Benchmarking regions in the enlarged Europe: diversity in knowledge potential and policy options

3. Benchmarking regions in the enlarged Europe: diversity in knowledge potential and policy options

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INTRODUCTION

It has become popular in policy-making circles to argue that regions can only prosper by investing more in R&D and that regional policy-makers can learn most from the 'best' practices in the 'most innovative' regions. However, there are many ways to invest in the knowledge economy, many relevant indicators to measure innovation, and there is more than one driving factor of regional performance. In this chapter, we explore a methodology that allows us to identify the main drivers of economic performance in 220 regional knowledge-based economies in the enlarged European Union. We argue that regional policies should address these drivers, allowing each region to fully exploit its potential. We also argue that it is more appropriate to benchmark regions with similar characteristics, because innovation policy options differ, due to regional diversity, e.g. some regions are strong in public knowledge, while others are strong in private knowledge. This brings us to the following questions. Does the European paradox and the gap between science and industry have a regional component? Does each region have a Triple Helix? Is there perhaps a fourth factor?

Based on the analysis of 13 indicators, four drivers of regional knowledge economies emerge. These four drivers determine economic performance (jobs and growth) and they are used to develop a typology of regional knowledge economies in Europe. This typology of regional innovation systems highlights the diversified nature of regional innovation potential; it rejects the option of having one-size-fits-all policies from EU or national policy-makers; and calls for a tailored policy response.

Theoretical concepts concerning regional or territorial innovation such as:

'milieux innovateur' (Aydalot 1986), 'National Innovation System' (Nelson 1993; Lundvall 1992; and Edquist 1997), 'the learning region' (Morgan, 1997), and the more recent concepts of 'knowledge-based economy' (Cooke and Leydesdorff 2006), 'Open Innovation' (Chesbrough 2003) and 'Triple Helix' (Leydesdorff 2006) are not easily translated into verifiable theories. Our approach is not based on a single integrated overall theoretical framework about the regional knowledge economy, because we claim that there are several models, and we reject the idea that there is one best model that should be copied by all the less performing regions. With the aim to show the relevant differences, we adopt a pragmatic and explorative approach by selecting both knowledge variables and socio-economic variables. The first reason for this pragmatic approach is the scarce availability of statistical data on regional innovation systems that is comparable across the regions of the EU-27. The second reason is that we want to include a broad set of indicators, not only on R&D and high-tech activity. Bearing in mind the more quantitative regional economic development literature and multifactor quantitative analysis methods (see e.g. Amendola et al. 2004), we also include some structural, socio-economic, demographic and human resource indicators. In this respect, our approach is explorative and eclectic, since it is open to suggestions coming from different strands of literature.

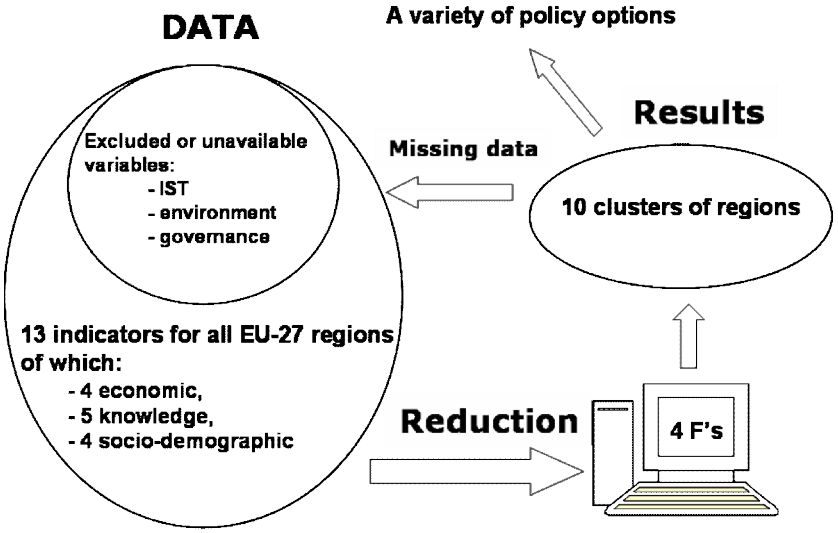

Figure 3.1 Overview of methodological steps

The method of analysis involves several steps, as reflected in Figure 3.1. In the first step, we use regional NUTS 2 level data from EUROSTAT to distinguish the main factors of economic performance contained in the set of variables that characterize knowledge economies at the regional level. In the second step, we test if and to what extent these factors (the four F's resulting from factor analysis) are relevant to explain the performance of the regions in terms of GDP per capita and unemployment. The third step brings us to the statistical identification of different types of knowledge economies at regional level. In a fourth step, we test this typology by looking at some individual regions, and we translate the typology into challenges and innovation policy options. The sections in this chapter follow these steps in the analysis. The chapter ends with an overall conclusion.

SELECTION OF INDICATORS AND METHOLOGY

A Diversity of Relevant Indicators

There are several different strands of literature dealing with regions and innovation. One is more in the quantitative tradition of (regional) economics and the other in the qualitative tradition of innovation. As Moulaert and Sekia (2003) have pointed out in their overview of mainly qualitative studies on (regional) innovation, the concepts used in this strand of literature mainly address firm behaviour and inter-firm exchange, and other linkages between firms and their environment. Central in most of these concepts are buyer – supplier relationships in the value chain and the quality of such economic linkages which are embedded in specific social and institutional structures. Concerning knowledge, the focus has been on tacit knowledge and learning as localized 'market-externalities' or agglomeration advantages, referring to Marshall's (1920) observation that such localized externalities or advantages are 'in the air'. For example, students of industrial districts (Becattini 1989) had been inspired by the economic growth in districts in the Third Italy (located between the rich regions in the north and the poor in the south of Italy), referring to a development model that can be described as 'innovation without R&D', based on the flexible linkages between specialized family-owned firms in traditional industries. Antonelli (2000) has incorporated codified knowledge and R&D into this model and labelled it 'technological districts'. Other aspects of the regional environment that are relevant to innovating firms are captured by Aydalot (1986) who has cornered the concept of 'milieux innovateur'.

Because there is not much statistical data on such qualitative aspects of

innovation across all regions of the enlarged EU, most of the above mentioned theoretical studies on regional innovation and innovation policy are conceptual and based on in-depth case studies. In trying to underpin the observed economic success of some regions (or actually firms or sectors in some selected regions) they mostly highlight relational assets (Cooke and Morgan 1998) such as trust or conventions (Storper 1997; Storper and Scott 1988).

The more recent concepts emphasize knowledge and the importance of a variety of actors, including other actors besides firms. With concepts such as 'Regional Innovation Systems' (Rosenfeld 1997; Cooke 1998); 'knowledge-based economy' (Cooke and Leydesdorff 2006), 'Open Innovation' (Chesbrough 2003), and 'Triple Helix' (Leydesdorff 2006), we witness the increased importance given to both public and private research. According to Leydesdorff: 'The systematic organization of knowledge production and control provides a third coordination mechanism to the social system in addition to the traditional mechanisms of economic exchange and political decision-making' (Leydesdorff 2006, p. 42). University, industry and government together form the Triple Helix model, but we question to what extent these aspects of innovation systems are co-agglomerated in the same regions. Perhaps the respective agglomeration advantages or externalities differ, which could result in regional specialization in one of these (f)actors. In this respect, a distinction between public and private knowledge is relevant (Dunnewijk et al. 2004) and perhaps there are more factors than the three drivers of the Triple Helix model. A fourth (f)actor or driver could be the individual knowledge worker and his or her household. Concerning human resources, Florida (2002) has shown that due to the mobility of the 'creative class' of knowledge workers it has become important for a region's innovation performance to attract young talent with a cosmopolitan culture and a tolerant environment.

Criticizing the one-size-fits-all reasoning, Tödtling and Trippl (2005) have drawn on a conceptual framework describing different policy needs for three hypothetical types of EU-15 regions: institutional thin, restructuring old industrial, and fragmented metropolitan regions (Nauwelaers and Wintjes 2003). Other existing typologies are based on statistical classifications,[1] often identifying groups of regions that are R&D intensive and regions which are less R&D intensive. This paper aims for a broader coverage of relevant variables. It also aims at a broader geographical coverage, since we are not aware of an existing regional classification scheme that covers the whole of the EU-27.

Another strand of literature consists of the more quantitative regional economic development studies. These macro-economic studies are not

focused on explaining the success of a selection of regions, but they aim at a more generally applicable understanding of differences in performance and whether regions converge or diverge with respect to growth and employment. European regions have been converging, but very slowly. Econometric estimates agree that (before 2000 in Europe) the convergence of per capita GDP has been very slow and has instead fostered the formation of clusters of regions which are internally converging, but diverging with respect to each other. According to Amendola et al. (2004), this has been due to the trend in the unemployment rate and therefore to the characteristics of the regional labour market (see also: Overman and Puga 2002; Combes and Overman 2003; Padoa Schioppa Kostoris 1999). Literature on convergence – divergence processes pays increasing attention to the institutional mechanisms that regulate the labour market, as well as to the characteristics of labour supply and demand, and their dependence on spatial factors (Niebuhr 2002).

One conclusion from both strands of academic literature (the quantitative macro-economic on the one hand and the qualitative, meso-level innovation studies on the other) is that Europe consists of regional contexts with extremely diverse socio-economic features, which is hardly reflected in regional-specific European innovation policies.

Description of the Data

These theoretical considerations together with availability of regional data has led to a collection of explanatory regional variables (Table 3.1) that characterize innovation, labour participation, demography, government presence, economic structure and learning habits in a region.

The data exhibited in Table 3.2 originates from the EUROSTAT REGIO database. However, not all observations report on the same year, or on the most recent year (see Table 3.1). One implication is that there is no possibility of covering distant years on all indicators. This selection informs us on the current state of the economic structure, knowledge and learning situation, demography and other contextual categories. The data represents 220 regions in EU-27, mostly on the NUTS 2 level. For several Member States, such as Denmark, Estonia, Luxembourg and Malta, regional data is lacking. Moreover, for some countries we had to take NUTS 1 level data, because NUTS 2 level is not available, e.g. for Belgium and the UK.

In the next section, these variables will be analysed in order to reduce the number of variables to a limited number of factors. These factors can be seen as important for the conditions under which growth and jobs materialize. We expect to find a ‘public factor’ and a ‘private factor’. Looking at the

distribution on the two R&D variables, we already observe that in many countries the region with the highest public R&D intensity is often not the same as the region with the highest business R&D intensity (see Ciffolilli et al. 2006).

Table 3.1 Explanatory variables

Higher education	Share of the population that completed higher education (HRSTE), 2003
High-tech services	Share of employment in knowledge-intensive high-technology services, 2003, NACE codes 64, 72, 73
Public R&D	R&D expenditures in higher education sector and government R&D institutes as a share of GDP (HERD+GOVERD), 2002
Value-added services	Share of services in total gross value added at basic prices in millions of euros, 2002, NACE codes G to P
Value-added industry	Share of manufacturing industry in total gross value added at basic prices in millions of euros, 2002, NACE codes C to F.
Government employment	Share of employment in public administration in total employment, 2003, NACE codes 75 and 99
Population density	Population per square km, 2002
High-tech manufacturing	Share of high and medium high-tech manufacturing employment in total employment, 2003, NACE codes 24, 29 to 35
Business R&D	Share of Business R&D expenditures in GDP (BERD), 2002
Science and Technology workers	Share in total population that has an occupation in Science & Technology, (HRSTO), 2003
Youth	Share of population under ten years of age, 2001
Life-long learning	Share of adults having recently enjoyed training or courses, 2003
Activity rate females	Share of women that is employed or looks for employment in total female population, 2003

Public R&D expenditure (as a percentage of GDP) is highest in Berlin (DE3). Other capital cities, such as Vienna (AT13) and Lazio (IT6), but also some more peripheral regions perform well with respect to public R&D expenditure; for instance, Languedoc-Roussillon (FR81) in France, Scotland

Table 3.2 Descriptive statistics of explanatory variables

	Number of regions	Min.	Max.	Mean	Standard Deviation
Economic structure					
Value-added industry	220	7.6	48.3	29.1	7.7
Value-added services	220	42.8	87.9	66.4	8.8
High-tech manufacturing	220	0.1	20.6	6.5	3.7
High-tech services	220	0.5	8.1	2.8	1.4
Knowledge, learning					
Higher education	220	6.4	36.4	19.0	7.2
Business R&D	220	0.0	5.3	0.8	0.9
Public R&D	220	0.0	1.9	0.5	0.4
Science and Technology workers	220	7.4	42.9	19.6	6.0
Life-long learning	220	0.8	28.5	7.2	5.7
Demography/Other					
Population density	220	3.3	6104.2	294.9	674.0
Youth	220	6.1	15.8	10.6	1.8
Government employment	220	3.6	17.0	7.5	2.4
Activity rate females	220	27.0	67.2	47.3	7.4

Source: EUROSTAT REGIO database

(UKM) and Kriti (EL43) in Greece. Some other surprising observations are that the Warsaw region Mazowieckie (PL12) and Prague (CZ01) in Czech Republic have reached 'the public part of the Barcelona target' (spending 1 per cent of GDP on public R&D expenditures, a third of the overall 3 per cent target); while, for instance, Brussels (BE1) has not. R&D expenditure is highly concentrated, and even among the best performing Member States there are regions with below EU average performance. Concerning business R&D expenditure (BERD), taken as a percentage of regional GDP, the best performing regions in many Member States are not the capital cities, but often the less well-known regions such as Braunschweig (DE91), Västsverige (SE0A), Eastern (UKH), Noord-Brabant (NL41) and Střední Čechy (CZ02).

Methodology, a Combined Factor and Cluster Analysis

In order to synthesize the regional statistical information captured in the 13 variables for all regions, we use a combination of two data reduction methods: factor analysis and cluster analysis. Factor analysis is a branch of multivariate statistical analysis, designed to explain the correlations or co-variances among a set of variables in terms of a limited number of unobservable, latent variables or factors (see also Berlage and Terweduwe 1988). The aim of this analysis is to reduce the variables exhibited in Table 3.1 to the fundamental drivers of the knowledge economy at regional level in Europe. The methodology used in this paragraph describes the link between the selected variables and these fundamental drivers, forces or factors. The contribution of factor analysis is that we can express (almost all) the information that is contained in the original list of variables with the help of a very limited number of factors. For statistical details of the methodology see Annex 1.

Benchmarks often contain lots of data and until recently it was thought that the more data the better for factor analysis based on these data. However, little is known about how size and composition of the data affect factor estimates. In a recent paper, Boivin and Ng (2005) showed that more data is not always better. Problems arise when residuals are correlated and when datasets differ in size because the dominant factor in a small dataset might be dominated in a larger dataset. Therefore, the factor analysis might be distorted, but it is the quality of the data that counts and a careful selection of data based on practical as well as theoretical considerations. As explained above, we cannot base this broad selection of variables on one single overall theory, neither can we choose from a large dataset. Therefore, we start from a practical viewpoint and we use what is available for as many as possible regions of the EU-27.

FACTOR ANALYSIS: FOUR DRIVERS OF REGIONAL KNOWLEDGE ECONOMIES

This section presents and interprets the results from the factor analysis. First, the factors are discussed and linked to existing literature. After this interpretative part, the factors are used to explain regional GDP per capita and unemployment.

Estimation of Factors

The collection of the 13 benchmark indicators is reduced to only four factors, simplifying the original dataset to the smallest possible set of fundamental factors in which the smallest possible number of variables with high factor loadings play a role. The aim of factor analysis is, as explained above, to reduce the dimensions of the benchmark to a much smaller number of unobserved factors. These unobserved factors are based on certain but rather unknown relations between the original variables. A variable is part of a certain factor given the absolute size of the factor loadings. The factors that remain after factor analysis are exhibited in Table 3.3.

Table 3.3 Reduction of the dataset into four factors by means of factor analysis

	F1	**F2**	**F3**	**F4**
High-tech services	**0.59**	0.44	0.40	0.26
Higher education	**0.68**	0.36	0.26	0.04
Public R&D	**0.68**	-0.05	0.27	0.28
Population density	**0.64**	0.05	-0.10	0.11
Value-added industry	-0.46	-0.10	0.46	**-0.68**
Value-added services	0.56	0.17	-0.18	**0.68**
Government employment	-0.07	-0.19	0.08	**0.89**
High-tech manufacturing	-0.12	-0.07	**0.88**	-0.20
Business R&D	0.21	0.38	**0.71**	0.02
S&T workers	0.49	0.50	**0.57**	0.13
Life-long learning	0.29	**0.79**	0.18	-0.06
Youth	-0.32	**0.80**	-0.10	0.10
Activity rate females	0.27	**0.68**	0.28	-0.32

Note: Extraction Method is Principal Component Analysis. Rotation Method: Equamax with Kaiser Normalization.

Based on the variables with the highest factor loadings, the meaning of each of the four factors can be interpreted and we gave them a short symbolic name. Public Knowledge (F1) consists mainly of high-tech services, higher education, public R&D, and population density; Young Learning Dynamics (F2) contains life-long learning, the share of the population under ten years of age, and women labour market participation; Private Knowledge (F3) incorporates high-tech manufacturing, business R&D and science and

technology workers; finally, the economic structure of a region, as far as manufacturing, services and the government sector are concerned, are packed together in the fourth factor Government Services (F4).

The factor analysis statistically confirms the earlier expressed hunch that the two indicators regarding public R&D and business R&D do not belong to the same driver of the knowledge economy at regional level.

Interpretation of the Four Factors

Public Knowledge (F1)

Knowledge creation has an important public dimension. This factor of public knowledge shows there is a link between 'the campus' and 'the city'. The idea is that direct effects of knowledge generation are at work in public knowledge abundant regions (Audretsch and Feldman 1996), but also indirect effects, such as students moving from 'catchment areas' into the local labour market after graduation. These direct and indirect effects are a function of the dynamism and the structure of the local economy (Cheshire and Magrini 2002).

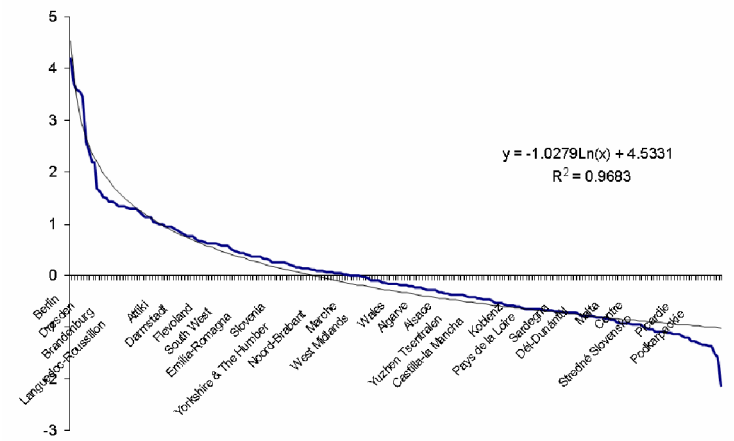

Figure 3.2 Distribution of Public Knowledge (F1) over the EU-27 regions

The dynamism and the (international) orientation of the region attracts high-tech services and ambitious students coming from other regions, creating an attractive location for international oriented multinationals and research labs. The presence of public knowledge in a region also facilitates economic growth and prosperity in the form of spin-off companies,

especially in high-tech service industries.

Figure 3.2 shows the distribution of Public Knowledge. It exhibits the tendency to be negatively exponential distributed over the EU-27 regions: quite a few regions are very well endowed, but most of the regions are below average endowed with Public Knowledge. The thick line in Figure 3.3 plots the value of Public Knowledge (F1) in the regions, while the thin line gives the estimated negative exponential distribution.

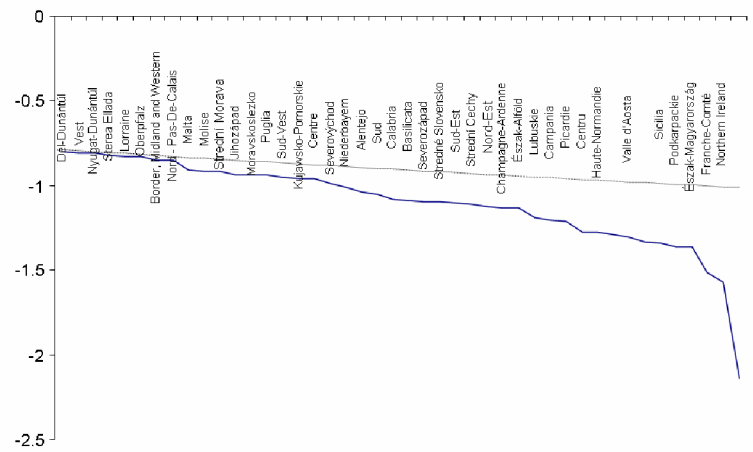

Figure 3.3 Regions with low endowment of Public Knowledge (F1)

Very well endowed with the factor Public Knowledge are regions such as Berlin, Vienna, Prague, Brussels, London, Hamburg, Leipzig, Utrecht, Dresden, Halle and Madrid. In Figure 3.2, these regions are represented in the left part of the graph. The endowments of the regions in the middle follow a pattern of regularly and gradually diminishing endowments. The group of regions at the right face quite low endowments of Public Knowledge. These poorly endowed regions indicate that the regional distribution of Public Knowledge in the EU-27 is skewed to the left, implying that there are more regions with below average endowment than above average.[2] The regions with exceptional low endowment of Public Knowledge are exhibited in Figure 3.3. In these regions it is difficult to realize indirect effects of economic dynamisms due to the lack of public knowledge. It is the absence of this public provision of services that hampers economic growth according to Cheshire and Magrini (2002). These regions are not peripheral at a European level, but peripheral at national level, since each country has its academic core regions and regions with hardly any Higher Education

Institutes or government research labs. At the lower end, regions are predominantly French, Italian, Czech and Romanian.

Table 3.4 Public Knowledge

Top 10 regions	z-value	Bottom 10 regions	z-value
Berlin (DE3)	4.2	Haute-Normandie (FR23)	-1.3
Wien (AT13)	3.7	Severozapaden (BG01)	-1.3
Praha (CZ01)	3.6	Valle d'Aosta (IT12)	-1.3
Bruxelles/Brussels (BE1)	3.6	Západné Slovensko (SK02)	-1.3
London (UKI)	3.4	Východné Slovensko (SK04)	-1.3
Hamburg (DE6)	2.6	Sicilia (ITA)	-1.4
Leipzig (DED3)	2.4	Podkarpackie (PL32)	-1.4
Utrecht (NL31)	2.2	Észak-Magyarország (HU31)	-1.5
Dresden (DED2)	2.2	Franche-Comté (FR43)	-1.6
Halle (DEE2)	1.7	Northern Ireland (UKN)	-2.1

Young Learning Dynamics (F2)

Female labour force participation is an indicator of the involvement of women in economic, social and political matters. Regions with faster economic growth often give a greater scope for women's agency in general (Dreze and Srinivasan 1996). On the other hand, women's participation might be resulting from a high incidence of unemployed men, especially in countries (regions) in which unemployment benefits are not defined individually (Dex et al. 1995). A high incidence of female labour participation, combined with a relatively large share of people under ten years of age in the population and a high incidence of life-long learning, are features of forward looking societies. This factor could, therefore, also be interpreted as an institutional factor indicating a child-, learning- and participation-friendly environment or culture, or even a 'knowledge society lifestyle', based on behavioural norms and values that are beneficial to a knowledge economy. A geographical representation of this factor shows a north-south distinction, with high scores in the north-west of Europe and low scores in the south, south-east of Europe. Swedish regions can be characterized especially as young dynamic societies. Also Denmark, Finnish regions, Île de France and most Dutch regions have a high score with regard to the Young Learning Dynamics factor.

On the other hand, regions that have particularly low Young Learning Dynamics factor scores are all caught in path dependent developments from

which an escape is always a painful structural transition. For these regions other explanatory variables may be more appropriate. These regions are predominantly German and Italian, but also Spanish and Greek. Sometimes the low score on this factor is due to the lack of young inhabitants such as in Dresden and Halle; in Sterea Ellada it is due to low scores in life-long learning and women's participation; and in Principado de Asturias and Liguria it is due to low performance in all three characteristics.

Table 3.5 Young Learning Dynamics

Top 10 regions	**z-value**	**Bottom 10 regions**	**z-value**
Stockholm (SE01)	3.8	Magdeburg (DEE3)	-1.4
Västsverige (SE0A)	2.8	Dessau (DEE1)	-1.4
Flevoland (NL23)	2.8	Friuli-Venezia Giulia (IT33)	-1.5
Sydsverige (SE04)	2.4	Chemnitz (DED1)	-1.5
Denmark (DK)	2.3	Cantabria (ES13)	-1.5
Östra Mellansverige (SE02)	2.2	Dresden (DED2)	-1.6
Utrecht (NL31)	2.1	Liguria (IT13)	-1.6
Småland med öarna (SE09)	2.0	Sterea Ellada (EL24)	-1.6
Övre Norrland (SE08)	1.8	Halle (DEE2)	-1.6
Noord-Holland (NL32)	1.8	Principado de Asturias (ES12)	-1.8

Private Knowledge (F3)

Private Knowledge as opposed to Public Knowledge refers to the incidence of high-tech manufacturing, business R&D and the presence of science and technology workers necessary for these activities. Especially in the German manufacturing industry, cooperation in R&D often enhances innovation input (R&D intensity) and innovation output (innovative products). Joint R&D with other firms and institutions stimulates the intensity of in-house R&D, and the mix of heterogeneous actors in R&D cooperation enfolds synergy and improves research productivity (Becker and Dietz 2004). The geographical distribution of the Private Knowledge factor is mainly present in Germany. Braunschweig leads the pack, followed by Stuttgart, Tübingen, Karlsruhe, Rheinhessen-Pfalz, Oberbayern, Franche-Comté, Střední Cechy, Freiburg, Mittel- and Unterfranken, Västsverige and Oberpfalz. These regions show that there can be a clear link between high and medium high-tech manufacturing and business R&D expenditures. However, we must keep in mind that this might be true in general, but the higher the science and technology component the less importance is given to the presence of local manufacturing production (Mariani 2002). This type of deindustrialization or

'crowding-out' may explain why London and Brussels as top performers in Public Knowledge have a relatively low score in Private Knowledge.

The regions that are poorly endowed with Private Knowledge are predominantly Greek, Polish, Portuguese and Spanish; they lack the private research and technology networks that make up the Private Knowledge infrastructure.

Table 3.6 Private Knowledge

Top 10 regions	**z-value**	**Bottom 10 regions**	**z-value**
Braunschweig (DE91)	4.3	Kentriki Makedonia (EL12)	-1.6
Stuttgart (DE11)	3.6	Ipeiros (EL21)	-1.6
Tübingen (DE14)	2.8	Dytiki Makedonia (EL13)	-1.6
Karlsruhe (DE12)	2.6	Algarve (PT15)	-1.8
Rheinhessen-Pfalz (DEB3)	2.4	Bruxelles/Brussels (BE1)	-1.8
Oberbayern (DE21)	2.3	London (UKI)	-2.1
Strední Cechy (CZ02)	2.0	Illes Balears (ES53)	-2.1
Franche-Comté (FR43)	2.0	Notio Aigaio (EL42)	-2.1
Mittelfranken (DE25)	1.8	Kriti (EL43)	-2.2
Västsverige (SE0A)	1.8	Ionia Nisia (EL22)	-2.4

Government Services (F4)

This factor shows that public administration does not necessary co-locate with academic centres (F1). It is clear that this service factor, or de-industrialization factor is not associated with formal R&D, since R&D is more relevant for innovation in manufacturing than for service industries. This factor shows that sector structure and de-industrialization matters. It reminds us of the discussions in the 1990s when many European countries experienced a period of privatization and devolution of administrative powers. The East European economies experienced such transformations after the collapse of communism. In fact, de-industrialization is an inherent part of economic development, and redistribution of public employment is still an important element in regional development policies (Alesina et al. 1999). De-industrialization may imply a loss in purchasing power in the region because industrial wages are higher than the average wages in the service sector, although wages in public administration are rather high. A large service sector (measured in value added), including a large government administration (measured in terms of employment) and a small manufacturing sector, characterizes the Government Services region. Many regions that score high on this factor have a high level of autonomy or are in

a rather isolated position, e.g. many islands have a rather high score. What is measured in this factor are the relative proportions between the manufacturing, service and government sectors. Regions with a high score on the factor Government Services are typically major and local centres in which government administrations are located, while the manufacturing sector has migrated out of the region, or has never played a significant role in the regional economy.

Table 3.7 lists the regions with a high and low score of Government Services; regions such as Sicilia, Lazio and Northern Ireland do well on Government Services. The regions that have very low scores on Government Services are to be found in Romania, Spain and the Czech Republic.

Table 3.7 Government Services

Top 10 regions	**z-value**	**Bottom 10 regions**	**z-value**
Sicilia (ITA)	3.6	Střední Morava (CZ07)	-1.5
Lazio (IT6)	3.2	Småland med öarna (SE09)	-1.6
Northern Ireland (UKN)	3.0	Comunidad Foral de Navarra (ES22)	-1.6
Valle d'Aosta (IT12)	2.9	Länsi-Suomi (FI19)	-1.7
Calabria (IT93)	2.7	Norte (PT11)	-1.7
Campania (IT80)	2.6	País Vasco (ES21)	-1.7
Sardegna (ITB)	2.3	Nord-Est (RO01)	-1.9
Région Wallonne (BE3)	2.3	Sud (RO03)	-2.0
Provence-Alpes-Côte d'Azur (FR82)	2.1	Centru (RO07)	-2.0
Île de France (FR1)	2.0	Sud-Vest (RO04)	-2.4

Relevance of Factors for GDP per Capita and Unemployment

Before using the factor scores to come to a typology of regional knowledge economies in Europe, we test the relevance of the four regional knowledge economy factors or forces in relation to two economic 'outputs' or 'target-variables': GDP per capita and the unemployment rate.[3] Due to the lack of sufficient data that cover previous years, it was not possible to base the factors on lagged variables, as implied by the structure performance hypothesis. However, because of the structural character of the factors there might not be a problem in using contemporaneous variables in this regression. Table 3.8 exhibits that each of the factors is relevant in explaining differences in income (GDP per capita) at very high levels of significance. In

particular a high incidence of Public Knowledge has a strong impact on GDP per capita according to these results.

The four factors also explain part of the variance in unemployment rates of the 220 regions. Both factors, Young Learning Dynamics and Private Knowledge, have a positive impact on unemployment;[4] Public Knowledge has no significant impact; and the Government Services factor appears to have a negative impact. The negative impact of Government Services could be the result of the fact that government employment has been used as a policy instrument to combat unemployment in high unemployment regions.

Thus, Young Learning Dynamics (F2) and Private Knowledge (F3) contribute to both GDP per capita and unemployment in a positive way. Of these two, Young Learning Dynamics has the strongest impact, in particular on reducing unemployment. For regions wanting to improve their economic performance, investing in these two factors seems most appropriate.

Table 3.8 Regression results

	F1	F2	F3	F4	Adj. R^2
GDP per capita (z-score)	0.519 (0.000)**	0.296 (0.000)**	0.295 (0.000)**	0.198 (0.000)**	0.474
Inverse of unemployment rate (z-score)	0.021 (0.733)	0.362 (0.000)**	0.149 (0.016)*	-0.180 (0.004) **	0.171

Notes: ** Significant at 1%; * significant at 5%; N=220.

RESULTS OF THE CLUSTER ANALYSIS

A Statistical Defined Regional Typology on the Factors

Using the four factors in a cluster analysis brings us to ten clusters of regions. Table 3.9 exhibits the clusters and averages for the target variables and the factor scores.[5] Target variables are the level and growth rate of per capita GDP and the level and change in the unemployment rate.

Based on the averages of the factor scores we can describe each cluster or group of regions as a certain type of region. For each cluster, performance on each of the factors is shown in a radar graph. The shaded area in that graph represents the average performance of all regions.

Table 3.9 Cluster averages

Regions	GDP per capita		Unemployment		Factor scores			
	2002	growth	2003	change	F1	F2	F3	F4
All regions	18888	4.85	9.48	0.07	0.000	0.000	0.000	0.000
Low-Tech Peripheral	12769	6.21	13.22	-0.05	-0.096	-0.274	-1.290	-0.119
Capital Service	19930	6.46	9.97	0.05	0.854	-0.075	-0.364	0.749
Medium-Tech	16470	4.51	10.98	0.07	-0.708	0.035	-0.011	0.453
Ageing Educated	20369	4.76	10.08	0.14	0.713	-1.056	0.343	-0.230
Branch Plant	17527	3.71	7.58	-0.07	-0.783	-0.221	1.202	-0.607
Rural Industries	9194	5.16	8.28	-0.08	-0.705	-0.581	-0.757	-1.613
Young & Learning	23198	4.93	5.23	0.28	0.204	1.514	-0.036	-0.348
High-Tech	27921	3.81	7.10	-0.02	0.501	-0.033	2.308	0.655
Public Services	19153	4.55	13.35	0.03	-0.891	-0.256	-0.330	2.597
Public Knowledge Metropoles	36055	4.56	9.60	-0.18	3.201	0.593	-0.496	0.282

Note: For 'All regions', values equal the unweighted mean of all 220 regions. GDP growth equals the annual average growth rate between 1996 and 2002. The change in unemployment equals the difference between the unemployment rate in 1996 and 2003.

1) Low-Tech Peripheral regions

In these regions, Private Knowledge and Young Learning Dynamics are scarce. On average, unemployment is high and GDP per capita low; however, almost all Low-Tech Peripheral regions exhibit high growth rates of GDP per capita. The regions are peripheral because they exhibit very low population density and a very low score on the Private Knowledge factor, and all its components. These regions lack high-tech activities in both manufacturing and service industries.

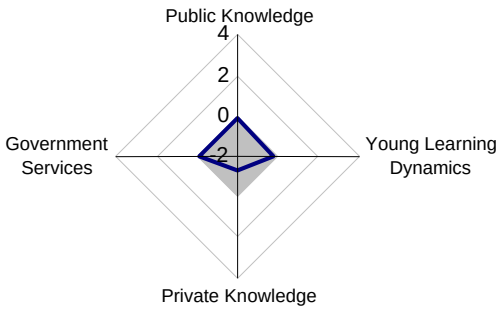

Figure 3.4 Low-Tech Peripheral regions

2) Capital Service regions

This small group of regions consists of growing, capital city regions which are strong in science and services, namely: Warsaw, Lisbon, Bratislava, Athens and two French regions. They score above average on Public Knowledge and Government Services. These regions have on average the highest growth in GDP per capita. These service economies have a rather large share of high-tech services.

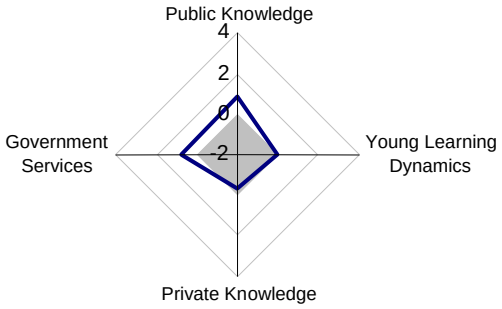

Figure 3.5 Capital Service regions

3) Medium-Tech regions

This group includes some old, central European regional economies that have not succeeded in finding their competitive advantage in the knowledge economy. They are still performing at an acceptable level, regarding GDP per capita and unemployment, but their evolution away from old industries and

activities is not completed. Being more industry-driven, their trajectory leads them more towards a High-Tech region than towards Young & Learning regions, but with relatively low R&D intensities and an average level of education, this is likely to take time. These are often the 'ex-rich' regions in Western Europe and some regions from former communist countries.

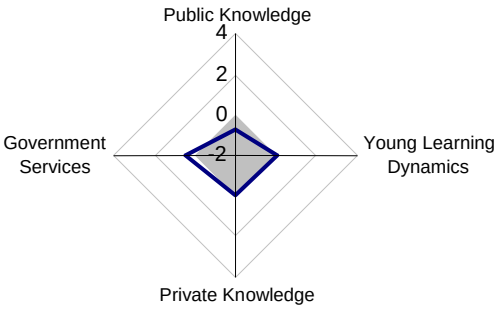

Figure 3.6 Medium-Tech regions

4) Ageing Educated regions

These regions combine a low score on the Young Learning Dynamics factor with a high score on Public Knowledge. Especially the share of children under ten years of age is very low in these regions that are mostly located in Spain, East Germany and Italy. The share of the population with a higher education is high, but the number of students and new graduates will decrease soon.

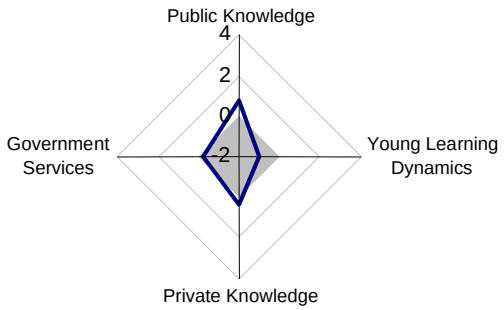

Figure 3.7 Ageing Educated regions

5) Branch Plant regions

Branch Plant regions generate little value added. They are specialized in manufacturing industries including high and medium high-tech industries, but these industrial activities do not require much knowledge investments, so they are more likely to constitute Branch Plant economies relying on cheap reproduction, rather than a well-educated innovative labour force. Their future looks gloomy with regard to further competition from emerging economies, as already indicated by the unchanged unemployment situation. Many Branch Plant regions are located in Germany and the Czech Republic.

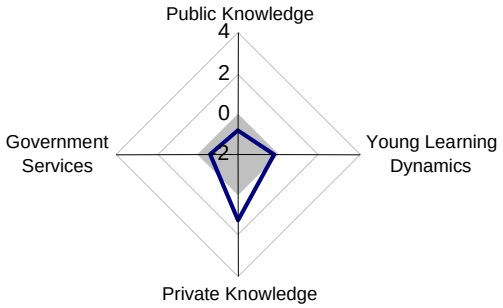

Figure 3.8 Branch Plant regions

6) Rural Industries

These rural regions are still very heavily focused on agriculture and manufacturing. They are not engaged in high-tech activities, not in services and not in private R&D activities. Almost all Romanian regions are in this cluster, and there are two Greek, Polish and Portuguese and one Bulgarian region. These regions are problematic, with high unemployment and few knowledge-related activities, poor qualifications of the population, and low density. They are in need of a major transformation towards the knowledge economy.

7) Young & Learning regions

The Young & Learning regions are pointing to a new model of knowledge societies. These regions are the best able to give jobs to their populations, including women, while the share of people under ten years of age is relatively large. Growth in income and jobs is high and that is what policy-makers are really aiming at. GDP performance is the highest amongst 'old' EU Member States' regions (not considering the catching-up ones). They

base their success on life-long learning and the involvement of the entire population in knowledge activities, and show important rates in public R&D investments. They depend less on public employment than others, perhaps contradicting expectations from the 'Nordic model'. These regions are mostly located in Sweden, the Netherlands, Finland and the UK.

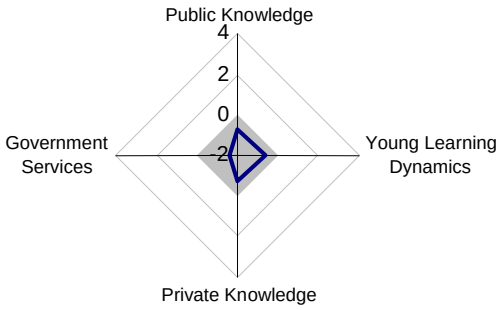

Figure 3.9 Rural Industries

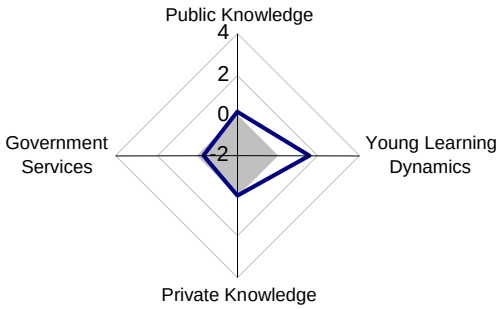

Figure 3.10 Young & Learning regions

8) High-Tech regions

Wealth in High-Tech regions comes from the Private Knowledge factor and its major components: private R&D expenditures, high and medium high-tech manufacturing activities and human resources in science and technology. These regions also invest in public R&D. So, in a sense, they conform to the traditional linear R&D-innovation model, where innovation is based on research. These High-Tech regions perform well, but, especially in terms of

employment they may be endangered by global competition, since their investment in education and lifelong learning is notably less intensive than in the Young & Learning regions, manufacturing activities are relatively foot-loose and these regions are aging societies.

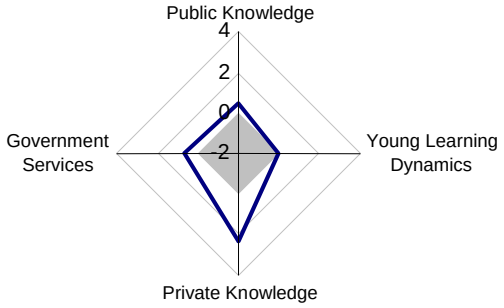

Figure 3.11 High-Tech regions

9) Public Services regions

This type of region has in common a very high score on the Government Services factor, but a below average score on the other factors. Most regions of this type are Italian (e.g. Sicily and Sardinia), but also this type of region includes, for instance, Northern Ireland, Wallonia and Notio Aigaio (which consists of many Greek islands). On average, employment in public administration is with 13.4 per cent a very important sector. These regions are service economies, since manufacturing and agriculture are relatively small sectors. GDP per capita is not a major problem in these regions, but unemployment is. Besides the low scores on Public Knowledge, this type has on average the lowest rate of female participation.

10) Public Knowledge Metropoles

This group consists of regions that are very strong in the Public Knowledge factor, while on average the score on Private Knowledge is below average. These regions are rich, densely populated capital regions, whose prosperity comes from knowledge intensive services and the availability of a highly educated, learning population. Stockholm, London and Prague have shown growth in GDP per capita. For Vienna, Brussels, Berlin and Hamburg, unemployment has increased and the growth in GDP per capita is below average. They do not correspond to the classical view of innovation based on high-tech manufacturing, which means that policy-makers should be aware

not of following classical policy instruments which are largely based on this view. Still, they are less able to give employment to their population than Young & Learning regions.

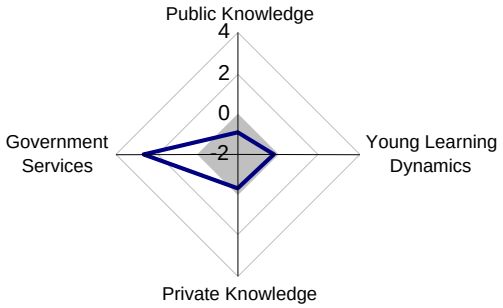

Figure 3.12 Public Services regions

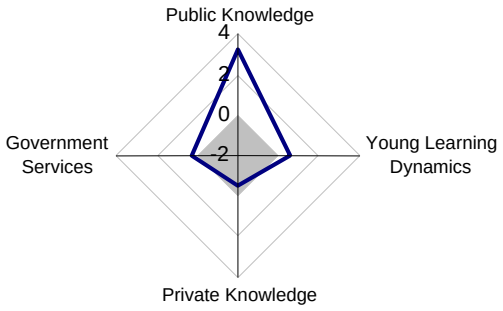

Figure 3.13 Public Knowledge Metropoles

Testing the Typology and Translation to Policy Options

Analysing some concrete regions for a number of clusters more in depth serves as an empirical validation of the relevance of the typology and leads to some possible policy lessons in terms of opportunities or threats.

Cluster 1: Low-Tech Peripheral regions

The 30 regions of this type have a very low score on Private Knowledge (F3). Most of these regions have a low level of per capita GDP and are located in

Greece, Poland and Spain. Population density is very low, and often it is declining. The common explanation for the peripheral characteristics of this type of region seems to be the difficult geographical conditions. Agriculture is still an important sector, but the share of agriculture in the production structure has decreased most in these Low-Tech Peripheral regions. The manufacturing sector often still consists of traditional industries. The main opportunity for future development seems to be tourism as the best performing Low-tech Peripheral regions, Tirol (AT33), Illes Balears (ES53), Algarve (PT15) and Kriti (EL43), are all successful in tourism. An additional and related challenge is to preserve the environment. Promoting environmentally friendly production methods, including environmentally friendly tourism, and promoting cooperation between the agriculture and tourism sector is important for this type of region, since environmental issues are of major concern to these vulnerable regions.

Information Society developments and networking policies enhance the development potential of these regions, e.g. in Extremadura (ES43) and Estonia (EE). ICT is a remedy to the peripheral characteristics and at the same time it very well matches with the environmental vulnerability.

Although Tirol (AT33) is close to the centre of the enlarged EU, it has peripheral characteristics due to mountainous conditions. On the other hand, due to the same conditions 44 per cent of foreign tourists to Austria choose Tirol as their holiday destination. According to Boesch (2006) Austria's regional policy is the most decentralized in the Alpine realm. The communes in Tirol have quite a lot of power and may decide more or less independently on their regional planning concepts (Boesch 2006). In Tirol, many have chosen the concept of an eco-region, e.g. the 'Bioregion Wilder Kaiser', which is based on cooperation between tourism and agriculture (Schermer 2002).

Also in the Algarve (PT15) the geographical conditions relate to the peripheral characteristics of the region as well as the strength and potential of tourism. Here the beaches, landscape and weather explain why the Algarve hosts 39 per cent of the accommodation capacity in Portugal. Correia et al. (2004) present a sustainability assessment framework including environmental, economic and social dimensions, which shows that there are good conditions in the Algarve for the development of further golf tourism, and that it should be framed within high service and environmental quality standards.

The region of Podlaskie (PL34) is with 60 people for every km², one of the voivodships with the lowest population density in Poland. The net migration in the region has been negative for a number of years. Podlaskie hosts the largest complex of swamps and primeval forests in Europe. The

four National Parks, four landscape parks and the Augustowska primeval forest are of a special historic, recreational and ecological value (Capire Consulting AB 2006).

Also for Voreio Aigaio (EL41), which consists of the mountainous islands of Lesvos, Chios and Samos, geographical conditions have lead to peripheral characteristics, shortage of land, limited natural resources and particular communications problems, but on the other hand a growing tourism sector. Recently the European Commission has approved the regional programme BIOBUS – Biodiversity resources for innovative business development (Chamber of Commerce of Lesvos 2006). Regional Business & Biodiversity Resource Centres (RBBC) will be set up. They will operate with three offices (sub-centres), one on each main island, as a one-stop-shop where entrepreneurs and other interested people can find out about the important role biodiversity plays in business.

Table 3.10 SWOT, Low-Tech Peripheral regions

Strengths	**Weaknesses**
Education level of population Tourism	Low income Low and declining population density Little high-tech and very limited business R&D
Opportunities	**Threats**
Innovative (eco-)tourism Promote urban networking Information Society developments Innovation in traditional industries and services	Environmental vulnerability Marginalization of economy

Cluster 2: Capital Service regions

This type of agglomerated region is strong in Government Services and Public Knowledge. It includes a small number of regions from various countries and consists mainly of capital cities, such as Warsaw, Lisbon and Athens. These urban regions serve as national centres for business services, government administration, public research institutes and universities. GDP per capita is on average slightly below the EU-27, but growing. Another strong point is the growth in R&D intensity over the last decade. The low score on life-long learning is a weakness in most Capital Service regions, especially when compared to the wealthier and more advanced Public Knowledge Metropoles. The latter type could serve as a benchmark for the Capital Service regions and comparing their profiles suggests that a further specialization in higher education and public research is a promising

opportunity for future growth, and this will depend on the international popularity of these regions among new students and young researchers.

Table 3.11 SWOT, Capital Service regions

Strengths	Weaknesses
Agglomeration of public knowledge Growth in R&D intensity High-tech services	Lifelong learning
Opportunities	**Threats**
To become European centres of public knowledge Attracting foreign students Growth of knowledge intensive service industries	Dominant public sector, crowding out private R&D Crowding out of high-tech manufacturing

Cluster 3: Medium-Tech regions

This large group of 43 regions of diverse nationality includes many non-capital, French, German and Polish regions, but also includes regions in Hungary, Slovakia, Austria and Italy. In terms of our four factors, these regions have close to average scores, which is also reflected in the diversified economic structure of most of these regions.

Molise (IT72), for instance, hosts a large Fiat plant, but the industrial sector is dominated by SMEs in the building industry. Another important industry is food processing, and agriculture remains a characteristic activity of the region.

Rhône-Alpes (FR71) also belongs to this group, but it has shown an above average performance in terms of growth and jobs (see Annex 2). The region has a long-standing industrial tradition and also a high-quality services sector has emerged. As in our typology, Carrincazeaux and Lung (2005) have also placed Rhône-Alpes and Alsace (FR42) in the same group. In their typology of regions in France, these regions are referred to as 'Diversified industrial regions that are scientifically dynamic'.

Lüneburg (DE93) is the growth corridor between the city-states of Bremen and Hamburg. The region has an above average increase in employment, generally low rates of unemployment, and population growth due to immigration.

Pomorskie (PL63) is located in the northern part of Poland. Gdańsk, the capital of the region, has been the largest port on the Baltic for centuries. It was part of the Hanseatic League and it is one of the richest cities of the Republic.

Table 3.12 SWOT, Medium-Tech regions

Strengths	Weaknesses
High share of high-tech manufacturing activity Growth in R&D intensity	Low share of higher educated people Low growth of GDP per capita
Opportunities	**Threats**
Developments in new technology sectors Specialized knowledge intensive clusters Public knowledge investments could boost Triple Helix dynamics	Further loss of jobs in the manufacturing, especially the more traditional industries

Cluster 4: Ageing Educated regions

These 39 regions combine low Young Learning Dynamics with high knowledge scores. Most of these regions are located in Germany (15 regions), Spain (10) and Italy (9). Especially the share of children under ten years of age is very low in these regions, mainly due to emigration. The share of the population with a higher education is high, although with a tendency to decline, following the decreasing trend in the number of students and new graduates. Transition is the buzzword in these regions. In Germany, transition is related to, both the shift from heavy industries to weightless industries and reunification. In Italy, it is linked to the ascendance of SMEs, at the expense of the large firms, and in some Spanish regions it is the lack of transition that plays a role. The unemployment situation has improved in the Ageing Educated regions, but the level of unemployment is still very high. A main challenge for these regions is to reverse the decline of public R&D activities by improving linkages with industry and enhancing entrepreneurship. The consequences of an ageing society will also become a major challenge in these regions.

The economy of Düsseldorf (DEA21) is still in transition from heavy industry to weightless industry. Knowledge workers make up much of the high-quality element in the region, but for the less educated people it is hard to find a job.

Emilia-Romagna (IT4) is an Italian region in transformation from large-scale production to small-scale production, carried out in small and medium-sized firms. Prosperity in the regions depends much on the dynamic modern SMEs rather than on the older larger-scale enterprises. This region is part of the Third Italy (Shin et al. 2006).

Magdeburg (DEE3) like Dresden (DED2), Chemnitz (DED1), Halle (DEE2), Leipzig (DED3), Brandenburg (DE4), Thüringen (DEG) and Mecklenburg-Vorpommern (DE8) were merger and acquisition target regions

during the restructuring of the East German economy in the wake of German reunification (Zademach 2006). The former three regions are also Objective 1 regions (i.e. regions with income per head below 75 per cent of the average EU-15).

Galicia (ES11) lacks the transition problematic of the above-described regions because neither old nor new industries gained a substantial share in the regional economy. The economy of Galicia never produced a vibrant commercial and industrial class, and local Galician culture is still seen as an obstacle to modernity. Emigration to South America and other regions in Europe is significantly reducing the share of 'young people' (Keating 2001).

A main challenge of the Ageing Educated regions (Table 3.13) is to reverse the decline of their public R&D activities by improving linkages with industry and enhancing (academic) entrepreneurship. The problems relating to an ageing society are also a major challenge for these regions.

Table 3.13 SWOT, Ageing Educated regions

Strengths	Weaknesses
Highly educated population Increased GDP and improved unemployment	Demographics (ageing and decreasing population) Lifelong learning High (long-term) unemployment
Opportunities	**Threats**
Growth in high-tech services Academic spin-off	The strength in public knowledge is very vulnerable Increased negative impact from demographic development

Cluster 5: Branch Plant regions

The 21 regions of this type are mostly located in Germany and the Czech Republic, but also in Hungary and France. This type of region has on average the largest manufacturing sector of all types of regions. However, the share of manufacturing in total production has decreased. A loss of jobs in manufacturing has increased the level of unemployment. Typically, these regions host a very high share of high and medium high-tech manufacturing, but with little business R&D. The business sector in these economies is dominated by subsidiaries and branches of multinationals which have their headquarters and R&D labs in other regions. In the case of the German and French Branch Plant regions, this means elsewhere in the country, in High-Tech regions such as Stuttgart, Munich and Paris, and in the case of the Czech Republic and Hungary the situation is related to foreign direct investments.

In Niederbayern (DE22), the share of high and medium high-tech manufacturing is with 16 per cent at an even higher level than in Oberbayern (DE21), but the business R&D intensity is ten times smaller in Niederbayern than in Oberbayern. The situation of the German Branch Plant regions accords with the results of Gebauer et al. (2005), who conclude that various regional technology policy measures adopted in German states (research infrastructure, technology centres and innovation support programmes) have been more successful in the economically better-off large cities.

For Haute-Normandie (FR23) and Franche-Comté (FR43), the relative proximity to Paris (Île de France, FR1) may be a disadvantage (Carrincazeaux and Lung 2005). Franche-Comté (FR43) is highly specialized in car manufacturing and metal work which employ 43 per cent of employees in the region's industrial sector. The region is very dependent on big companies (Hancké 2003), whose establishments are located especially in the north-eastern part of the region (Peugeot and its equipment suppliers in Montbéliard, Alstom at Belfort, Solvay at Dole-Tavaux).

Table 3.14 SWOT, Branch Plant regions

Strengths	**Weaknesses**
Large and strong manufacturing sector High-tech manufacturing industries Foreign Direct Investments	Unemployment Branch plants with low research intensity
Opportunities	**Threats**
Upgrading by investments in education and R&D Promote innovative linkages and local embeddedness	Further loss of jobs in manufacturing Competition from low-cost countries

The Czech and Hungarian regions belong to the Branch Plant type of regions because of their success in attracting foreign direct investments in automotive and other manufacturing industries (see also Horváth 2004). But, so far, delocalization of manufacturing production from regions in the West towards regions in Central and East European countries did not bring along many research intensive activities. Thus, one of the challenges of these regions will be to increase the embeddedness of the existing foreign plants, e.g. by the promoting and upgrading of local buyer – supplier networks. These regions are dependent on the headquarters, which are mostly located in High-Tech regions or Public Knowledge Metropoles. Since labour costs are rising there is need for improvements in productivity and in qualifications of the labour force. Investing in public knowledge will also be essential in

trying to attract more knowledge and research intensive activities. Comparing the profile of Branch Plant regions with the profile of High-Tech regions, indeed, suggests that investing in public knowledge could be a good opportunity for upgrading.

Cluster 6: Rural Industries

Rural Industries have a strong industrial-agricultural tradition and, due to relative low levels of productivity, the employment share of agriculture and manufacturing in the local economy is relatively high. Coordination between private and public knowledge is weak, and the private and public services sectors are small. The administrative and planning capabilities, which are very important in the process of restructuring the local economy, are insufficient and in need of improvement and modernization. This lack of governance capabilities is hampering the efficient use and absorption of funds to restructure the local economy, despite the presence of excellent tools to assist local SMEs (Committee on Regional Development 2007). The mere incidence of public and private knowledge is quite low, but compared to the Low-Tech Peripheral regions its composition is more balanced. This indicates that there could be potential for public private partnerships in knowledge development. However, the levels of R&D expenditure are very likely to be lower than the minimum requirement for passing the Schumpeterian threshold to have positive effects on innovation and economic growth (Rodriquez-Pose 2001).

The two Greek regions belong to the central part of Greece. Agriculture, forestry and heavy industry make up a large part of these regional economies. These regions are considered as satellites of Athens. Transition towards modernization is hampered by the low endowment of private and public knowledge and human capital, while networking with nearby Athens and its R&D capabilities might be very helpful in this respect (Maroulis and Nioras 2006).

The Romanian and Bulgarian regions in this cluster undergo large structural reforms (Rogin 2006): closing down large energy intensive industries while new enterprises emerge that have often much higher levels of productivity. Employment is growing fuelled by the good prospects for high economic growth driven by foreign direct investments (Invest East 2007), but at the same time, employment is declining because of labour productivity gains. The macro result is still a declining employment. Most foreign direct investment projects are in the regional specializations of food, beverages and tobacco industry as well as the transport vehicle industry (LOCOmonitor 2007).

The Polish region of Slaskie (PL22) is a relatively developed industrial-

agricultural region in the Southwest of Poland with income per capita above the Polish average. The region is particularly attractive for new initiatives: it is highly urbanized, relatively well endowed with public and private knowledge, and enjoys close proximity to EU markets. The region is well positioned for a modernization of the (traditional) heavy industries.

Table 3.15 SWOT, Rural Industries

Strengths	**Weaknesses**
Industrial tradition	Low R&D
Presence of public and private knowledge	Low administrative and planning capabilities
Opportunities	**Threats**
Large potential for productivity gains	Further job loss in manufacturing industries
Strong growth potential in industrial sectors	Inward migration of the lowly skilled, outward migration of the highly skilled

Cluster 7: Young & Learning regions

These 40 regions are strong in the Young Learning Dynamics factor and its main components, such as life-long learning, youth and female participation rates. The score on the Public Knowledge factor is above EU regional average. These regions are strong in knowledge creation. When aggregated, the public and private expenditures on R&D result in a high R&D intensity. A strong point in economic performance is the rate of unemployment, which is the lowest compared to the other EU regions, and the trend has been very positive.

The share in employment of public administration is, with an average of 6 per cent, the lowest for all types of regions. GDP per capita is rather high, but GDP growth has (on average) been very weak. Young & Learning regions are mainly located in the UK, the Netherlands, Sweden, Austria and Finland. A strength of these regions is a relatively innovation friendly environment and a high R&D intensity based on Triple Helix dynamics as well as strong science – industry linkages. The main challenging policy options concern: the trend towards more market-oriented R&D in government labs, the promotion of innovative SMEs and innovation in service industries. A continued threat is the loss of jobs in manufacturing industries, due to labour cost differentials.

Labour market participation of women has increased dramatically in Sydsverige (SE04). With 67 per cent, the participation rate of women is now close to the rate for men (75 per cent). Better infrastructure, communication technology and increasing car ownership have helped commuter catchment

areas to expand, e.g. the opening of the Øresund Bridge in 2000, connecting Malmö and Copenhagen. The area's shipyard and textile industries have almost totally disappeared. Nowadays, the economy of Malmö is more diversified and SMEs are essential to the economy. The fact that the region is relatively densely populated, and has increased commuting and teleworking opportunities resulted in better conditions for a flexible labour market and good possibilities for the working population to develop their professional skills by moving from one job to another (Eurostat 2004).

Table 3.16 SWOT, Young & Learning regions

Strengths	Weaknesses
Low unemployment and long-term unemployment Lifelong learning and female participation rate High R&D intensity	R&D intensity did not increase
Opportunities	**Threats**
Triple helix dynamics and science – industry linkages, and services – manufacturing linkages	Further job loss in manufacturing industries

The province Noord-Holland (NL32) includes the city of Amsterdam. The region has strengths in higher education and knowledge workers, but it has a very disappointing share of high-tech companies, both in services and manufacturing. In cooperation with companies and knowledge institutes, the provincial government will focus the next four years on: improvement of the knowledge transfer and knowledge infrastructure, support to innovative start-ups; and supporting knowledge and business clusters. One of these clusters is based around the Energy Centre Netherlands, a major public – private funded research lab. Business R&D expenditures are rather low, but dynamics in ICT are rather high. Unemployment in the province Noord-Holland (NL32) is lower than both the national and European average, with only 2 per cent of the working population. For the many that belong to an ethnic minority and who are under-educated, re-training and further education are important elements of the economic and innovation policy in the region. Also for the new period of EU support from the Structural Funds the region will invest considerably in life-long learning and human resources (Wintjes 2006).

Cluster 8: High-Tech regions

The High-Tech regions host many high and medium high-tech manufacturing industries and include well-known technology regions such as Stuttgart

(DE11) and Oberbayern (DE21). These regions perform exceptionally well with respect to Private Knowledge, GDP per capita and labour productivity. However, the Young Learning Dynamics factor shows a relative weakness, e.g. in lifelong learning. Growth in GDP per capita has been the lowest of all of the ten types of regions and unemployment has not improved much in previous years. The major challenge for these High-Tech regions is to stay on the leading edge in core technology areas. Further focus on the resources in the strongest technological areas should serve the exploitation of regional excellence and RTDI poles based on strong Science – Industry linkages. It is also necessary to facilitate structural change in manufacturing, leading towards a more innovation-based productive fabric, and a more service-based high-tech production structure, that can counter off-shoring forces.

Table 3.17 SWOT, High-Tech regions

Strengths	**Weaknesses**
High-tech manufacturing	Lifelong learning
Business R&D	Slow growth GDP per capita
Level of GDP per capita	Unemployment
Opportunities	**Threats**
Innovation intensive high-technology clustering	Job loss in manufacturing industries
Triple Helix dynamics based on science – industry and service – manufacturing linkages in focus technologies	

Cluster 9: Public Services regions

This type of region is characterized by a very low score on Public Knowledge combined with a high score on Government Services. Especially the share of employment in public administration is very high. Unemployment is the strongest weakness for these regions but GDP per capita is close to the regional average. Many regions in this group are rather isolated, e.g. because they are islands, and this explains part of the relatively large presence of government services. A threat for these regions could be the combination of a low level of education and traditional values, as reflected by a very low female labour market participation rate. Opportunities for improvement could therefore lie in investments in higher education and in the promotion of female labour market participation, entrepreneurship and an innovation friendly environment. Other opportunities and appropriate policy priorities for these regions are the promotion of technology transfer and innovation in local SMEs, the creation of innovative enterprises, and the attraction of

foreign investment. Upgrading of human resources and innovation in the service industry are main challenges for the Public Services regions.

Public Services regions are mostly located in Italy in regions such as Lazio (IT6), Valle d'Aosta (IT12) and more southern regions. This is in line with the findings of Alesina et al. (1999) who have shown that the regional redistribution of wealth through public employment in Italy is more complex then a simple North – South division.

Table 3.18 SWOT, Public Services regions

Strengths	Weaknesses
Increasing level of education Presence of public administration	Limited high-tech activities Low level of education and R&D High unemployment
Opportunities	**Threats**
Revitalization due to upgrading education level Tourism and Information Society developments	Reduction of public investments and support policies Political instability

Cluster 10: Public Knowledge Metropoles

This group of major urban agglomerations, including London, Vienna, Stockholm, Prague, Brussels and Berlin, are the strongest regions in terms of, both Public Knowledge and Government Services. Population densities in these regions are extremely high. These regions are characterized by the highest GDP per capita and productivity rates. A weakness is the relatively low presence of high and medium high-tech manufacturing and low business R&D expenditures. Dominant sectors in these regions are usually financial

Table 3.19 SWOT, Pubic Knowledge Metropoles

Strengths	Weaknesses
Critical mass in knowledge creation and human resources High-tech services Higher education Female participation and lifelong learning Very high income per capita	Little high and medium high-tech manufacturing Increasing unemployment
Opportunities	**Threats**
International nodes of public knowledge Academic spin-off in service industries	Dependence on public resources Further crowding-out of business research and high-tech manufacturing

intermediation, business services, government administrations, government labs, creative industries, software, health services and tourism. These regions have the opportunity to serve as international 'knowledge capitals'. However, given the high concentration of public R&D expenditure and Higher Education Institutions, a threat for these regions could come from their dependence on public resources. Being very popular among international students, most regions in this group will be able to increase their concentration of human resources. Yet, such a concentration in the public sector could enhance the existing gap between science and industry in the respective regions and even countries.

CONCLUSIONS

Main Results

Public Knowledge, Young Learning Dynamics, Private Knowledge and Government Services are four factors that drive economic performance of the regional knowledge economies in the enlarged EU. Based on these four factors ten clusters emerge to which each of the 220 regions of the EU-27 could be assigned. This typology quite naturally suggests the formulation of a diversity of innovation policy options.

Part of the success and relevance of our analysis depends on the availability of indicators which measure different aspects of a region's socio-economic structure and knowledge base. Whereas data availability at country level is relatively good, we observe that data availability at regional level is much more limited. For example, regional data on R&D expenditures and Science & Technology workers are available from EUROSTAT for most of the EU-27 regions, but for most countries, regional data measuring the innovation process and the impact of innovations are not (yet) available.[6] Future research would benefit from more and better quality indicators at regional level, starting with regional data from the innovation surveys.

The four factors are, however, distributed very unevenly and, especially for the regions with the lowest scores, other indicators might be more relevant to characterize their potential and to identify feasible policy options. The need and relevance of additional data also differs per cluster of regions. The situation in the less innovative, less developed, traditional and peripheral regions is especially hard to assess. Besides lacking indicators on innovation, we also like to stress the lack of indicators on ICTs, foreign direct investments, the environment, policy indicators and the quality of regional governance in general.

Four Factors as Pivot Points of Many Implicit Relations

Qualitative and quantitative analysis on regional innovation systems make up two extreme different strands of academic and policy studies. Often, the implicit assumptions are that either all regions are unique and therefore need their own unique policy, or that all regions are, or could become, the same, i.e. converging to the best performing region. In the latter case, this best performing region serves as a benchmark: a best practice example to all others. In this chapter, we have shown that these extreme assumptions can easily be rejected. This rejection has implications, not only in terms of concepts and models of regional knowledge economies, but also in terms of policy practice and the possibilities for learning from the practices in other regions.

Between these two extremes, theories on regional innovation provide a confusing picture; confusing, because too many potential drivers and too many contextual factors are thought to play a crucial role in the innovation process. The reaction to this confusion in the literature is either to (over-) emphasize one dimension that makes all the difference and rank regions as high or low on that dimension only; or to use an all embracing conceptual framework (e.g. cluster, agglomeration, regional innovation system, learning region, etc.) that absorbs all potential differences and, therefore, is less revealing. Geographical concepts, including innovation itself, have been described very differently, e.g. the linear innovation model, the network model, open innovation, Triple Helix, etc. The resulting myriad of regional innovation theories is neither contradictory nor complementary and a positive pluralistic interpretation calls for an integrated approach in which the quality of local institutions, the local culture and the inescapable past of the region play a role. Multidimensionality of innovation and governance of the local community are the main categories of such an integrated regional innovation theory. Albeit implicit, this multidimensionality is captured in the four factors that we have presented in this chapter and these factors can be seen as pivot points for the relations called upon in the literature.

Geography of Knowledge and Innovation

Our contribution to the existing theory is largely based on the fact that the four identified factors make sense. We expected, and confirmed, the emergence of separate factors for public and private knowledge. While most of the models and concepts, such as ‘systems of innovation’ (Edquist 1997); ‘knowledge-based economy’ (Cooke and Leydesdorff 2006), ‘Open Innovation’ (Chesbrough 2003) and ‘Triple-Helix’ (Leydesdorff 2006),

emphasize the importance of science – industry linkages, science and industry appear as separate factors. This suggests that the relations between research and innovation, between university and industry have a geographical component. It also has a sector component in the sense that public R&D seems to benefit high-tech services, while business R&D is associated with high-tech manufacturing. Government Services is the factor that coincides with de-industrialization but also with the mere size of public administration. The size of the government in a region can also be the result of a conscious national allocation policy, aiming at a redistribution of income. Young Learning Dynamics as a factor may be less easy to interpret, but it is not the least interesting, since it is very significant in explaining regional differences in income and especially unemployment, and it also seems to indicate the future potential of a region.

The identified factors and the diversity among the clusters could be interpreted as differences in locational preferences in an increasingly mobile society. In this respect, we point at regional differences and the possibilities they have of attracting international students, foreign investors, R&D subsidies, tourists, public administration, young urban professionals, etc. The four factors can therefore also be seen as four different types of agglomeration economies and four types of peripheries.

In the end it is the quality of life, and in a collective form the quality of society, that matters, not in a 'one-model-fits-all' fashion, but in a model that takes account of indigenous qualities of a region. To our opinion, regional contexts in the EU have extremely diverse socio-economic features, which are not sufficiently reflected in regional European innovation policies.

Towards more Subtle Innovation Benchmarking and Policies

Policy-makers like to compare the achievement of their region with other regions in order to learn form the policies of better performing regions. Innovation policy-makers at regional, national and EU level often use (or promote the use of) innovation scoreboards, best-practice studies, indicator rankings and other one-dimensional mappings in an open coordination setting. The underlying assumption that every policy-maker can learn most from the policies of the best performing region is a rather naive form of benchmarking. It is obvious that not all regions in Europe can or will converge to a best performing type of knowledge region. In this chapter we have developed and applied an approach to benchmarking that is more subtle, in the sense that it acknowledges and confirms the fact that some regions have more similarities with others; not only in terms of knowledge economy characteristics, but in terms of policy options as well. Among members of the

same type of cluster, policy learning and benchmarking is therefore much more focused, hence more relevant. Stepping from one type of cluster into another more desired one requires much more effort and bears many more risks than improving the within-cluster position of a region.

A Broad Range of Policies Emerge from the Analysis

Confronting the statistical results with reality in some regions confirms that regions within the same cluster have more in common than is captured by the variables, e.g. the importance of tourism for cluster 1 (Low-Tech Peripheral) regions is obvious and such commonalities give rise to cluster specific policy options.

More examples are: the Low-tech Peripheral type of regions such as Tirol (AT33), Algarve (PT15) and Podlaskie (PL34) that share policy options concerning eco-tourism and the Capital Service type of regions (cluster 2) such as Warsaw (PL12) and Lisbon (PT17), which might be able to link up with global networks of cities and city dwellers. Compared to the innovation model of the more advanced Public Knowledge Metropoles (cluster 10) the Capital Service regions are weak in life-long learning and they could benefit from further specialization in higher education, public research and other knowledge intensive services. This example of concrete policy options also shows that some types of regions share policy options because they share strength in the same factor.

Strength in public knowledge (e.g. in type 10) calls for policies to generate spill-overs and spin-off from science and higher education, e.g. by promoting entrepreneurship at universities, technology transfer centres and incubation support for academic start-up companies. On the other hand, strength in private knowledge (e.g. in type 8) calls for policies that promote 'open innovation' and support corporate spin-off companies.

Lesson Learned

A lesson for European knowledge and innovation policy is that it must be tailored to the specific regional potential. Although there is an increased awareness among policy-makers at the European Commission that it is worthwhile to promote a certain level of geographical concentration of R&D, there is still insufficient support for experimentation and development of alternative innovation models and new practices. The least developed regions may indeed lack capacities to absorb mainstream or so-called 'best-practice' innovation policy support, e.g. from EU Structural Funds, but EU policy frameworks should have the flexibility to generate new good practices by

promoting strategic interventions addressing local strengths and weaknesses. Since governance of knowledge and innovation is to a large extent a region specific phenomenon, different types of regions justify different innovation policies.

NOTES

1 See, for example, Carrincazeaux and Lung 2003; Clarysse and Muldur 2001; Muller et al. 2005; PWC Consulting and Tsagaris Consult 2002; ECOTEC 2002.
2 Skewness equals 1.344 (standard error 1.64) and kurtosis 2.926 (standard error 0.327).
3 Annex 1 provides more details about the regression methodology.
4 The dependent variable in the regression is the inverse of the unemployment rate. An increase (decrease) in this inverse unemployment rate thus leads to a decrease (increase) in unemployment.
5 See also Annex 3 for cluster averages.
6 Harmonized regional data were not available from the 3rd Community Innovation Survey (CIS-3), but it is expected that from the CIS-4, regional data for a large number of European countries will become available (see also Chapter 1 in this book).

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