density measure, the higher the level of connectivity and cohesion of the network, either by means of research collaborations (co-patenting), spatial mobility of knowledge workers, or by means of patent citations.
2. **Degree of centralisation:** this measure is aimed to assess, in a sense, the organization, or the level of inequality, of the network. It evaluates whether the network is organized like a hub-and-spoke pattern, or whether it is more or less polycentric. Its values range between 0 and 1. Values close to one identify highly hierarchic systems, characterised by a hub-and-spoke organisation of the network.
3. **Average degree:** it is calculated by averaging out the degree centrality of each of the nodes (regions) of the networks. The *degree centrality* of a node is the number of linkages it has to other nodes. It measures how well connected is each of the nodes. As a consequence, in a dichotomised network, the average degree centrality measures the average level of connectivity of its nodes.

[4] Different from what we did in the former sub-section, the relationships between pairs of regions are dichotomised, i.e., a relationship is said to exist if at least either a co-patent, a movement or a citation between them is observed. We therefore lose information about the intensity of the relationships between pairs of regions. However, we gain information about the degree of connectivity of a given region to other regions, from where it extracts different and complementary pieces of knowledge. Another interesting approach would be to dichotomise the socio-matrix when a minimum, arbitrary threshold of interactions between two regions is reached. Results using alternative thresholds, however, do not change to a large extent.

4. **Clustering coefficient:** it measures to what extent the neighbours of a given node are also neighbours between them. It tries to assess how local is the network and the knowledge diffusion that goes through it.
5. **Average path length:** It measures the average geodesic distance between any two nodes of the network. It is therefore an inverse indicator of the efficiency of the network in terms of knowledge diffusion device. The geodesic distance between two nodes is the shortest path between two connected nodes –both directly connected and by means of a third or more nodes.

   The combination of large clustering coefficients and short average path lengths characterise networks that exhibit 'small-world' structures, which has been shown to be optimal structures for an efficient diffusion of knowledge and enhanced creativity. This alluded 'small-world' networks are defined as clusters of locally dense interactions that are connected via a few bridging ties (Fleming et al., 2007). The hypothesis behind a large body of literature (Watts 1999; Cowan and Jonard 2003, 2004; Verspagen and Duysters 2003) is that 'small-world' networks should enhance innovative creativity. More innovation occurs because 'small-worlds' enable dense and clustered relationships to coexist with distant and more diverse relationships. This is in line with theoretical models envisaged by, among others, Bathelt et al. (2004) or Fratesi and Senn (2009) concerning the appropriateness to have an apposite mixture of close ties and collaborations with more distant ties bringing fresh, non-redundant information to the cluster from complementary knowledge sources, in order to avoid regional lock-in.
6. **Inclusiveness (relative):** it also measures the overall connectivity of the network. It computes the number of connected nodes of the whole network minus the number of isolated nodes, as a proportion of the total number of points.

Table 120 shows the figures discussed so far for the co-patenting socio-matrix, for different time-spans. Have in mind that, to some extent, differences across time spans might be due to the fact that the patenting activity has notably increased over time. However, an important component should be due to changes in the agents' behaviour regarding research collaborations across regions among different time-spans. Arguably, we are not able to disentangle these two effects just looking at summary network figures, so they should be considered, at the most, informative.

Table 120. Network structural features. Co-patenting

	Co-patenting 1995-1997	Co-patenting 1998-2000	Co-patenting 1999-2001	Co-patenting 2002-2004
Density	0.12	0.15	0.16	0.17
Centralisation	0.41	0.41	0.44	0.43
Average degree	33.92	42.80	45.20	48.45
Coef. Variation ave.degree	0.93	0.89	0.87	0.84
Clustering coefficient	0.49	0.51	0.53	0.56
Coef. Variation CC	0.51	0.46	0.41	0.36
Average Path Length	2.11	2.01	2.00	1.96
Inclusiveness	0.81	0.85	0.90	0.92

Thus, from this table we learn that all the co-patenting networks are quite sparse (density figures ranging from 12% to 17%), but less sparse to what is found at the individual level. This means that only 12-17% of all possible links across regions due to co-patenting are actually observed. These results are in line with related studies in the field (Maggioni and Uberti, 2008) and indicates how difficult is to share knowledge between individuals located in different regions. Values are, however, increasing over time, indicating the growing participation in patenting activity of a larger number of regions, as well as a rising trend towards cross-regional collaborations in patenting. Regarding centralisation indexes, they remain quite stable over time, and at values not far from 0.5, indicating an intermediate structure (neither completely hierarchical nor a-hierarchical). It is also interesting to note here how the average degree has risen considerably over time, corroborating the idea of increasing cross-regional collaborative behaviour of agents.

This is also shown by the inclusiveness index, which is very high and increasing over time, pointing at the fact that the number of isolated nodes (regions without any cross-regional co-patent) is very low. Differences across regions are, however, very large (according to the average degree's coefficient of variation), though slightly decreasing over time. As regards the average clustering coefficient, values are also slightly increasing over time. It ranges between 48% and 56%, indicating that 48-56% of a given region's network neighbours are also neighbours between them, which are relatively high values. High average clustering coefficient values are shown to outperform regarding knowledge diffusion and creation in terms of efficiency (Cowan and Jonard, 2003,2004). Moreover, medium (and decreasing) values for its coefficient of variation points at the fact that this phenomenon is quite homogeneous for the entire sample. Relatively large –and increasing over time- clustering coefficients jointly with low –and decreasing over time- values of the average path length characterise 'small-world' structures. This is, as can be seen, the case for the co-patenting network of regions for all the periods. Thus, on average, only two ties are necessary to reach all other nodes of the network –considering only reachable nodes, since disconnected subgraphs are not taken into account because their geodesic distance equals infinite- as indicated by the average path length. As already asserted before, these kind of network structures has been shown a very efficient device for the diffusion of knowledge and the creation of innovations.

Table 121 repeats the former analysis but considering spatial mobility of knowledge workers –i.e., inventors- as the variable under scrutiny. Since the mobility socio-matrix is asymmetric, we compute the 'two sides of the same coin' for the majority of the structural measures, e.g., average indegree centrality and average outdegree centrality, or indegree and outdegree centralisation. In reality, this means to analyse the network of inflows of inventors and the network of outflows of inventors. Density measures indicate that regional mobility networks are even sparser than co-patenting networks –though, again, slightly increasing over time. Thus, only 1.2-1.7% of all possible links across regions due to mobility are actually observed. One partial explanation for this is that when a movement is observed between regions i and j, it only computes in the ij cell of the socio-matrix, and not in the ji cell. However, differences between density figures of co-patents and mobility are gorgeous and, as all the figures will show, this is mostly attributable to the fact that spatial mobility is a much more unusual phenomenon, regarding cross-regional co-patents. In fact, few regions are indeed benefiting from flows of inventors, as can be seen from the average degree figures and, especially, the high number of isolated nodes in all the time periods, as pointed by the inclusiveness index. Indeed, the number of regions not receiving any inventor ranges from 47% (1-0.53) during the first period to 36% (1-0.64) during the last period. The same applies for the majority of network measures for the case of outflows of inventors. This seems to indicate that, broadly speaking, regions benefiting from spatial mobility of highly skilled individuals –both in- and out-flows- are relatively scarce (compared with other networking phenomena). However, in spite of this, figures show that the number of regions involved in this phenomenon has robustly increased over time and, more and more, a larger number of locations may benefit from knowledge embodied in incoming individuals from other regions. On its side, degree centralisation measures are also quite low, which may indicate a clear polycentric structure of movements across the network of regions. We also compute the clustering coefficient and the average path length of these networks. To do so, we add up both inflows and outflows socio-matrices to get a symmetric matrix from where we are able to calculate this measures and to assess to what extent they show a 'small-world' structure or not. Results show that, still, the average path length to reach all other nodes starting from a given node is low and decreasing over time. However, this measure is slightly higher than for the co-patenting socio-matrix for all the periods. On the other hand, the clustering coefficient shows that, on average, 27-28% of the neighbours of each region in terms of mobility are also neighbours between them. This is not a minor percentage, but, by no means, as large as for the former case. Thus, if a 'small-world' structure remains for the case of spatial mobility of skilled workers, it is definitely less pronounced than for the case of co-patenting.

Table 121. Network structural features. Spatial mobility of inventors

	Mobility 1995-1997	Mobility 1998-2000	Mobility 1999-2001	Mobility 2002-2004
Density inflows	0.01266	0.01720	0.01771	0.01799
Density outflows	0.01265	0.01719	0.01771	0.01799
Indegree centralisation	0.14	0.20	0.20	0.17
Outdegree centralisation	0.16	0.18	0.20	0.19
Average indegree	7.24	9.84	10.13	10.29
Coef. Var. ave.indegree	1.21	1.21	1.21	1.17
Average outdegree	7.24	9.84	10.13	10.23
Coef. Var. ave.outdegree	1.29	1.25	1.25	1.19
Clustering coefficient	0.28	0.29	0.28	0.29
Coef. Variation CC	0.98	0.90	0.89	0.89
Average Path Length	2.70	2.58	2.51	2.56
Inflows inclusiveness	0.53	0.51	0.53	0.64
Outflows inclusiveness	0.44	0.52	0.55	0.65

Table 122 shows the results for the case of cross-regional patent citations made by a given region. Only in-degree measures are presented, since this is an asymmetric matrix. Summary figures are pretty much similar to the case of co-patents. Again, this network is relatively sparse, but considerably denser than for the case of inventors' flows. Centralisation indexes indicates intermediate structures (neither completely hierarchical nor a-hierarchical) as well, while the number of regions not citing other regions (and therefore not extracting knowledge from other regions) is relatively low and decreasing over time, as indicated by the inclusiveness measure. A small distinction is worth to be highlighted: the average in-degree centrality is much larger than for the case of the former type of networks. On average, therefore, regions are able to connect to a larger number of other regions –and sources of complementary knowledge- by means of other mechanisms that may result in a patent citation more easily than by means of collaborations or spatial mobility of inventors. This result is not surprising, since these later phenomena should be more costly than other non-physical methods. However, the coefficient of variation is also large, indicating that large levels of connectivity are also reserved for a specific subsample of regions.

Table 122. Network structural features. Cross-regional citations

	Citations 1995-1997	Citations 1998-2000	Citations 1999-2001	Citations 2002-2004
Density	0.13	0.15	0.15	0.16
Centralisation	0.44	0.43	0.43	0.47
Average indegree	72.87	84.81	87.94	89.02
Coef. Var. ave.indegree	0.81	0.75	0.73	0.72
Inclusiveness	0.83	0.85	0.85	0.91

3.5 Identification of Knowledge Networking Regions

Although the main explanation on the identification of Knowledge Networking Regions is given in the main text of the report, in this Scientific Report we provide with some additional information in the way the synthetic indicators are computed as well as some additional output to extract further conclusions.

With respect to the construction of the two synthetic indicators, on the spatial and a-spatial linkages, Table 123 shows the different proxy variables used to develop these indicators as well as the weighs for each one.

Table 123. Description on the indicators used for synthetic indicators

Variable	Description	Sources	Years	Weights
VARIABLES USED FOR THE CONSTRUCTION OF THE SYNTHETIC INDICATOR ON SPATIAL LINKAGES				
R&D exp. per 1000 population in the neighbouring regions	Average value of the millions of Euro spent in RD activities over Population divided by 1000 in the first-order neighbouring regions	CRENoS elaboration on Eurostat, ISTAT and Institut National de la Statistique et des Études Économiques	2006-2007	1/3
Patent activity per capita in the neighbouring regions	Average number of patents released over population divided by 1000 in the first-order neighbouring regions	CRENoS elaboration on OECD REGPAT database	2005-2006	1/3
FP funding per capita in the neighbouring regions	Average funding received by the 5th Farmework Programme projects in per capita terms in the first order neighbours	CRENoS elaboration on CORDIS database	1998-2002	1/3
VARIABLES USED FOR THE CONSTRUCTION OF THE SYNTHETIC INDICATOR ON A-SPATIAL LINKAGES				
Co-patents per million population	Number of patent co-authored with inventors from outside the region over population divided by 1 million	AQR elaboration on OECD REGPAT database	2002-2004	1/3
Inflows of inventors per million population	Number of inflows of inventors coming from other regions over population divided by 1 million	AQR elaboration on OECD REGPAT database	2002-2004	1/3
Cross-regional citations per million population	Number of citations made to patents from other regions over population divided by 1 million	CRENoS elaboration on OECD REGPAT database	2002-2004	1/3

In Figure 3 we present the scatter of regions with respect to the two dimensions of spatial and a-spatial linkages. We can observe that most of the regions are either *Networking regions* (124) and *Non-interactive regions* (113) whereas only 41 regions are categorised as Clustering regions and 9 as Globalizing regions (9).

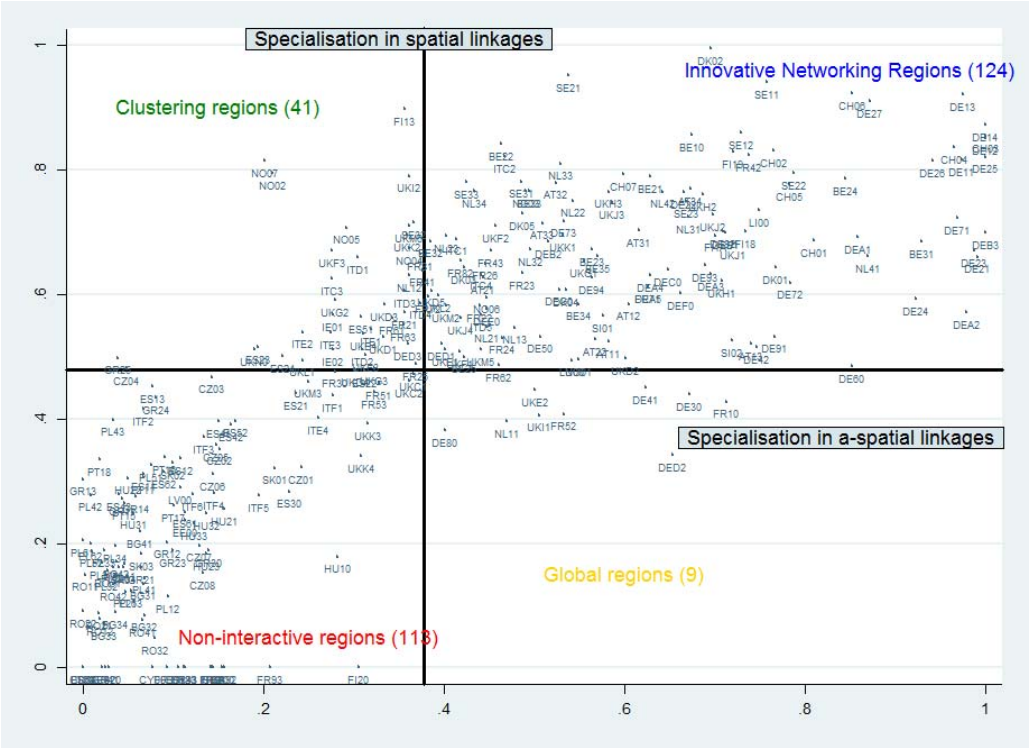


Figure 3. Scatterplot of ESPON regions according to the indicators of spatial and a-spatial linkages

In Table 124 we show some descriptive statistics for the variables used to develop the synthetic indicator. As one would expect, the highest average values are shown by the sample of *Networking regions*.

Table 124. Descriptive statistics by typology of region

	Networking Regions					
	R&D exp.	**Patents pc**	**FP Funding**	**Co-patents**	**Inflows**	**Citations**
Average	0.65	0.18	28387.33	483.49	13.85	132.36
Median	0.59	0.15	25816.16	312.16	9.47	101.50
Min	0.18	0.06	7987.15	94.46	2.08	16.78
Max	2.63	0.49	121799.70	3313.68	157.13	445.64
St. Deviation	0.30	0.10	16038.84	496.74	15.82	93.03
Coefficient of Variation	0.47	0.55	0.57	1.03	1.14	0.70
	Globalizing Regions					
	R&D exp.	**Patents pc**	**FP Funding**	**Co-patents**	**Inflows**	**Citations**
Average	0.20	0.07	7944.22	294.67	13.04	70.66
Median	0.21	0.08	7446.94	263.03	12.11	59.62
Min	0.00	0.00	0.00	25.30	4.39	4.27
Max	0.30	0.10	13451.11	592.88	25.35	163.26
St. Deviation	0.09	0.03	3998.34	178.44	7.20	43.96
Coefficient of Variation	0.44	0.49	0.50	0.61	0.55	0.62
	Clustering Regions					
	R&D exp.	**Patents pc**	**FP Funding**	**Co-patents**	**Inflows**	**Citations**
Average	0.53	0.09	26730.42	74.99	2.25	32.75
Median	0.47	0.08	23308.15	77.08	1.84	32.41
Min	0.15	0.01	8501.84	1.67	0.00	1.01
Max	1.28	0.25	62397.20	173.48	5.70	77.65
St. Deviation	0.24	0.04	12611.33	37.37	1.39	15.69
Coefficient of Variation	0.46	0.47	0.47	0.50	0.62	0.48
	Non-Interactive Regions					
	R&D exp.	**Patents pc**	**FP Funding**	**Co-patents**	**Inflows**	**Citations**
Average	0.10	0.01	6561.80	23.77	0.55	6.65
Median	0.05	0.00	5364.17	10.19	0.18	2.28
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.35	0.14	42828.03	127.97	5.18	51.48
St. Deviation	0.10	0.02	6622.97	30.70	0.95	10.91
Coefficient of Variation	1.02	1.65	1.01	1.29	1.71	1.64

Notes: R&D exp. Is Total intramural R&D expenditure per capita (1000 population) - Average 2006-2007, Patents pc is average value for patent activity 2005-2006, FP Funding is Framework Programme funded euros over population, Co-patents is the number of patents co-authored with inventors from outside the region over population, Inflows is the number of inflows of inventors over population, and Citations is the citations made to patents of other regions over population.

In Table 125 we present the list of *Networking regions* ranked with respect to the decreasing value of the synthetic indicator (in the last column). The first column present the region code, the second the region name, the third and fourth, respectively, values for the Spatial linkage composite indicator and the A-spatial linkage indicator. As we observe this subsample consists of 124 regions, most part belonging to the northern and central countries of Europe.

Table 125. List of Networking Regions

Code	Region name	Spatial linkages	A-spatial linkages	Synthetic Indicator
DE13	Freiburg	0.920	0.975	1.895
DE14	Tubingen	0.871	1	1.871
CH03	Nordwestschweiz	0.853	1	1.853
DE12	Karlsruhe	0.849	1	1.849

DE25	Mittelfranken	0.820	1	1.820
CH04	Zurich	0.835	0.966	1.801
DE11	Stuttgart	0.816	0.974	1.790
DE27	Schwaben	0.910	0.872	1.782
CH06	Zentralschweiz	0.923	0.852	1.774
DE26	Unterfranken	0.815	0.942	1.757
DEB3	Rheinhessen-Pfalz	0.699	1	1.699
SE11	Stockholm	0.939	0.758	1.697
DE71	Darmstadt	0.722	0.969	1.692
DK02	Sjaelland	0.995	0.696	1.690
DE23	Oberpfalz	0.669	0.987	1.656
DE21	Oberbayern	0.660	0.991	1.650
BE24	Prov. Vlaams-Brabant	0.785	0.845	1.630
BE31	Prov. Brabant Wallon	0.685	0.929	1.613
CH02	Espace Mittelland	0.830	0.765	1.595
SE12	OEstra Mellansverige	0.859	0.729	1.588
SE22	Sydsverige	0.793	0.788	1.582
FR42	Alsace	0.824	0.738	1.561
CH05	Ostschweiz	0.777	0.783	1.559
DEA2	Koeln	0.571	0.979	1.550
FI19	Laensi-Suomi	0.828	0.721	1.549
DEA1	Dusseldorf	0.691	0.858	1.549
NL41	Noord-Brabant	0.661	0.870	1.531
BE10	Region de Bruxelles	0.855	0.674	1.529
DE24	Oberfranken	0.592	0.923	1.515
CH01	Region lemanique	0.686	0.809	1.496
SE21	Smaland med oearna	0.951	0.538	1.489
LI00	Liechtenstein	0.734	0.749	1.483
UKH2	Bedfordshire and Hertfordshire	0.760	0.687	1.447
AT34	Vorarlberg	0.769	0.674	1.443
FI18	Etelae-Suomi	0.700	0.734	1.435
DE22	Niederbayern	0.764	0.666	1.430
UKJ2	Surrey, East and West Sussex	0.727	0.698	1.425
BE21	Prov. Antwerpen	0.789	0.629	1.418
SE23	Vaestsverige	0.749	0.668	1.417
DK01	Hovedstaden	0.643	0.767	1.410
DE92	Hannover	0.700	0.710	1.410
DEB1	Koblenz	0.698	0.711	1.409
NL42	Limburg (NL)	0.764	0.643	1.407
DE72	Giessen	0.618	0.784	1.403
UKJ1	Berkshire, Buckinghamshire and Oxfordshire	0.681	0.721	1.402
FI1A	Pohjois-Suomi	0.694	0.700	1.395
NL31	Utrecht	0.724	0.670	1.394
CH07	Ticino	0.792	0.599	1.392
UKH3	Essex	0.764	0.582	1.346
NL33	Zuid-Holland	0.809	0.529	1.338
DE60	Hamburg	0.484	0.852	1.336
DE93	Luneburg	0.647	0.689	1.336
UKJ3	Hampshire and Isle of Wight	0.747	0.587	1.334
UKH1	East Anglia	0.621	0.708	1.329
DEA3	Munster	0.631	0.696	1.328
AT31	Oberoesterreich	0.702	0.616	1.318
BE22	Prov. Limburg (B)	0.841	0.464	1.304
AT32	Salzburg	0.779	0.524	1.303
DE91	Braunschweig	0.532	0.767	1.299
NL22	Gelderland	0.750	0.543	1.292
ITC2	Valle d'Aosta/Vallee d'Aoste	0.822	0.468	1.289
DEC0	Saarland	0.638	0.649	1.287
SE31	Norra Mellansverige	0.780	0.486	1.266
DEF0	Schleswig-Holstein	0.601	0.662	1.263
DE42	Brandenburg - Sudwest	0.515	0.746	1.261
AT13	Wien	0.519	0.741	1.260
BE33	Prov. Liege	0.765	0.495	1.260
DEA4	Detmold	0.630	0.628	1.259
NO03	Sor-Ostlandet	0.765	0.491	1.257
DE73	Kassel	0.718	0.533	1.251
SI02	Zahodna Slovenija	0.525	0.719	1.244
FR71	Rhone-Alpes	0.612	0.626	1.238
DEA5	Arnsberg	0.611	0.626	1.238
BE23	Prov. Oost-Vlaanderen	0.671	0.564	1.235

BE35	Prov. Namur	0.661	0.570	1.231
UKK1	Gloucestershire, Wiltshire and Bristol/Bath area	0.696	0.532	1.228
AT33	Tirol	0.714	0.510	1.224
DK05	Nordjylland	0.729	0.487	1.216
UKG1	Herefordshire, Worcestershire and Warwickshire	0.654	0.555	1.209
SE33	OEvre Norrland	0.779	0.426	1.205
DEB2	Trier	0.684	0.516	1.201
NL34	Zeeland	0.766	0.434	1.200
DE94	Weser-Ems	0.626	0.565	1.191
AT12	Niederoesterreich	0.584	0.606	1.190
UKF2	Leicestershire, Rutland and Northamptonshire	0.709	0.458	1.167
NL32	Noord-Holland	0.671	0.496	1.167
DK04	Midtjylland	0.606	0.535	1.141
SI01	Vzhodna Slovenija	0.565	0.576	1.141
DEG0	Thuringen	0.607	0.528	1.136
BE34	Prov. Luxembourg (B)	0.584	0.549	1.133
FR43	Franche-Comte	0.670	0.453	1.123
FR23	Haute-Normandie	0.634	0.488	1.121
AT11	Burgenland (A)	0.524	0.583	1.107
ITC1	Piemonte	0.689	0.414	1.102
UKD2	Cheshire	0.496	0.601	1.098
NL23	Flevoland	0.693	0.402	1.096
FR26	Bourgogne	0.649	0.446	1.095
AT22	Steiermark	0.527	0.568	1.095
ITC4	Lombardia	0.633	0.441	1.074
FR82	Provence-Alpes-Cote d'Azur	0.654	0.419	1.073
AT21	Kaernten	0.627	0.444	1.071
BE32	Prov. Hainaut	0.685	0.385	1.070
DK03	Syddanmark	0.642	0.423	1.065
NO01	Oslo og Akershus	0.495	0.549	1.044
NO06	Trondelag	0.595	0.447	1.042
DE50	Bremen	0.532	0.507	1.039
LU00	Luxembourg (Grand-Duche)	0.494	0.541	1.035
NL13	Drenthe	0.546	0.479	1.025
DEE0	Sachsen-Anhalt	0.576	0.447	1.023
FR22	Picardie	0.581	0.440	1.021
ITD5	Emilia-Romagna	0.566	0.442	1.008
NL21	Overijssel	0.548	0.448	0.996
FR24	Centre	0.530	0.464	0.994
UKD5	Merseyside	0.606	0.387	0.993
UKL2	East Wales	0.598	0.394	0.991
UKM2	Eastern Scotland	0.582	0.403	0.985
UKJ4	Kent	0.561	0.419	0.980
FR72	Auvergne	0.595	0.383	0.978
UKM5	North Eastern Scotland	0.511	0.441	0.952
FR62	Midi-Pyrenees	0.486	0.461	0.947
UKF1	Derbyshire and Nottinghamshire	0.508	0.417	0.925
BE25	Prov. West-Vlaanderen	0.499	0.422	0.921
DED1	Chemnitz	0.520	0.397	0.917
UKE1	East Yorkshire and Northern Lincolnshire	0.511	0.401	0.912

4. Community Innovation Survey

4.1 A methodological note

4.1.1. The Community Innovation Survey

The Community Innovation Survey (CIS) is a survey designed to obtain information on innovation activities within enterprises, as well as various aspects of the process such as the effects of innovation, sources of information used, costs etc.

Data are collected on a four-yearly basis.

The first CIS (CIS1) was a pilot exercise, held in 1993 while the second survey (CIS2) was carried out in 1997/1998, except Greece and Ireland where it was launched in 1999.

The third survey (CIS3) was implemented in 2000/2001 in most of the participating countries.

The CIS4 was launched in 2005, based on the reference period 2004, with the observation period 2002 to 2004.

The fifth survey CIS 2006 was launched in 2007, based on the reference period 2006, with the observation period 2004 to 2006.

The last survey CIS 2008 was launched in 2009, based on the reference period 2008, with the observation period 2006 to 2008.

CIS covers EU Member States, EU Candidate Countries, Iceland and Norway.

Country coverage however differs in the different waves.

CIS3 was run in the 25 EU Member States, Candidate Countries, Iceland and Norway.

CIS4 was run in the 27 EU Member States, Candidate Countries, Iceland and Norway.

CIS2006 and CIS2008 were run in the 27 EU Member States, Candidate Countries, and Norway.

However, participating countries are free not to release some information which thus might appear as confidential in EUROSTAT database and are not available (e.g. some UK and Iceland data for CIS4).

EUROSTAT in fact reports that confidentiality of CIS data is flagged by Member States.

In order to ensure comparability across countries, EUROSTAT, in close cooperation with the EU Member States, developed a standard core questionnaire starting with CIS3 data collection, with an accompanying set of definitions and methodological recommendations. The responsibility for the survey at a national level is in most cases, with the National Statistical Office or a national Ministry. EUROSTAT collects aggregated data and micro-data from countries.

Still, problems of comparability across waves represent a rather pressing issue. Different waves may in fact have different sectoral coverage. For example, CIS3 has a different sectoral coverage from CIS4 and CIS2006; also, CIS2008 uses NACE Rev.2 classification of economic activities, whereas previous waves were based on NACE Rev.1.1 classification of economic activities. This limits the scope of comparisons across waves to the comparison between CIS4 and CIS2006.

The CIS is designed to obtain information on innovation activities within enterprises with 10 or more employees. Enterprises are classified by type of innovation activity according to the following definitions.

Innovation: an innovation is a new or significantly improved product (good or service) introduced to the market or the introduction within an enterprise of a new or significantly improved process. Innovations are based on the results of new technological developments, new combinations of existing technology or the utilisation of other knowledge acquired by the enterprise. Innovations may be developed by the innovating enterprise or by another enterprise. However, purely selling innovations wholly produced and developed by other enterprises is not included as an innovation activity. Innovations should be new to the enterprise concerned. For

product innovations they do not necessarily have to be new to the market and for process innovations the enterprise does not necessarily have to be the first one to have introduced the process.

Product innovators: introduced new and significantly improved goods and/or services with respect to their fundamental characteristics, technical specifications, incorporated software or other immaterial components, intended uses, or user friendliness. Changes of a solely aesthetic nature and the pure sale of product innovations wholly produced and developed by other enterprises are not included.

Process innovators: implemented new and significantly improved production technologies or new and significantly improved methods of supplying services and delivering products. The outcome of such innovations should be significant with respect to the level of output, quality of products (goods or services) or costs of production and distribution. Purely organisational or managerial changes are not included.

More in details, EUROSTAT makes available the data on firms that introduce **only product innovation**, firms that introduce **only process innovation**, firms that introduce **both product & process innovation**. This sharper distinction is in our option better suited to fully acknowledge the different set of capabilities necessary to complete and introduce into the market these different types of innovation. In our estimation strategy, thus, we will make use of this information.

It is important to clarify that only product innovators represent a sub-sample of product innovators, namely those that introduce product innovation without introducing process innovations. On parallel, only process innovators represent a sub-sample of process innovators, namely those that introduce process innovation without introducing product innovations. The following table clarifies this distinction. The third category is composed of innovators that introduce both product and process innovations. The three categories together represent the largest group of innovators, those that introduce product and/or process innovations (indicated in yellow in the table reported below)[5].

PRODUCT INNOVATORS

PROCESS INNOVATORS		**Yes**	**No**
	Yes	PRODUCT & PROCESS INNOVATORS	ONLY PROCESS INNOVATORS
	No	ONLY PRODUCT INNOVATORS	----

The last category of innovators is composed of those firms that introduce **marketing and/or organizational** (i.e. non-technological) innovation to one of their markets and aims at better capturing innovation processes in services. Marketing innovation is defined as the introduction of 'Significant changes to the design or packaging of a good or service" or "New or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses". An organisational innovation is defined as the introduction of either "New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your enterprise", "A major change to the organisation of work within your enterprise, such as changes in the management structure or integrating different departments or activities" or "New or significant changes in your relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting.

Unfortunately, EUROSTAT provides data at NUTS0 level only (and only for those participating countries allowing for data release) and there are limited official sources of CIS data at the regional level (NUTS2 or NUTS1).

[5] This distinction makes further complex the comparability of CIS NUTS2 data coming from National Statistical Offices. In fact, some countries, as it will be discussed more in details below, make CIS NUTS2 data publicly available, but unfortunately, they refer to different categories of innovators, which eventually prevents their use in a comparative perspective.

Some regional data may come from some National Statistical Offices. This is the case of Italy, Romania, Czech Republic, UK.

Unfortunately, however, the information coming from these sources are not consistent and directly comparable. In fact, the types of innovation covered may differ and the weighting procedure are not necessarily harmonized or still awaiting for approval by EUROSTAT.

For instance, UK provides information on Product innovators and Process innovators whereas Italy provides information on Only Product innovators only and Only Process innovation

This seriously hampers the opportunity to use these data in a comparative perspective.

Regional data are also available from the Annex to the Methodology Report of the Regional Innovation Scoreboard (RIS) but only for the largest category of innovators, i.e. product and/or process innovators, and for a selected group of countries, whereas the data for the others are estimated and not released.

Table 126 lists European countries participating to CIS4 according to the NUTS level of data availability, as reported in RIS Methodology Report (2009).

Table 126. European countries participating to CIS4

NUTS0	CY, DE, DK, EE, IE, LT, LU, LV, MT, NL, SE
NUTS1	AT, BE, BG, FR, UK
NUTS2	CZ, ES, FI, HU, GR, IT, NO, PL, PT, RO, SI, SK

4.1.2. NUTS2 data estimation methodology

We estimate regional data (i.e. NUTS2 level) starting from the national data (i.e. NUTS0 level) available from EUROSTAT in order to ensure comparability across countries. To do so we used weights to redistribute the NUTS0 data at NUTS2 level. At present, we concentrated our efforts on CIS4 wave only.

Firstly, we estimated the regional respondents sample. We redistributed the NUTS0 value according to the regional employment share.

Next, we estimated the regional sample of only product innovators, only process innovators, product and process innovators, and marketing and/or organizational innovators. To this end, we used different weights according to the different types of innovations. All weights are computed as regional share of national values of the selected variables. The weights aim at capturing both a functional as well as a sectoral dimension. The former is captured by looking at the share of professions, the latter by looking at the sectoral specialization. In absence of any a priori assumption on different relevance of the functional vs the sectoral dimension, we attributed equal importance to the selected weights.

Table 127 shows the selected weights.

Table 127: Selected weights

TYPE of INNOVATION	**Weights**
Only PRODUCT	% scientists, % employment in high-tech (DL)
Only PROCESS	% employment in manufacturing, % technicians, % managers
PRODUCT & PROCESS	% scientists, % employment in high-tech (DL), % employment in manufacturing, % technicians, % managers
Marketing &/or organisational	% managers, % employment in services

The choice of the weights is based on logical expectations.

Product innovation is expected to take place at a greater extent in regions characterised by a larger endowment of advanced high-tech sectors, such as electrical and electronic equipment manufacturing (share of employment in the sector DL according to Nace Rev.1.1 classification), and advanced functions such as R&D (i.e. share of scientists). The definition used of high-tech sectors is restricted to advanced manufacturing sectors, since these are the sectors that are expected to generate product innovation. Sectors that can deploy product innovation are left aside.

Process innovation is expected to take place at a greater extent in regions characterised by a larger endowment of manufacturing sectors in which new production technologies or methods for producing goods can be introduced (share of employment in manufacturing) and a larger share of functions deeply involved into the production process implementation and monitoring (i.e. share of technicians and managers).

Product and process innovation is expected to take place at a greater extent in regions characterised by both a larger endowment of advanced high-tech sectors, such as electrical and electronic equipment manufacturing (share of employment in the sector DL according to Nace Rev.1.1 classification), and advanced functions such as R&D (i.e. share of scientists) as well as a larger endowment of manufacturing sectors in which new production technologies or methods for producing goods can be introduced (share of employment in manufacturing) and a larger share of functions deeply involved into the production process implementation and monitoring (i.e. share of technicians and managers).

Marketing and/or managerial innovation is expected to take place at a greater extent in regions characterised by a larger endowment of the service sector (share of employment in services), and a larger share of managerial functions (i.e. share of managers).

4.1.3. Robustness of the estimates

To check the robustness of our estimates we implemented a series of benchmark exercises. In detail, we implemented three types of tests, namely on the equality of means, on the equality of standard deviation, and of Kolmogorof-Smirnoff, to assess whether our estimates diverge from the original sample distribution.

We performed two sets of comparisons.

First, we compared our estimates of the share of only product innovators, the share of only process innovators and the share of product and process innovators with regional data from National Statistical Offices. These latter have been rescaled at the National value available from EUROSTAT, since the National figures available from EUROSTAT and National Statistical Offices may differ according to different strata weighting procedures. The tests could be implemented only on limited set of countries, namely Italy, Romania and Czech Republic that publicly release these data on their websites.

Next, to support further our estimates, we made use of data on product and/or process innovators from RIS. In particular, we compared our estimates of product and/or process innovators, obtained as sum of the first three categories of innovators (i.e. only product innovators, only process innovators, product and process innovators), with RIS data. The tests could be implemented only on those countries whose data are available in the annex to the RIS methodology report.

Still, some problems of comparability remain. For example, the France NUTS0 data available from RIS on the share of product and/or process innovators is different from the France NUTS0 data available from EUROSTAT (in particular, the former is smaller than the latter), which may affect the mean value of our estimates.

Table 128 summarizes the results of these tests.

Overall, they indicate that our estimates do not statistically differ in their mean, standard deviation and distribution from the official data released either by National Statistical Offices or by RIS. Although for some countries, the tests indicate that either the mean or the standard deviation can be statistically different, the output of the Kolmogorov-Smirnoff test lends support

to our estimates and indicates that the distribution of the original sample does not statistically differ from that of our estimates.

Table 128. Consistency tests

Sample	Type of innovation				
	Product only				
	Mean estimates	**Mean benchmark estimates**	**Mean difference**	**Std. Dev. Difference**	**Kolmogorov-Smirnoff test (different distr.)**
IT*	4.41	4.53	N.S.	N.S.	Not significant; p-value equals 0.94.
RO*	1.95	1.69	N.S.	> ; p<0.05	
	Process only				
	Mean estimates	**Mean benchmark estimates**	**Mean difference**	**Std. Dev. Difference**	**Kolmogorov-Smirnoff test (different distr.)**
IT*	14.27	14.00	N.S.	N.S.	Not significant; p-value equals 0.95.
RO*	4.72	4.82	N.S.	> ; p<0.01	
	Product and process				
	Mean estimates	**Mean benchmark estimates**	**Mean difference**	**Std. Dev. Difference**	**Kolmogorov-Smirnoff test (different distr.)**
CZ*	14.48	14.38	N.S.	< ; p< 0.05	
IT*	8.90	9.01	N.S.	N.S.	Not significant; p-value equals 0.98.
RO*	13.87	13.15	N.S.	< ; p< 0.01	
	Product and/or process				
	Mean estimates	**Mean benchmark estimates**	**Mean difference**	**Std. Dev. Difference**	**Kolmogorov-Smirnoff test (different distr.)**
AT§	49.03	50.03	N.S.	N.S.	
BE§	42.37	46.61	N.S.	N.S.	
BG§	15.03	15.21	N.S.	N.S.	
CZ§	37.03	36.05	N.S.	N.S.	
ES§	29.97	29.06	N.S.	> ; p<0.01	Not significant; p-value equals 0.98.
FI§	34.45	34.52	N.S.	N.S.	
FR§	27.55	24.37	N.S.	> ; p<0.01	
GR§	29.72	39.30	< ; p<0.01	N.S.	
HU§	18.09	17.37	N.S.	N.S.	
IT§	31.77	32.21	N.S.	N.S.	

PL[§]	23.07	38.95	N.S.	N.S.
PT[§]	39.40	38.95	N.S.	N.S.
RO[§]	20.18	17.74	N.S.	N.S.
SI[§]	34.11	23.85	> ; p<0.05	N.S.
SK[§]	22.43	20.01	N.S.	N.S.
UK[§]	25.80	42.08	NA	NA
IT[*]	31.77	27.59	N.S.	N.S.
RO[*]	20.18	20.54	N.S.	N.S.

Marketing and organizational

	Mean estimates	Mean benchmark estimates	Mean difference	Std. Dev. Difference	Kolmogorov-Smirnoff test (different distr.)
AT[§]	80.52	80.52	N.S.	N.S.	
BE[§]	80.33	70.36	N.S.	N.S.	
BG[§]	0.76	0.94	N.S.	N.S.	
CZ[§]	54.83	54.23	N.S.	N.S.	
ES[§]	35.72	32.53	> ; p<0.05	N.S.	
FI[§]	69.13	72.81	N.S.	N.S.	
FR[§]	55.78	56.04	N.S.	> ; p<0.05	Not significant; p-value equals 0.51.
IT[§]	49.12	51.39	N.S.	N.S.	
PL[§]	26.88	27.43	N.S.	N.S.	
PT[§]	64.49	67.43	N.S.	N.S.	
RO[§]	33.71	32.10	N.S.	N.S.	
SI[§]	54.35	54.28	N.S.	N.S.	
SK[§]	19.65	18.15	N.S.	> ; p<0.05	
UK[§]	42.14	43.44	N.S.	> ; p<0.05	

[*] *Source of data used as benchmark: National Statistical Offices.*

[§] *Source of data used as benchmark: Regional Innovation Scoreboard 2009.*

4.1.4. Ad-hoc solutions to specific cases

In some cases, the methodology described above was not applicable either because of the lack of data on EUROSTAT (e.g. UK) or the lack of data on weights (e.g. Norway). We detail below the solutions adopted in such cases. ESPON Contact Point have been contacted to ask for help with some successful results.

The benchmark vector for the marketing and organizational innovation measure is made available in the Regional Innovation Scoreboard 2009. In order to be able to compare our estimates with the RIS data, we applied our methodology to the RIS national data, instead of Eurostat national data. For this purpose, we estimated the marketing and organizational vector as follows. The numerator of our ratio (number of innovative firms in marketing and organization) has been calculated by multiplying the total national sample by the percentage of innovative firms as from the RIS. This national number has been then spit into regional values according to the regional weights mentioned before, while the denominator (the total number of firms) has been calculated following our standard methodology, i.e., by assigning the total national CIS sample according to regional shares of value added. As a result, **the marketing and organizational vector has been structured in order to isolate the possible bias stemming from different samples**.

Results of the comparisons are therefore of particular importance in this specific case, since **the almost perfect adherence of our results to the RIS ones point at a satisfactory estimation procedure**. For those countries for which we are able to calculate basic statistics, mean values cannot be considered statistically different across countries, but for the case of Spain; the standard deviation is instead statistically different only for France, Slovakia, and the UK (and in particular higher for our estimates). More importantly, **the Kolmogorov-Smirnoff test for the equality of distributions cannot be rejected at any conventional significance level**. All these comparisons have been run on standardized data, the only available RIS regional data.

The satisfactory results of our estimates guarantee that our methodology rightly captures the phenomenon, and therefore we applied it to the Eurostat national data.

Norway

Data on weights are not available since Norway does not participate to LFS survey from which data are drawn. However, EUROSTAT provides the NUTS0 data for only product innovation, only process innovation and product and process innovation. Also, RIS provides NUTS2 data on product and/or process innovation. Therefore, in order to estimate the NUTS2 data for only product innovation, only process innovation and product and process innovation, we applied the regional share of product and/or process innovation available from RIS to NUTS0 data from EUROSTAT on only product innovation, only process innovation and product and process innovation.

Analogously, marketing and organizational innovation shares have been calculated by assigning each Norwegian region the share of national marketing and organizational innovation issued in the RIS data set.

UK

EUROSTAT does not provide NUTS0 data on UK for the following variables:

- only product innovation
- only process innovation
- product and process innovation
- product and/or process innovation

However, the Department of Trade and Industry (DTI) provide the following data

- product innovation
- process innovation

which however are limitedly comparable with the data on only product innovation and only process innovation available for the other countries (see section 1 and table 1 above). To estimate product and process innovation as well as product and/or process innovation we summed up product innovation and process innovation. Unfortunately, this bears the risk of double counting (and overestimation) since both categories include also firms performing both product and process innovation.

As for marketing and organizational innovation, we proceeded along the lines of the other vectors. A national share of firms innovating in marketing and organization has been inferred from DTI documents. This share has been applied to the EUROSTAT national CIS sample, thus obtaining a regional number of innovative firms. Next, the denominator (i.e. the total number of firms in the regional CIS sample) has been obtained by splitting the national CIS sample according to regional value added shares. Finally, the ratio has been calculated between these two values according to our methodology above explained.

Switzerland

Data on weights are not available since Switzerland does not participate to LFS survey from which data are drawn. Also, Switzerland does not participate to CIS so that CIS NUTS0 data neither are available. However, the Swiss ESPON Contact Point enabled us to access data on product innovation and process innovation, but not on only product innovation, only process innovation, product and process innovation, product and/or process innovation.

To estimate product and process innovation as well as product and/or process innovation we summed up product innovation and process innovation. Unfortunately, this bears the risk of double counting (and overestimation) since both categories include also firms performing both product and process innovation.

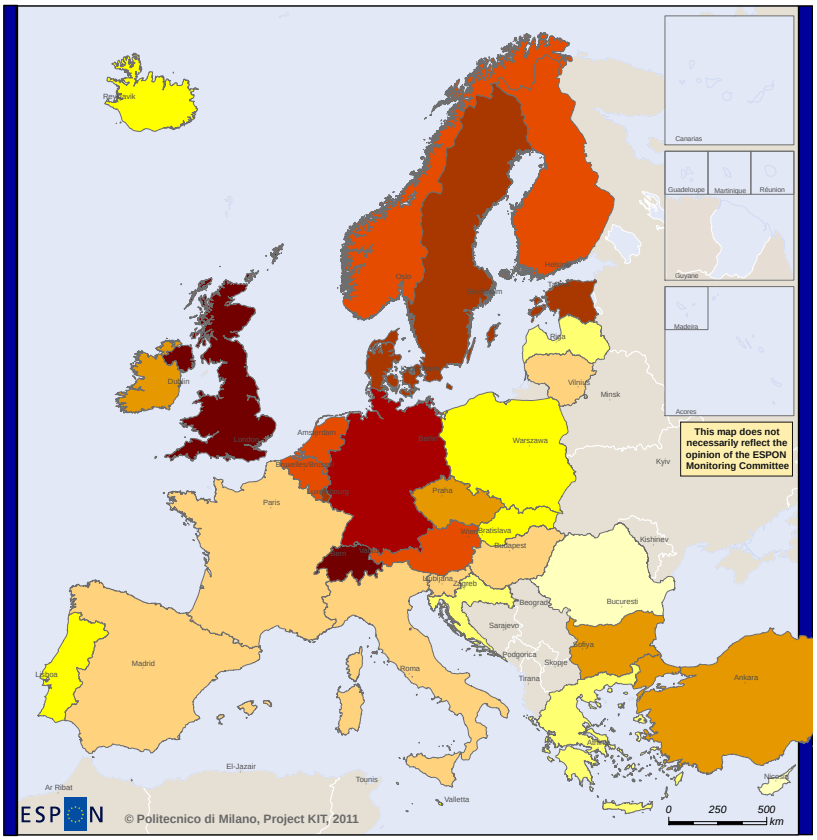
The data on marketing/organizational innovation is unfortunately not available.

Iceland does not disclose information on only product innovation, only process innovation, product and process innovation, product and/or process innovation for CIS4. The data used thus refer to CIS3. This bears a problem of comparability due to the different sectoral coverage of the two different CIS waves. Also, the data on marketing/organizational innovation is unfortunately not available since questions on this issue were firstly introduced in CIS4.

Macedonia, Croatia, Turkey did not participated to CIS4.

Liechtenstein does not collect innovation statistics.

4.2 National CIS statistics



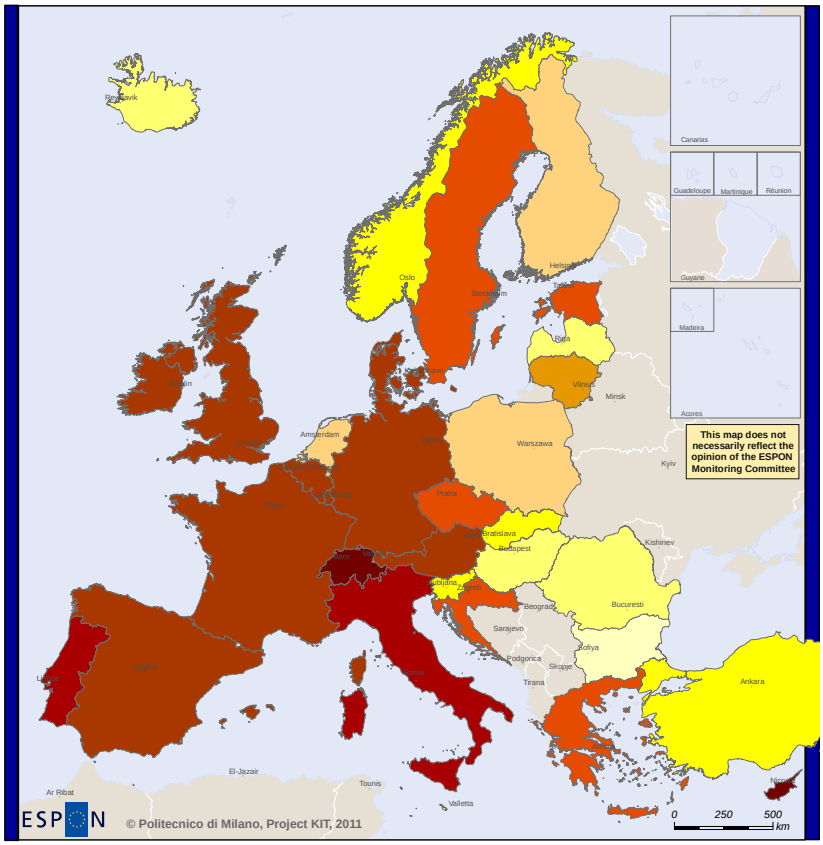
EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

Regional level: NUTS2
Source: Politecnico di Milano, 2011
Origin of data: Community Innovation Survey 2004
© EuroGeographics Association for administrative boundaries

CIS NUTS0 2004
Share of product innovation only
- 1.23 - 1.76
- 1.77 - 3.29
- 3.30 - 5.54
- 5.55 - 6.59
- 6.60 - 8.60
- 8.61 - 12.59
- 12.60 - 15.73
- 15.74 - 20.05
- 20.06 - 36.00

Switzerland: share of product innovation.
Iceland: CIS3 data.
Croatia, Latvia, Slovenija, and Turkey: CIS 2006 data.

Map 77. Product innovation only, national CIS 2004 data.



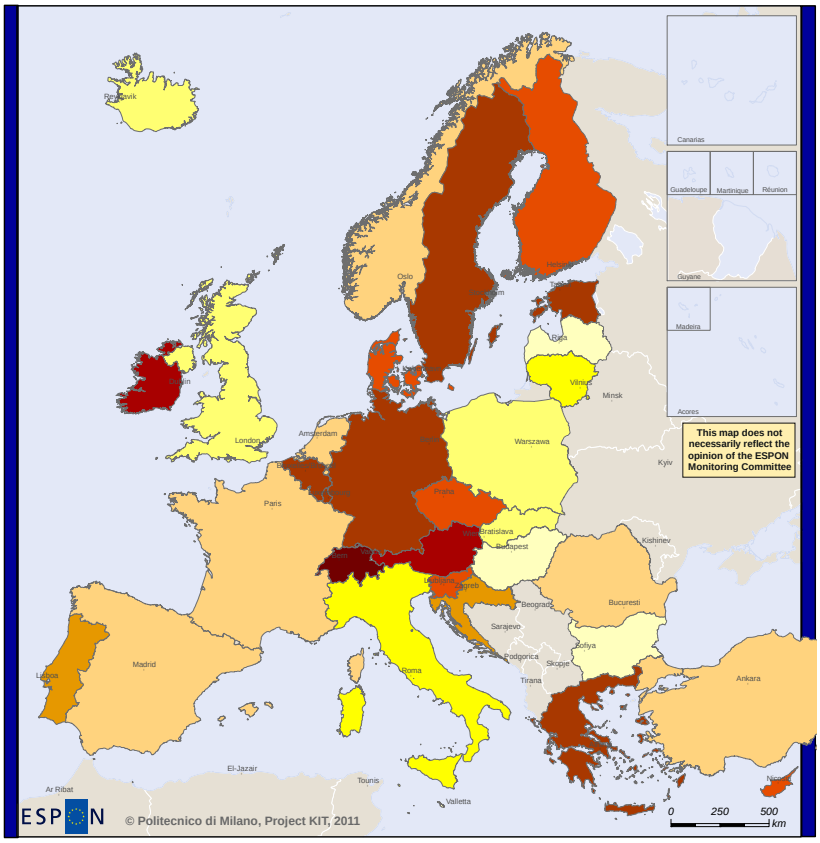
EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

Regional level: NUTS2
Source: Politecnico di Milano, 2011
Origin of data: Community Innovation Survey 2004
© EuroGeographics Association for administrative boundaries

CIS NUTS0 2004
Share of process innovation only
- 1.18 - 2.01
- 2.02 - 5.17
- 5.18 - 7.91
- 7.92 - 9.05
- 9.06 - 9.45
- 9.46 - 10.58
- 10.59 - 14.06
- 14.07 - 17.01
- 17.02 - 29.00

Switzerland: share of process innovation.
Iceland: CIS3 data.
Croatia, Latvia, Slovenija, and Turkey: CIS 2006 data.

Map 78. Process innovation only, national CIS 2004 data.



EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

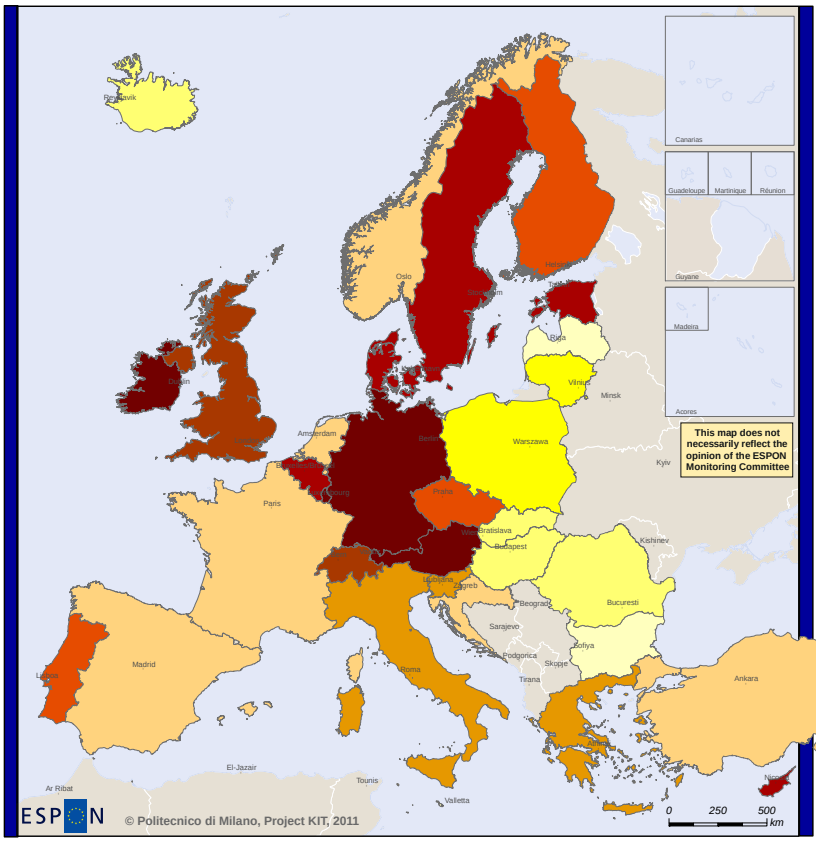
Regional level: NUTS2
Source: Politecnico di Milano, 2011
Origin of data: Community Innovation Survey 2004
© EuroGeographics Association for administrative boundaries

CIS NUTS0 2004
Share of both product and process innovation

- 7.22 - 8.35
- 8.36 - 10.35
- 10.36 - 12.18
- 12.19 - 14.73
- 14.74 - 17.44
- 17.45 - 20.27
- 20.28 - 24.08
- 24.09 - 29.32
- 29.33 - 45.00

Switzerland: share of process and process innovation.
Iceland: CIS3 data.
Croatia, Latvia, Slovenija, and Turkey: CIS 2006 data.

Map 79. Both product and process innovation, national CIS 2004 data.



EUROPEAN UNION
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INVESTING IN YOUR FUTURE

Regional level: NUTS2
Source: Politecnico di Milano, 2011
Origin of data: Community Innovation Survey 2004
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CIS NUTS0 2004

Share of product and/or process innovation

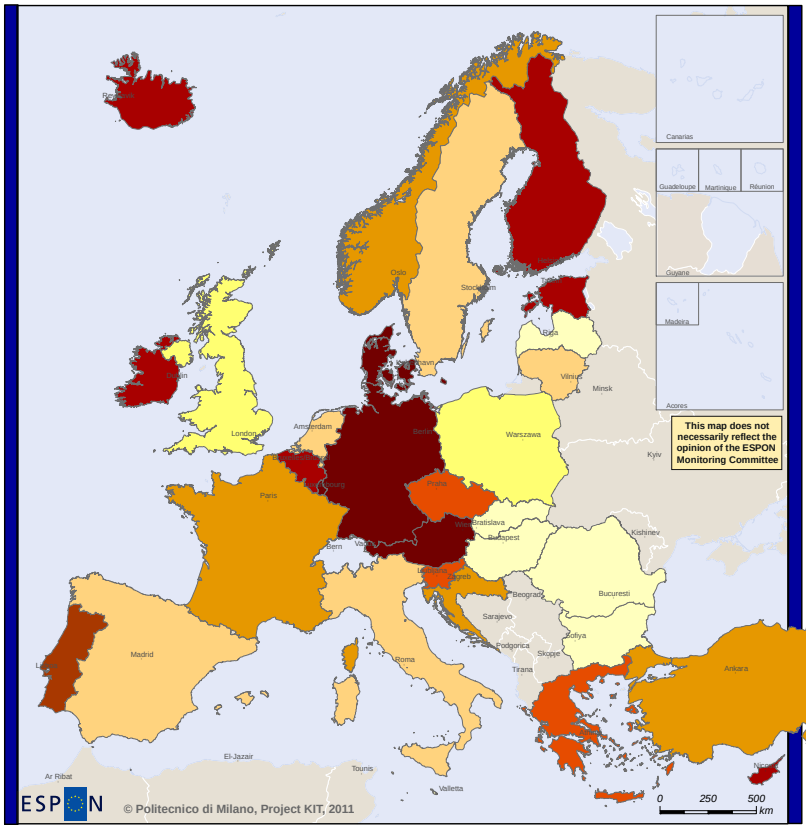
- 15.47 - 15.68
- 15.69 - 21.83
- 21.84 - 26.76
- 26.77 - 32.91
- 32.92 - 35.37
- 35.38 - 39.29
- 39.30 - 45.00
- 45.01 - 48.22
- 48.23 - 56.23

Switzerland: share of process and process innovation.

Iceland: CIS3 data.

Croatia, Latvia, Slovenija, and Turkey: CIS 2006 data.

Map 80. Product and/or process innovation, national CIS 2004 data.



EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

Regional level: NUTS2
Source: Politecnico di Milano, 2011
Origin of data: Community Innovation Survey 2004
© EuroGeographics Association for administrative boundaries

CIS NUTS0 2004

Share of marketing and organizational innovation

- NA
- 0 - 14.39
- 14.40 - 18.00
- 18.01 - 21.34
- 21.35 - 24.44
- 24.45 - 26.86
- 26.87 - 29.69
- 29.70 - 36.42
- 36.43 - 46.96

Iceland: CIS3 data.
Croatia, Latvia, Slovenija, and Turkey: CIS 2006 data.
Swedern: CIS 2008 data.

Map 81. Marketing and organizational innovation, national CIS 2004 data.

5. The geography of scientific activity in China, India and the United States of America

5.1 Introduction

This Section of the Appendix of the KIT Interim Report is devoted to the presentation of the preliminary findings of the project on the comparative analysis of the territorial dynamics of innovation in China, India and the US. The text is organised into five sections that lay the foundations of research in this area for the final report. In section 5.2 an in-depth analysis of the spatial distribution of patenting activity, by country, region and key technology fields (ICT, biotech and nanotech) is pursued. In section 5.3 a conceptual framework to inform the quantitative analysis of these territorial dynamics is outlined. Section 5.4 provides brief conclusions. Section 5.5 gives a summary of key methodological issues.

5.2 Key trends of innovation dynamics in China, India and the USA

5.2.1 Country-level comparative perspective

We begin with an overview of the comparative 'innovation performance' of the three countries. At this stage we focus on patents as a key innovation 'output' (see section 3 for more on this). The USA is the acknowledged innovation systems world leader on a range of metrics (Crescenzi et al 2007). Figures 4 and 5 illustrate America's performance on patents per capita over the past two decades. The US has increased its national patenting activity more or less continuously during this time, with counts rising from around 15,000 patents to 55,000.

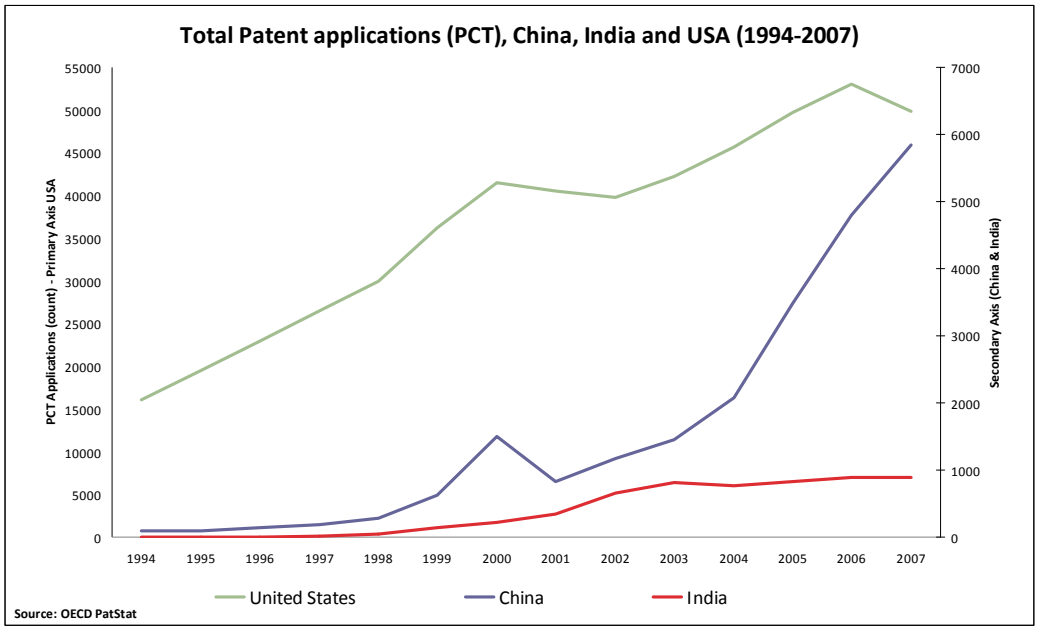


Figure 4 Total patent applications (PCT), China, India and USA 1994-2007

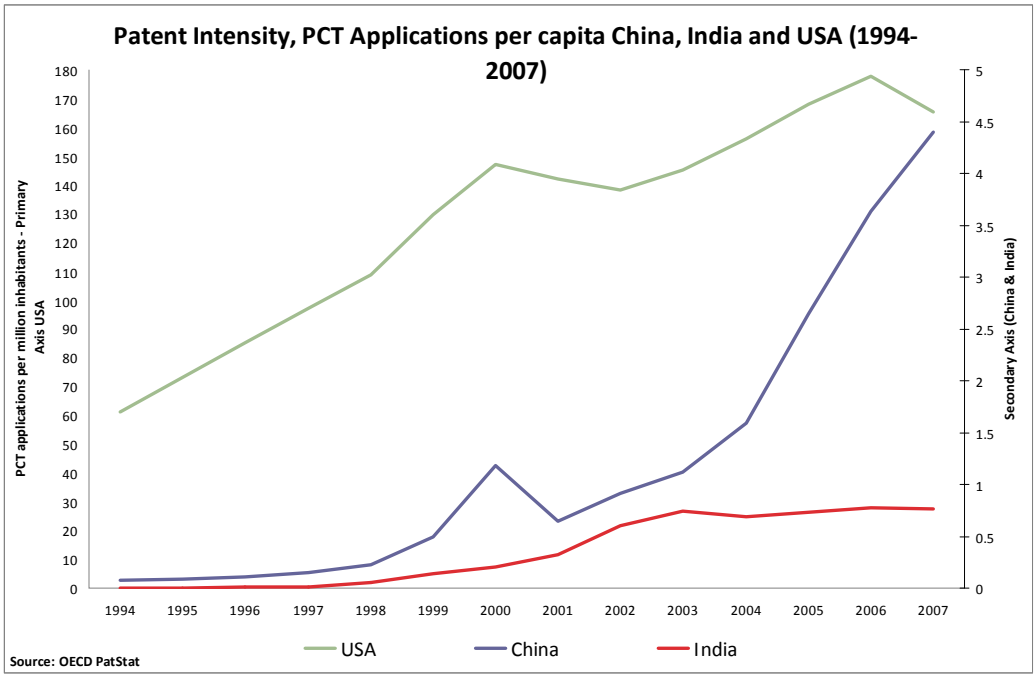


Figure 5 Patent intensity, PCT applications per capita, China, India and USA 1994-2007

During the 1990s both India and China invested heavily in innovation 'inputs', particularly China, increasing literacy rates and HE enrolment, raising production of engineering graduates and increasing spend on R&D. Both countries also began to 'globalise' their economies, increasing FDI flows, licensing of foreign technology and moving students abroad (Dahlman 2010).

The results of these efforts can be seen in rising patent rates. Both countries increased overall patenting and patent intensity during the 1990s. From 2000 onwards India patenting rates rose substantially. However, India's impressive improvements have been dwarfed by the huge jump patenting in China post-2001. Overall patent counts rose from 1,000 to nearly 6,000, with patent intensity (per capita patenting) rising over four-fold.

We now move on to consider the territorial aspects of the three countries' innovation systems. Figure 6 illustrates the cumulative distribution of patenting across space in India, China and the USA from 1994 to 2007, focusing on the 20 regions with the highest patent counts.

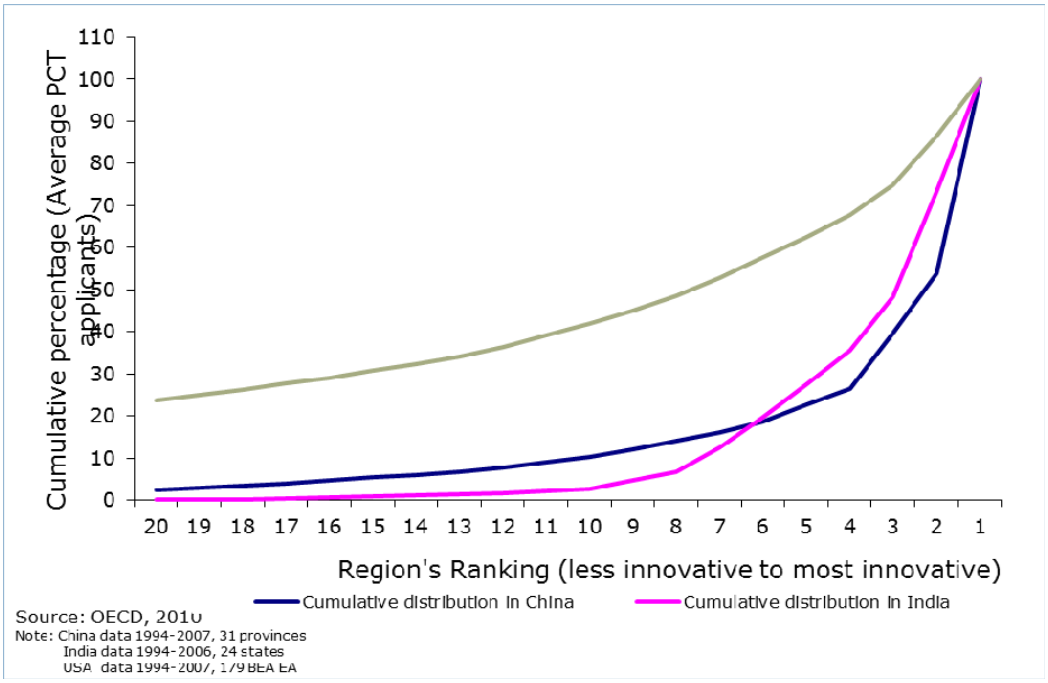


Figure 6. Generation of Innovation in China, India and the US Cumulative Distribution of PCT Patent Applications: Top 20 most innovative regions

Two points stand out from the graph. First, there seems to be a clear difference in the spatial features of 'mature' and 'emerging' innovation systems, with patenting in India and China far more spatially agglomerated than in the United States where the distribution of patenting activity is more smoothly distributed across space. Second, differential levels of investment in innovation inputs also appear to influence where innovative activity takes place. The six highest-patenting regions in China account for a bigger share of innovative activity than those in India, although the pattern reverses after that with a long tail of Indian regions.

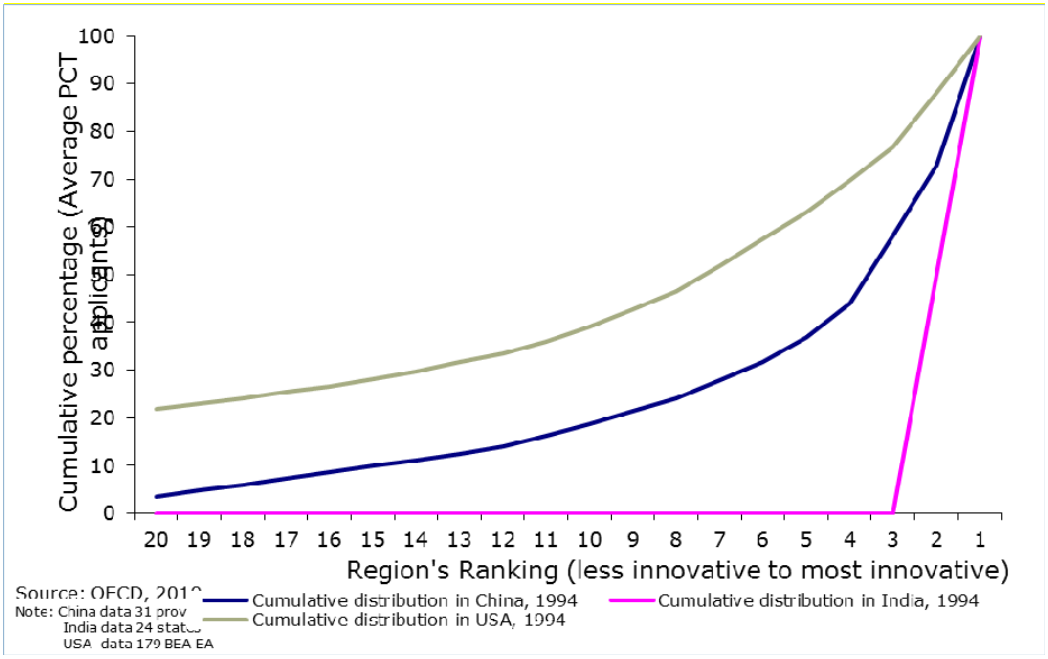


Figure 7. Cumulative Distribution of average PCT applications: Top 20 most innovative regions, 1994

Figures 7-9 break down these numbers over time. Sun (2003) finds evidence of increasing spatial agglomeration of innovative activity in China during the 1990s, as measured by patents. The graphs confirm this: in 1994 innovative activity in India is far more concentrated than in China. By the late 1990s the pattern is beginning to change: by 2007 patenting is more clustered in Chinese provinces than in Indian states. Indian patenting remains more concentrated in 2000, so agglomeration of patenting activity in China took place in parallel with the country's overall rise in patenting activity.

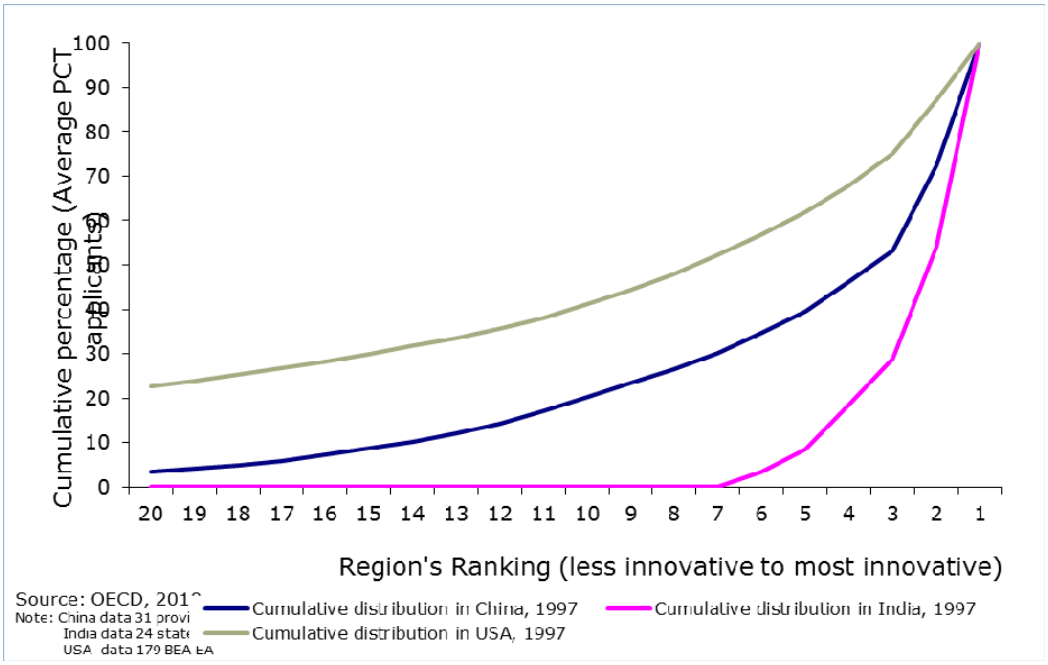


Figure 8. Cumulative Distribution of average PCT applications: Top 20 most innovative regions, 1997

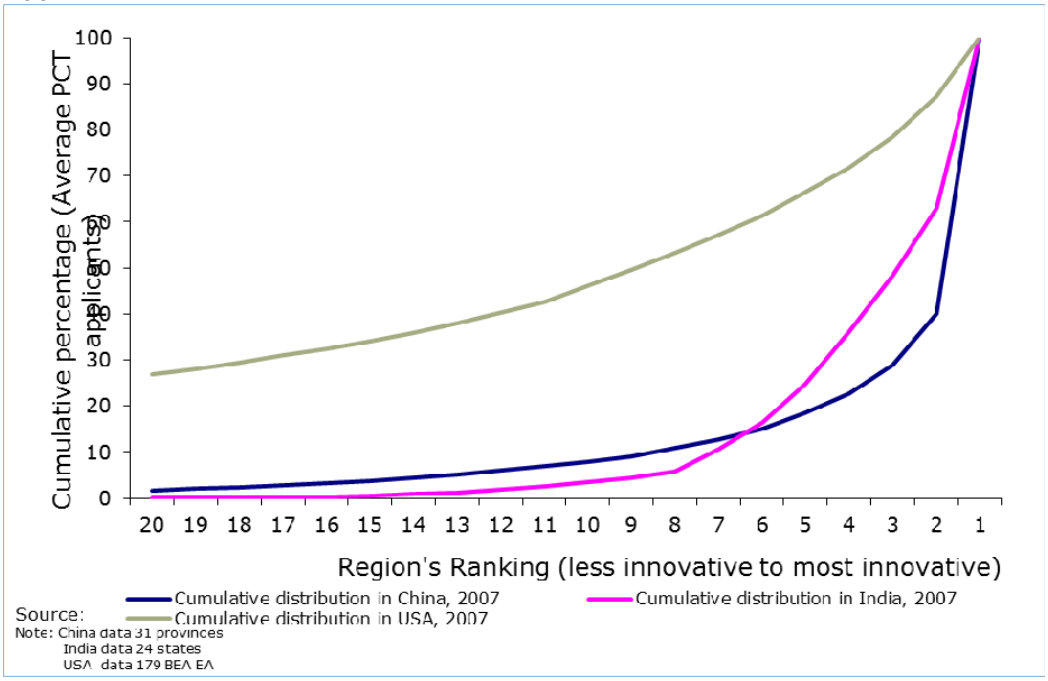


Figure 9. Cumulative Distribution of average PCT applications: Top 20 most innovative regions, 2007

5.2.2 Key trends: most / least 'innovative' regions in China, India and the US

Table 129 lists the twenty most innovative regions in the three countries over the whole time period, 1994-2007. It usefully complements our graphs and maps.

Table 129. Top 20 innovative regions, 1994-2007

	China	*India*	*USA*		*China*	*India*	*USA*
1	Beijing	Delhi	San Jose-San Francisco-Oakland, CA	**11**	Chongqing	Himachal Pradesh	Reno-Sparks, NV
2	Shanghai	Haryana	San Diego-Carlsbad-San Marcos, CA	**12**	Heilongjiang	West Bengal	New York-Newark-Bridgeport, NY-NJ-CT-PA
3	Guangdong	Chandigarh	Appleton-Oshkosh-Neenah, WI	**13**	Sichuan	Kerala	Gainesville, FL
4	Tianjin	Maharashtra	Minneapolis-St. Paul-St. Cloud, MN-WI	**14**	Shaanxi	Punjab	Seattle-Tacoma-Olympia, WA
5	Zhejiang	Andhra Pradesh	Boston-Worcester-Manchester, MA-NH	**15**	Jilin	Uttar Pradesh	Boise City-Nampa, ID
6	Fujian	Karnataka	Cincinnati-Middletown-Wilmington, OH-KY-IN	**16**	Hainan	Jharkhand	Chicago-Naperville-Michigan City, IL-IN-WI
7	Jiangsu	Goa	Rochester-Batavia-Seneca Falls, NY	**17**	Hubei	Rajasthan	Houston-Baytown-Huntsville, TX
8	Liaoning	Gujarat	Austin-Round Rock, TX	**18**	Shanxi	Madhya Pradesh	Hartford-West Hartford-Willimantic, CT
9	Shandong	Tamil Nadu	Philadelphia-Camden-Vineland, PA-NJ-DE-MD	**19**	Inner Mongolia	Jammu & Kashmir	Raleigh-Durham-Cary, NC
10	Hunan	Pondicherry	Albany-Schenectady-Amsterdam, NY	**20**	Xinjiang	Orissa	Santa Fe-Espanola, NM

The **USA** has a smoother spatial distribution of patents by applicant than either China or India. The three leading regions are San Jose-San Francisco-Oakland (Northern California), San Diego-Carlsbad-San Marcos (Southern California) and Appleton-Oshkosh-Neenah (Wisconsin). These three account for only 32% of all patenting by applicant, compared to 73% and 64% shares for, respectively, the leading Chinese and Indian regions. Generally, the more innovative regions in the US are located on the Western and Eastern seaboards, or the Great Lakes region (Michigan, Wisconsin). Less innovative areas are located in the Midwest or South, with a couple of exceptions – Houston-Baytown-Huntsville (Texas) and Denver-Aurora-Boulder (Colorado).

In **China**, as we have seen, the leading regions for innovation tend to be in coastal areas. Outside these regions, the next group of provinces, accounting for 1-3% of total patenting on average are also mainly coastal – only Sichuan (SW) and Hunan (Middle) are not coastal provinces. The

middle and West of China are less innovative, such as Tibet, Qinghai and Ningxia, which are far SW or NW provinces.

In **India**, leading regions tend to be in/around Delhi and the South. The provinces in the next group, which % is above 1%, are generally around Delhi and Mumbai, such as Karnataka (8.7%, close to Mumbai), Haryana (7%, Delhi located) and Tamil Nadu (7%, South). States in north-east India or border states, are less innovative. Some of them do not have any patents applicants until 2007 (for example Assam on the North East border with Bhutan and Bangladesh).

5.2.3 Key trends in different technology areas

We now explore patenting trends by more detail by breaking down overall counts into key technology fields. Patent data is organised by 'technology field' rather than industry (as in employment data, for example); OECD data follows standard IPC classifications, from which we explore counts for biotechnology, information and communications technology (ICT) and nanotechnology.

Figure 10 shows the spatial distribution of **biotechnology** patenting across the countries, for the whole time period 1994-2007. Biotechnology patenting is somewhat more spatially agglomerated in China and India than overall patenting; in China, the top three 'biotech regions' account for over 80% of overall patenting in the field. As with overall counts, however, both countries have more concentrated biotech patenting activity than the USA – where the top three regions account for just over 30% of all biotech patents.

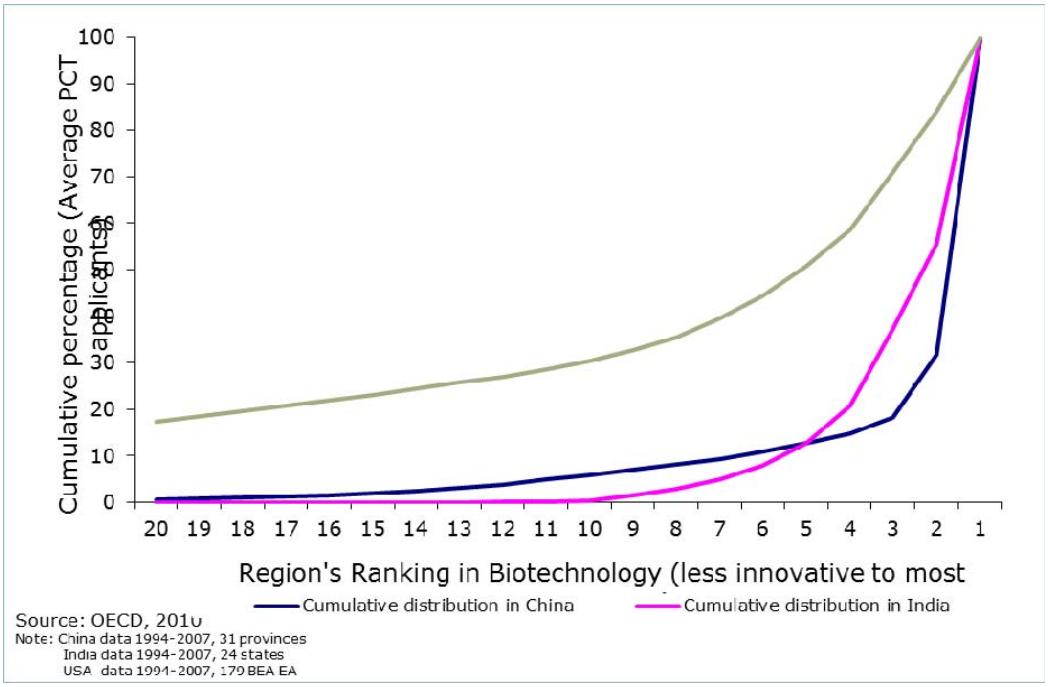


Figure 10. Cumulative Distribution of average PCT applications in Biotechnology: Top 20, 1994-2007

Figure 11 shows the distribution of ICT patents, where similar patterns persist. Sectoral activity is even more agglomerated in China than in India, with both countries having long tails of trailing regions. Again, both countries' ICT patenting is much more spatially clustered than in the USA.

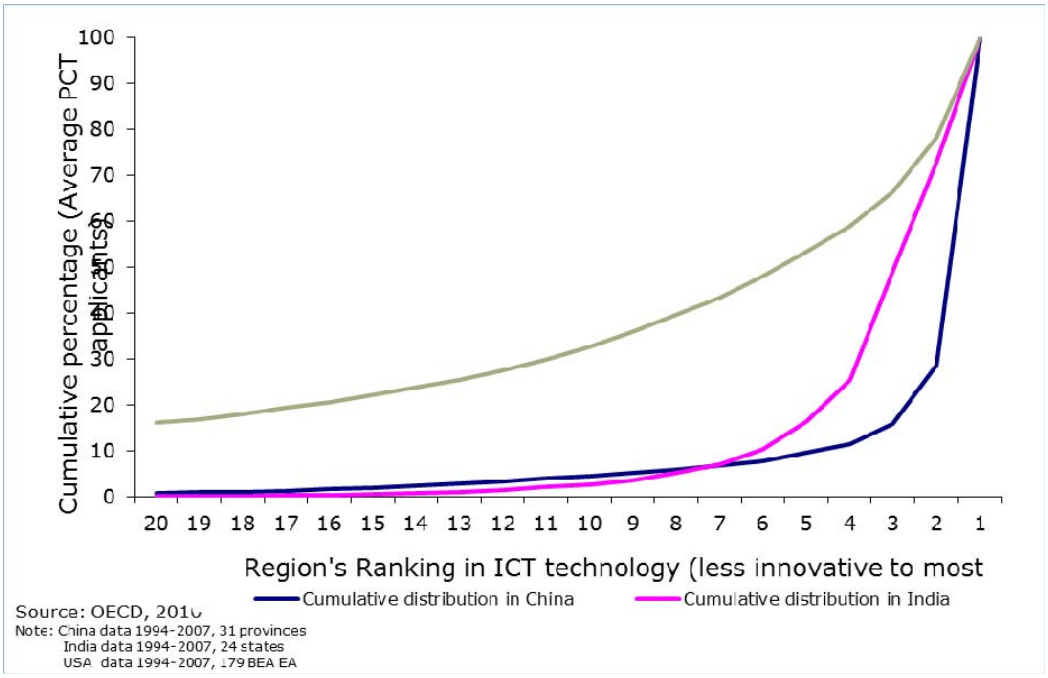


Figure 11. Cumulative Distribution of average PCT applications in ICT technology: Top 20, 1994-2007

Figure 12 gives trends for the nanotechnology patenting field. Here the pattern is somewhat different over our study period. India has the more agglomerated sectoral innovation system than China, with the top three Indian regions accounting for over 80% of nanotech patenting, against an approximate 60% share for the leading Chinese regions. As with the other two industries, nanotech patenting in both of these countries is significantly more agglomerated than in the USA.

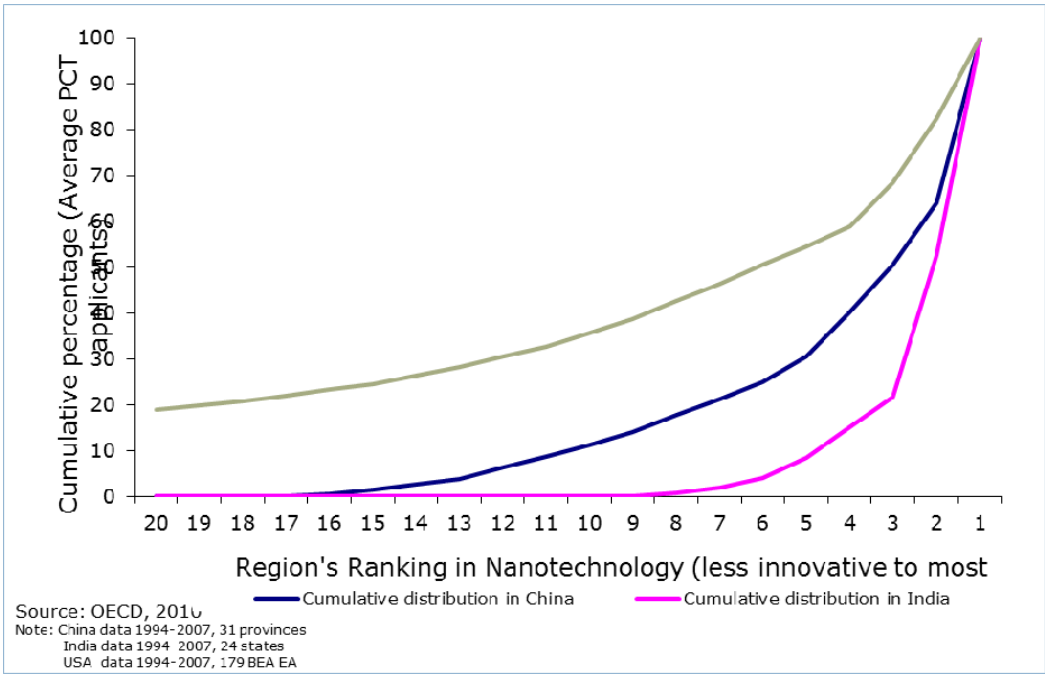


Figure 12. Cumulative Distribution of average PCT applications in Nanotechnology: Top 20, 1994-2007

5.3 A conceptual framework for comparative territorial analysis of 'mature' (EU and US) and 'emerging' (China and India) innovation systems

The regional innovation systems literature is used in this report in order to provide a scalable framework for exploring territorial dynamics of innovation in emerging countries (such as China and India), which allows for the specificities and histories of particular countries and regions. The analysis also incorporates insights from two other perspectives: endogenous growth models and new economic geography – the importance of R&D and human capital from endogenous growth theories, and the importance of spillovers from NEG models. These are set alongside a complex 'social filter' approach which allows us to understand important country-specific features.

5.3.1 The linear model of innovation of Endogenous Growth Theories

Endogenous growth theories highlight the importance of human capital and knowledge in advancing the technological frontier. Subsequent productivity gains drive long-term growth rates (Romer 1990). In practice, national governments have tended to operationalise endogenous growth ideas by seeking to raise overall levels of human capital and ideas production. As such, policy frameworks are effectively 'national innovation system' models describe key actors such as businesses, central government, universities and public research institutes (Liu and White 2001) – closely resembling the 'national science systems' explored by David Mowery and others (Mowery 1995, Mowery and Oxley 1992). Analyses focus on countries' performance on key inputs – R&D spending, human capital stock, university investment – and their links to key outputs such as patenting rates and 'gazelle' firms, which approximate ideas generation and diffusion respectively.

These linear, national-level perspectives of innovation systems are relevant to China and India because of both countries' current and historic emphasis on technology-led national growth (Leadbeater and Wilsdon 2008). Both China and India are now investing heavily in 'innovation inputs', such as R&D and HE investment, which both feeds into and feeds from rapid macroeconomic growth (Kjuis and Wang 2006). The main drawback of linear models of innovation activity is that they pay minimal attention to space – and so do not explain why innovative activity is often spatially concentrated.

5.3.2 Bringing 'space' and geography into the picture: the 'New Economic Geography' and Knowledge Spillovers

A second set of perspectives explores these geographies of innovation in detail. New Economic Geography studies (NEG) show how agglomeration supports innovative activity, via localised knowledge spillovers (e.g. Carlino et al 2007, Acs et al 2001, Audretsch and Feldman 1996, Malmberg et al 1996, Jaffe, Tratjenberg and Henderson 1993). As neither agglomeration nor innovation can be measured directly, density and patenting are typically used as proxies.

A number of studies suggest that proximity-spillover-innovation links also operate in developing country contexts, with strong evidence that urbanisation boosts productive efficiency (Xu 2009, Duranton 2008, Scott and Garofoli 2007). However, these effects may be constrained by the pace of urbanisation and/or institutional capacity. Specifically, rapid or chaotic urbanisation can outstrip governments' ability to provide adequate infrastructure and public services (Cohen 2006, Venables 2005). As such, agglomerations are also strongly correlated with poverty and informal development.

These models offer important insights for China and India – which are both undergoing extensive urbanisation and exhibit significantly spatially clustered systems of innovation. However, NEG models alone do not allow for important country-specific variables – history, institutions, networks and norms – which in practice will significantly influence innovation outcomes.

5.3.3 Institutions and (Regional) Systems of innovation

The innovation systems literature helps to fill some of the gaps in NEG models. Originally defined by Freeman (1987) as 'the network of institutions in the public and private sectors whose

activities and interactions initiate, import, modify and diffuse new technologies', innovation systems are now viewed broadly as including social institutions, education and communications infrastructures and the norms and rules that regulate economic and social interaction (Lundvall et al 2009). Such frameworks allow incorporation of country-specific factors that NEG models may not include.

'Regional innovation systems' (RIS) localise and spatialise these frameworks to specific regions and clusters (Asheim and Gertler 2005, Cooke 2002, Cooke et al 1997, Storper 1997, Saxenian 1994, Piore and Sabel 1984). The central insight – shared with NEG approaches – is proximity facilitates innovation, or Asheim and Gertler (2005) suggest, 'the geographic configuration of economic agents … is fundamentally important in shaping the innovative capabilities of firms and industries'.

RIS analysis is centred on firms and firms' capabilities. Business performance is influenced by a number of regional-level factors at the regional level. These include other actors (e.g. universities, public agencies) networks (e.g. public-private partnerships) and institutions (rules, customs and norms). These meso-level factors are also influenced by national-level institutions (such as legal and IPR frameworks, or public spending programmes), and by sectoral factors (industry-specific conditions or technological trends/shocks). Within these systems, critical dynamics are the 'triple helix' of private-university-public sector interactions (Cooke 2002), and the 'untraded interdependencies' that regulate agents' behaviour (Storper 1997).

Synthesizing the debate, Storper (1997) famously sees regional outcomes as being governed by three spaces – territory, organizations and technologies. This suggests RIS perspectives usefully complement national and sectoral 'systems' approaches, as well as the endogenous growth and NEG perspectives explored earlier. Recent evolutionary studies also suggest the importance of deep history, path-dependence in explaining regional and national innovation trajectories (Simmie et al 2008, Martin and Sunley 2006). Sectoral perspectives help illuminate the intersections between regional, national and industry factors, and the co-evolution of innovation systems through the interactions of their component parts (Malerba and Mani 2009).

A growing number of researchers are attempting to recalibrate RIS frameworks for developing country perspectives (Lundvall et al 2009, Perez-Padilla et al 2009 and Scott and Garofoli 2007 provide useful overviews). It is important to make these adaptations. First, in both China and India development in the formal economy partly depends on the performance of the broader, informal innovation system – social capital and networks, institutions and governance capacity (Lundvall et al 2009). Second, China and India's 'innovation experiences' need to be understood as part of the globalisation of both production and R&D that has been occurring since the 1970s (Bruche 2009, Mitra 2007). As Yeung (2009) points out, the task is to explain innovation under globalization. Third, local, spatial patterns of innovation are linked to these global flows. As Saxenian and Sabel (2008) argue, research needs to explain the specific 'puzzle' of rapid development of high-tech hubs in countries without the consistent quality of institutions generally thought necessary for growth.

Unlike innovation systems in developed countries, formal institutions may be weak in developing countries, especially at regional level, with intellectual property regimes providing only partial coverage and public agencies that may not always be welfare-maximising (Altenburg 2009, Joseph 2009). Capital and finance may be limited, and university-industry collaborations are likely to be limited, with universities mainly providers of human capital (of varying quality) (Perez-Padilla et al 2009).

All of these factors place constraints on firms' ability to develop new products and services – and limits managers' incentives to collaborate with other firms (Altenburg 2009). In this context, multinational enterprises (MNEs) may become important providers of both capital flows (via FDI) and new technologies (via alliances / collaborations and spillovers) (Cantwell 2005). More than half of global R&D is currently done within multinational enterprises; in 2007 Toyota ($8.4bn) and GM ($8.1bn) each spent more on R&D than India (Dahlman 2010).

Similarly, export markets become an important source of growth alongside home markets; and the national state (and national policy frameworks) may become more important than regional

actors in supporting firms and mediating economic activity (Perez-Padilla et al 2009). 'Discretionary public policies' in national development strategies are critical (Cimoli et al 2009).

These predictions echo the themes of other literatures on the globalization of innovation (Mowery 2001) and its impact on regional economies in developing countries. Archibugi and Iammarino (2002), studying the globalisation of innovation, identify three key processes: international exploitation of locally-generated ideas; 'global generation' of innovations by multi-national enterprises; and global 'techno-scientific collaborations'. Another stream of work focuses on MNE location strategies (Cantwell 2005, Dunning 1998, Dunning 1996), and the behaviour of 'lead firms' (Yeung 2009) which engage in different types of spatially specific 'strategic coupling' with local firms, influencing cluster formation and producing heterogenous patterns of spatial development.

From a different perspective, Saxenian and Sabel (2008) and Saxenian (2006) emphasise the role of migrants and trans-national communities in facilitating innovation, by spreading ideas, developing globalised production systems and influencing institutional reform in 'home' countries. Finally, both Leadbeater and Wilsdon (2008) and Yeung (2009) compare institutional and policy factors in shaping innovation outcomes in South / East Asian countries. They note the importance of more open markets, and public investments in human capital and other 'innovation-enabling' infrastructure.

5.4 Conclusions

Our exploratory work leaves us with two main tasks for further research. First, we need to model the catch-up in patenting activity of India and China with respect to the USA and the EU. Second, we need to understand the differences in patent intensity and spatial patterning between China and India. To do this we have developed a scalable framework for exploring geographies of innovation. It allows us to systematically compare country experiences, and to explore specific country-level and regional dynamics. The evidence so far suggests India and China's innovation systems are the product of interaction of global flows and local forces, which then influence spatial patterns of innovative activity. The next stage of the analysis will seek to understand these issues in more detail.

5.5 Methodological note

Other innovation metrics for India and China also tend to follow similar spatial patterns to our findings, so we can be fairly confident we have identified real trends. For example, multinational firms' location patterns closely follow those of patents: Between 60-80% of all MNEs in India and China are concentrated in the Beijing-Shanghai and Bangalore / Pune / National Capital Regions (Bruche 2009). Also, our data is from OECD PCT Patent Applications – so avoids problems that might arise using domestic Chinese or Indian data (Li and Pai 2010, Wadhwa 2010).

An important caveat is that patent applications in India and China partly reflect patenting activity by multinational firms (MNEs). MNE patents may be filed in any office around the world, regardless of where the invention actually took place, making it hard to assign patents to specific territory (Li and Pai 2010). There are close links between foreign firms, MNE clusters and patenting clusters in India and China. For example, Duan and Kong (2008), in a study of Chinese patents 1988-2007, observe that most 'Chinese' applications to the USPTO are owned by foreign applicants. Da Motta e Alberquque (2003) suggests similar patterns for India. In order to minimise this potential bias – potentially significant in emerging countries - we make reference to patent data based on the applicant's region/country in order to capture the innovative activities of local firms.

6. Case studies: Annexes

6.1 Interview protocol: knowledge creation

6.1.1: Company profile

Please check if the following details regarding your company and the person completing this survey form are correct and amend, if not:

Company	
Post code	
Name of respondent	
Position in company	
Contact information (e-mail and /or telephone number)	

1. **a) Could you please initially describe your firm in broad terms, and provide some background information concerning the foundation of the firm?** (e.g. established independent company/ subsidiary/ division/ spin-off : Note this is intended to open the interview gently with an open ended question that allows the respondent to feel comfortable and to begin to interact with the interviewer)

b) Could you please provide us with the figures in the table below for 2009-10: (best estimates are sufficient)

Year the company was established	
Turnover in £/ Euro	
R&D spending in % of turnover	
Export in % of turnover	
Number of employees	
Number of patents	
Number of new products in past 3 years	

6.1.2: Innovation Capacity of the Firm (Knowledge Creation)

1. **Could you please make an assessment of the quality of the available workforce in this region and its suitability to your firm's activities?** (including need for initial and continued training)

2. **Through which channels do you receive knowledge from local external (to your company) sources, and how is this knowledge being exchanged?**

   (How important are, e.g., mobile researchers, publications and products as carriers of knowledge, and which role does frequent personal contacts play as well as the internet, phone, and email)

3. **Does your firm look for collaborative activities or projects with other actors? If so could you say why the firm may be interested in collaboration and can you discuss how do you prepare for collaboration** (how does the firm organises itself for collaboration and ask for the following a-d. If there is no collaboration ask why that may be)

   a. which actors to collaborate with

   b. what the nature and goals of the collaboration are

   c. what the reasons for the collaboration are

   d. and whether external collaboration has affected your own company's performance

4. **Could you please explain where the company's product or process innovation activities are mainly carried out?**

   (It may help in specifying the answer, to think of a typical innovation project undertaken as an example. Answers should cover areas such as the following (a-c),

   a. In your firm's own R&D and/ or other departments (which ones)?

   b. Location of the firm's innovation activity – if it is possible to specify e.g. within the region; within the UK; outside the UK…and in each case where that is.

   c. ask about the reason for the location of innovation activity

   Information for a) and b) may be identified more specifically by using the following table. The table can be presented to the respondent for completion during the interview or filled in by the interviewer.

   In column 2 of the table please assess the importance of individual sources of knowledge *in general*, using an evaluation scale ranging from 1 to 5, according to the following key:

   1 = not at all important, 2 = not very important, 3 = neutral, 4 = important, and 5 = very important.

   In columns 3 to 8 indicate the significance of particular *geographical areas* in which the firm's knowledge sources are situated and assess how important they are in delivering knowledge. Please use the 1-to-5 scale again.

1	2	3	4	5	6	7	8
Source of knowledge	**Importance of source**	**Local region (specify)**	**UK**	**EU**	**USA and Canada**	**Asia**	**Rest of world**
Partner firms within your corporation							
Internal R&D department			-	-	-	-	-
Internal quality management system or other internal sources of knowledge generation			-	-	-	-	-
General media							
Employees (new employees) outside R&D							
Customers							
Suppliers							
Competitors							
Consultants							
Commercial R&D institutions							
Universities and other HEIs*							
Other public R&D institutions							
Technology transfer centres**							
Other sources***							

*Key: * HEIs = Higher Education Institutions, ** e.g. Technology parks and business incubation units, *** e.g. the internet, please explain*

6.1.3: Regional Sources of innovation

1. **Why was the region where you are currently based chosen as the location for your company?**

2. **How important is it that [same sector] companies are located in the region? Do these firms influence research activities? (**firms as sources of ideas, information, firms as cooperation partners, firms as sources of financing, etc.)?

3. **How important was the innovation activities of other companies in the region for your location decision? Could you describe / assess the links between local companies (**including: social capital, culture of networking, trust, etc?)

4. **If the firm is involved in collaborative activities with other actors could you describe how the collaboration has worked** (if yes ask for the following information…If not ask why that may be)
   a. which actors you are collaborating with
   b. where your collaborators are located
   c. what form the collaboration takes (e.g. contract, informal agreement, favour, agreed financial return)
   d. what reasons do you have for choosing your collaborators/ them to choose you
   e. how has collaboration affected your partner(s)' performance

5. **How important are the innovation activities of local public research institutions and universities for your innovation in your company? Could you describe / assess the links between your firm and these institutions (**including: social capital, culture of networking, trust, etc?)

6. **Which local institutions (not other firms or research institutions) do you use as sources of knowledge, and what types of knowledge do you obtain from these sources?**

7. **What would you describe is the role of regional knowledge intensive business services provided to your company in supporting knowledge creation?**

8. **Is your firm active in regional trade associations or similar bodies? In what ways does participation benefit the firm?**

6.1.4: Regional Policy Support

1. **What are the strengths and weaknesses of the regional policy promoting [*relevant sector*] in the region?**

2. **How satisfied are you / your firm with policy measures to support innovation and learning activity in the region? Are existing measures being used effectively?**

3. **What do you see as the main problems that you face in trying to exploit local advantages such as local knowledge sources or state / institutional support? What is completely missing in the region?**

4. **Which support-institutions at the regional, national, and EU level are important for firm in this sector and why? Is there sufficient support or is there a lack of specific organisations, activities, funding schemes etc.? If there is a lack, please specify what this may be.**

5. **How would you describe your relationship to, and levels of co-operation with, public institutions in your region?**

6. **What factors are hampering the exchange and transfer of knowledge from public institutions? What measures is your organisation taking to tackle these problems?**

7. **How important is education policy and institutions in pre-university sectors to your firm?**

----------End of Sections---------

8. **Are there any areas of concern regarding any aspect of innovation, knowledge creation and learning that we have not already covered that you would like to add to the discussion?**

----------End of Interview----------

6.2 Interview protocol: knowledge acquisition

6.2.1: Company profile

Please check if the following details regarding your company and the person completing this survey form are correct and amend, if not:

Company	
Post code	
Name of respondent	
Position in company	
Contact information (e-mail and /or telephone number)	

2. **a) Could you please initially describe your firm in broad terms, and provide some background information concerning the foundation of the firm?** (e.g. established independent company/ subsidiary/ division/ spin-off : Note this is intended to open the interview gently with an open ended question that allows the respondent to feel comfortable and to begin to interact with the interviewer)

b) Could you please provide us with the figures in the table below for 2009-10: (best estimates are sufficient)

Year the company was established	
Turnover in £/ Euro	
R&D spending in % of turnover	
Export in % of turnover	
Number of employees	
Number of patents	
Number of new products in past 3 years	

6.2.2: Local Channels for Knowledge Acquisition

5. **Why was the region where you are currently based chosen as the location for your company?**

6. **How important is it that [same sector] companies are located in the region? Do these firms influence research activities? (**firms as sources of ideas, information, firms as cooperation partners, firms as sources of financing, etc.)?

7. **How important was the innovation activities of other companies in the region for your location decision? Could you describe / assess the links between local companies (**including: social capital, culture of networking, trust, etc?)

8. **Are you engaged in any collaborative activities or projects with other actors? If so could you describe how you decide on collaboration and how you manage the collaboration** (if yes ask for the following information…If not ask why that may be)

   a. which actors you are collaborating with,

   b. what the nature and goals of the collaboration are,

   c. where your collaborators are located,

   d. what form the collaboration takes (e.g. contract, informal agreement, favour, agreed financial return),

   e. what the reasons for the collaboration are,

   f. and whether external collaboration has affected your own company's performance

9. **How important are the innovation activities of local public research institutions and universities for your location decision? Could you describe / assess the links between your firm and these institutions (**including: social capital, culture of networking, trust, etc?)

10. **Through which channels do you receive knowledge from local external (to your company) sources, and how is this knowledge being exchanged?**

    (How important are, e.g., mobile researchers, publications and products as carriers of knowledge, and which role does frequent personal contacts play as well as the internet, phone, and email)

11. **Which local institutions (not other firms or research institutions) do you use as sources of knowledge, and what types of knowledge do you obtain from these sources?**

12. **What would you describe is the role of knowledge intensive business services (in the region) provided to your company in supporting knowledge creation?**

13. Is your firm active in regional trade associations or similar bodies? In what ways does participation benefit the firm?

14. Could you please explain in summary of many of the questions above what are the main external sources of knowledge?

(It may help in specifying the answer, to think of a typical knowledge acquisition process as an example and refer to the location of the firm's knowledge sources – if it is possible to specify e.g. within the region; within the UK; outside the UK…and in each case where that is. Also ask about the reason for the location of the source)

Information for this question may be identified more specifically by using the following table. The table can be presented to the respondent for completion during the interview or filled in by the interviewer.

In column 2 of the table please assess the importance of individual sources of knowledge *in general*, using an evaluation scale ranging from 1 to 5, according to the following key:

1 = not at all important, 2 = not very important, 3 = neutral, 4 = important, and 5 = very important.

In columns 3 to 8 indicate the significance of particular *geographical areas* in which the firm's knowledge sources are situated and assess how important they are in delivering knowledge. Please use the 1-to-5 scale again

1	2	3	4	5	6	7	8
Source of knowledge	**Importance of source**	**Local region (specify)**	**UK**	**EU**	**USA and Canada**	**Asia**	**Rest of world**
Partner firms within your corporation							
General media							
Employees (new employees) outside R&D							
Customers							
Suppliers							
Competitors							
Consultants							
Commercial R&D institutions							
Universities and other HEIs*							
Other public R&D institutions							
Technology transfer centres**							
Other sources***							

Key: * HEIs = Higher Education Institutions, ** e.g. Technology parks and business incubation units, *** e.g. the internet, please explain

6.2.3: Sources of Knowledge External to the Region

1. **How important is it to your company that you attract personnel from international labour markets? In what way do these recruits provide additional value to the company in comparison to regional recruits?**

2. **Through which channels do you receive knowledge from external sources outside your region, and how is this knowledge being exchanged?**

   (How important are, e.g. mobile researchers, publications and products as carriers of knowledge, and which role does frequent personal contacts play as well as the internet, phone, and email)

3. **Could you describe / assess the relations between your firm and firms in other regions or countries? (**including: social capital, culture of networking, trust, etc?)

4. **How important are national or international public research institutions and universities as sources of knowledge to your company? Could you describe / assess the links between your firm and these institutions (**including: social capital, culture of networking, trust, etc?)

5. **Which national or international institutions (not other firms or research institutions) do you use as sources of knowledge, and what types of knowledge do you obtain from these sources?**

6. **Is your firm active in national or international trade associations or similar bodies? In what ways does participation benefit the firm?**

7. **Through which channels do you receive knowledge from national or international external sources, and how is this knowledge being exchanged?**

   (How important are, e.g., mobile researchers, publications and products as carriers of knowledge, and which role does frequent personal contacts play as well as the internet, phone, and email)

8. **What would you describe is the role of national or international knowledge intensive business services provided to your company in supporting knowledge creation?**

6.2.4: Public Policy support

9. What are the strengths and weaknesses of the regional policy promoting [*relevant sector*] in the region?

10. What are the strengths and weaknesses of policies to promote knowledge diffusion and exchange within the region?

11. What are the strengths and weaknesses of policies to promote knowledge diffusion and exchange into the region?

12. How satisfied are you/ your firm with public policy measures to support knowledge acquisition and learning activity? Are existing measures being used effectively?

13. How important is local education policy and institutions in pre-university sectors to your firm?

14. What do you see as the main problems that you face in trying to exploit knowledge sources from both within and outside the region? What is completely missing in support structures?

15. Which support-institutions at the regional, national, and EU level are important for firm in your sector and why? Is there sufficient support or is there a lack of specific organisations, activities, funding schemes etc.? If there is a lack, please specify what this may be.

16. How would you describe your relationship to, and levels of co-operation with, public institutions within and outside your region?

17. What factors are hampering the exchange and transfer of knowledge from public institutions? What measures is your organisation taking to tackle these problems? (ask to specify the type of knowledge being considered)

----------End of Sections---------

18. Are there any areas of concern regarding any aspect of knowledge acquisition and learning that we have not already covered that you would like to add to the discussion?

---------- End of Interview----------

6.3 Interview protocol: regional policy actors and support agencies

The Agency:

1. Please describe your agency including the aims and scope of the work of your institution in supporting innovation in firms, and in support of knowledge acquisition for those firms?

Major Support Schemes and Activities:

2. What are the main regional support programs that are available to firms in your region [*within the relevant sector*]?

3. What support-institutions at the national, regional and EU level are important for firms [in the relevant sectors] and why? Is there sufficient support or is there a lack of specific organisations, activities, funding schemes etc.? If there is a lack, please specify what this may be.

Successes and Limits:

4. What do you think are the strengths and weaknesses of the regional policy promoting [*relevant sector in the case studies*] in the region?

5. What would you describe as the major successes achieved by the agency in support of

   A) innovation activities

   B) and for knowledge acquisition and knowledge diffusion

   among firms in the region?

6. What would you describe as the major limits encountered in supporting innovation activities and knowledge acquisition and diffusion?

7. What factors are hampering the exchange and transfer of knowledge? And what measures is your organisation taking to tackle these problems?

8. What is the level of satisfaction among firms in [*relevant sector in the case study*] and their usage of policy support measures in this region?

Major Local Assets to support Innovation and Knowledge Acquisition / Diffusion:

9. How would you describe the level of co-operation between public institutions and firms in accessing support and developing innovation and knowledge creation activities?

10. Is your organisation active in promoting industry-based associations of firms in order to facilitate greater innovation activity and knowledge creation? Could you please specify what activities are undertaken in this regard?

11. How does education policy and institutions in pre-university sectors contribute to the regional policy support for innovation and knowledge creation in [*relevant sector for the case study*]?

12. How important to regional policy support for knowledge creation, innovation and knowledge diffusion is the presence of the following elements? In what way do they inform the development of regional policy?

- The range of firms and sectors
- Customer base
- Supplier base
- Competitors
- Consultants
- Commercial laboratories/ R&D enterprises
- Universities or other higher education institutes
- Other non-profit R&D (Public R&D)
- Technology Transfer Centres

13. Are there any areas of concern regarding any aspect of innovation, knowledge creation and learning that we have not already covered that you would like to add to the discussion?

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6.4 Timetable

The Case Studies will comprise of 12 cases. The same or closely associated sectors may be grouped as follows, which will aid cross regional comparison.

Wales (west)	Food
Tuscany	Wine
Piemonte	Automotive
Bratislava	Automotive
Arno Valley	High Tech (Tuscany)
Banska Bystrica region	Wood processing industry
Oxford	Biotechnology
Košice	ICT
Bratislava	ICT
Cambridge	ICT
Cardiff (Wales)	Digital Media/ TV
Milan (Lombardy)	Media

The phases of the case studies may be divided as follows:

Phase	Deadline
Identification and background information on individual firms	End March 2011
Identification and background information on support agencies	
Approach to individual firms and carry out semi-structured interviews	April – end June 2011
Approach to local support agencies and carry out semi-structured interviews (preferably following firm interviews in order to refer to specific information from firms	May – end July 2011
Interview transcription	End July 2011
Analysis and cross referencing within regions	End August 2011
Analysis and cross-referencing/ comparison between regions	
Reports for each region	End September 2011
Overall KIT case study report	Draft final

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