Benchmarking regions in the enlarged Europe

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

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1. 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, there are many relevant indicators to measure innovation, and there is more than one driving factor of regional performance. In this chapter we explore a methodology to identify the main drivers of economic performance for 220 regional knowledge-based economies in the enlarged European Union. Policies to improve a region's performance should be geared towards these drivers in order that a region's potential can be exploited efficiently and fully. When considering future policy options it is more appropriate to benchmark regions with similar characteristics. Due to regional diversity the options for innovation policy differ, e.g. some regions are strong in public knowledge, while others are strong in private knowledge. 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?

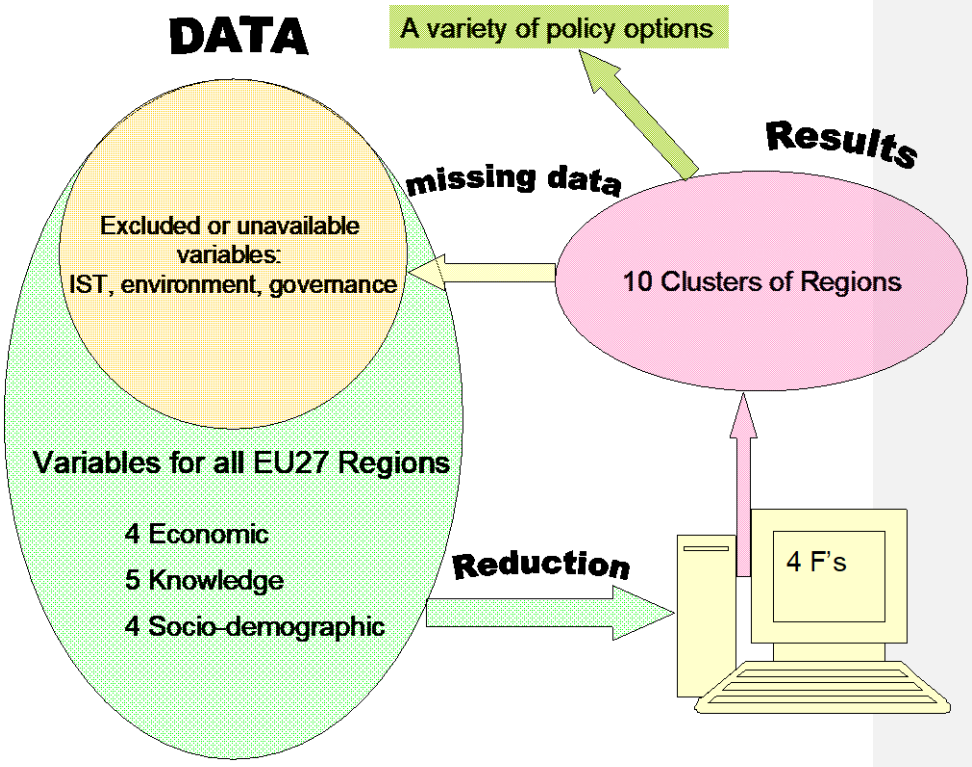
Based on 13 indicators, four drivers of regional knowledge economies emerge. These four drivers determine economic performance (jobs and growth) and they are used to develop a typology of regional knowledge economies in Europe. This typology of regional innovation systems highlights the diversified nature 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 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 EU27. 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.

The method of analysis involves several steps (see also figure 1). In the first step we use regional NUTS-II level data from EUROSTAT to distinguish the main factors of economic performance contained in the set of variables that characterise knowledge economies at the regional level. In the second step we test if, and to what extent, these factors (resulting from factor-analysis) are relevant to explain the performance of the regions in terms of GDP per capita and unemployment. The third step is 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 paragraphs in this chapter follow these steps in the analysis. Paragraph 2 describes the selection of the indicators and the method for statistical analysis. Paragraph 3 presents the factor analysis and the results of the cluster analysis are addressed in paragraph 4. We end with the overall conclusions in paragraph 5.

Figure 1: Overview of methodological steps



2. Selection of indicators and methodology

2.1 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 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 localised 'market-externalities' or agglomeration advantages, referring to Marshalls' (1920) observation that such localised externalities or advantages are 'in the air'. E.g. students of industrial districts (Becattini, 1989) had been inspired by the economic growth in districts in the Third Italy (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 specialised family-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 & Scot, 1988).

The more recent concepts emphasize knowledge and the importance of a variety of actors, that is, 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, pp.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 specialisation 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 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 regions' innovation

performance to attract young talent with a cosmopolitan culture and a tolerant environment.

Criticising the one-size-fits-all reasoning Tödtling and Trippl (2005) have drawn on a conceptual framework (Nauwelaers and Wintjes, 2003) describing different policy needs for 3 hypothetical types of EU15 regions: institutional thin, restructuring old industrial, and fragmented metropolitan regions. 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 EU27.

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 general 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). Analysis of convergence-divergence processes pays increasing attention to the institutional mechanisms that regulate the labour market, as well as to the characteristics of the 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.

2.2 Description of the data

These theoretical considerations together with availability of regional data has led to a collection of explanatory regional variables (Table 1) that characterise innovation, labour participation, demography, government presence, economic structure and learning habits in a region.

Table 1: Explanatory variables

Higher education	Share of the population that completed higher education degree (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 the government R&D institutes as a share of GDP (HERD+GOVERD), 2002

[1] See, e.g. Carrincazeaux and Lung (2003); Clarysse and Muldur (2001); Muller et al. (2005); PWC Consulting and Tsagaris Consult (2002); ECOTEC (2002).

Value-added services	Share of services in total gross value added at basic prices at NUTS level 2 in Millions of euro, NACE codes G to P, 2002
Value-added industry	Share of manufacturing industry in total gross value added at basic prices at NUTS level 2 in Millions of euro, NACE codes C to F, 2002
Government employment	Share of employment in public administration in total employment, NACE codes 75 and 99, 2003
Population density	Population per square km, 2002
High-tech manufacturing	Share of high-tech and medium/high-tech manufacturing employment in total employment, NACE codes 24, 29 to 35, 2003
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 10 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

The data exhibited in Table 1 originates from the EUROSTAT REGIO database. However, not all observations report on the same year, nor on the most recent year. One implication is that there is no possibility to cover distant years on all indicators. This selection informs us on the current state of the economic structure, knowledge and learning situation and demography and other contextual categories. The data represents 220 regions in EU27, mostly on the NUTS 2 level. For several Member States, such as Denmark, Estonia, Luxembourg and Malta regional data is lacking. 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.

Table 2: Descriptive statistics of explanatory variables

	Number of regions	Minimum	Maximum	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: REGIO database EUROSTAT

In the next paragraph these variables will be analysed in order to reduce the number of variables into a limited number of factors. These factors can be seen as important for the conditions under which growth and jobs materialise. 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 (Ciffolilli et al. 2006).

Public R&D expenditure (as a percentage of GDP) is highest in Berlin (DE3). Other capital cities, such as Wien (AT13) and Lazio (IT6), but also some more peripheral regions perform well; for instance, Languedoc-Roussillon (FR81) in France, Scotland (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" of spending 1% of GDP on public R&D expenditures (a third of the overall 3% 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) 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 Braunsweig (DE91), Västsverige (SE0A), Eastern (UKH), Noord-Brabant (NL41) and Střední Cechy (CZ02).

2.3 Methodology, a combined factor and cluster analysis

In order to synthesize the regional statistical information captured in the 13 variables for all the 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 1 into 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 Appendix 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 affects the factor estimates. In a recent paper Boivin & Ng (2005) showed that more data is not always better. Problems arise when the 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 is a good thing to do. 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 EU27.

3. Factor analysis: four drivers of regional knowledge economies

This paragraph presents and interprets the results from the factor analysis. First the factors are discussed and linked with some results from the literature. After this interpretative part of the paragraph the forces are used to explain regional GDP per capita and unemployment.

3.1 Estimation of the 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. The 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.

Based on the variables with the highest factor loadings, the meaning of each of the four factors can be interpreted, e.g. the indicators regarding public R&D and business R&D 'belong' to different factors. F1 consists mainly of high tech services, higher education, public R&D and population density. F2 contains life long learning, the share of the population under 10 years of age and women labour market participation. The third factor 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 F4.

Table 3: Reduction of the dataset into four factors by means of factor analysis

	F1 Public Knowledge	F2 Young Learning Dynamics	F3 Private Knowledge	F4 Government Services
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.

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. Based on the variable with the highest

factor loadings, the meaning of each of the four factors were interpreted and given a short symbolic name.

3.2 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 like 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). 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 2: Distribution of the Public Knowledge Factor over the EU27 regions

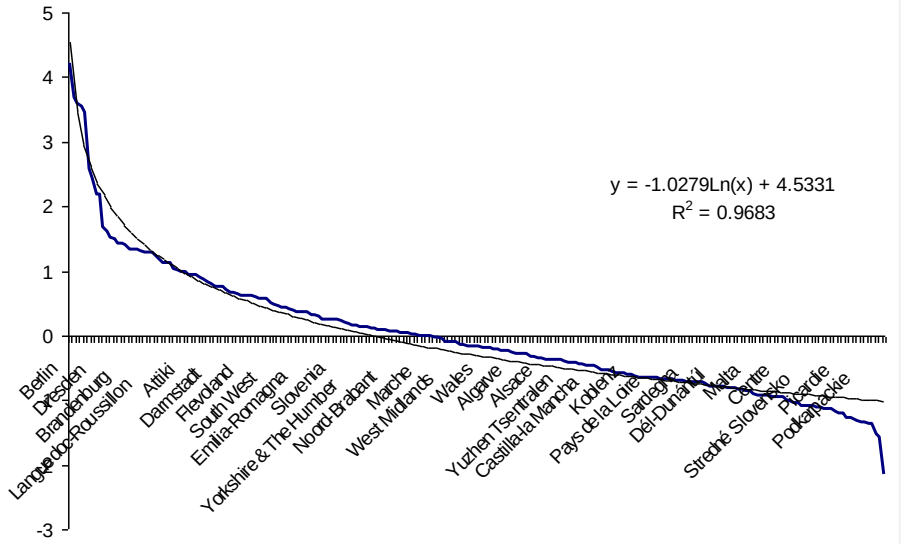


Figure 3: Regions with low endowment of Public Knowledge

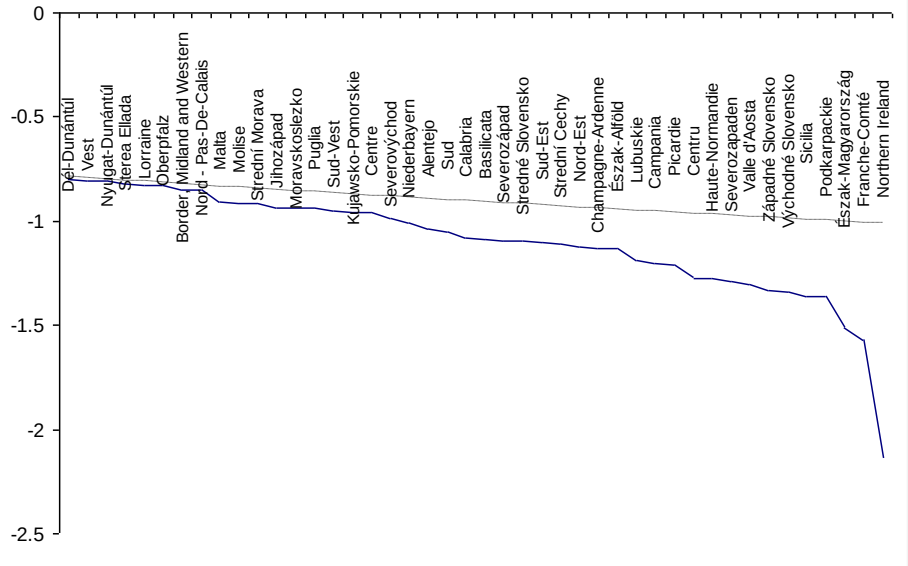


Figure 2 shows the distribution of Public Knowledge. It exhibits the tendency to be negatively exponential distributed over the EU-27 regions: quite a few regions are very well endowed, but most of the regions are below average endowed with Public Knowledge. The thick line in Figure 3 plots the value of public knowledge in the regions, while the thin line gives the distribution according to the estimated negatively exponential distribution mentioned in the figure.

Very well endowed with Public Knowledge are regions such as Berlin, Vienna, Prague, Brussels, London, Hamburg, Leipzig, Utrecht, Dresden, Halle and Madrid. In Figure 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 of face quite low endowment with the factor Public Knowledge. These poorly endowed regions indicate that the regional distribution of Public Knowledge in the EU27 is skew 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 Figuur 3. In these regions it is difficult to realise 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 the regions are predominantly French, Italian, Czech and Romanian.

[2] Skewness equals 1.344 (standard error 1.64) and kurtosis 2.926 (standard error 0.327).

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 Dynamism (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's labour participation combined with a relatively large share of people under 10 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-life-style' 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. Especially Swedish regions can be characterised as young dynamic societies. Also Denmark, Finish regions, Île De France, and most Dutch regions have a high score with regard to this Young Learning Dynamism factor.

Young Learning Dynamism			
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

On the other hand, regions that have particularly low Young Learning Dynamism 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 like in Dresden and Halle, in Sterea Ellada due to little life-long-

learning and women's participation, and in the regions Principado de Asturias and Liguria all three characteristics exhibit low scores.

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 the innovation input (R&D intensity) and 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 factor Private knowledge is mainly present in Germany. Braunschweig leads the pack followed by Stuttgart, Tübingen and Karlsruhe, Rheinhessen-Pfalz, Oberbayern, Franche-Comté, Střední Cechy, Freiburg, Mittel- and Unterfranken, Västsverige, and Oberpfalz are very well endowed with private knowledge. 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 is the less importance is given to the presence of local manufacturing production (Mariani, 2002). This type of deindustrialisation or 'crowding-out' may explain why London and Brussels as top performers in public knowledge have a relatively low score on the private knowledge factor.

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
Střední 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

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.

Government Services (F4)

This factor shows that public administration does not necessary co-locate with academic centres (F1). It is clear that this service or de-industrialisation 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 1990's when many European countries experienced a period of privatisation and devolution of administrative powers. The East European economies experienced such transformations after the collapse of communism. In fact de-industrialisation 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-industrialisation 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 characterises 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 governments are located, while the manufacturing sector has migrating out of the region, or never played a significant role in the regional economy.

The table below gives the regions with a high and low incidence of government services, especially Sicilia, Lazio, Northern Ireland, Valle d'Aosta, Calabria, Campania, Sardegna, Région Wallonne, Provence-Alpes-Côte d'Azur, Île De France, Puglia, Notio Aigaio, Midi-Pyrénées, Molise and Brussels do well on government services.

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

The regions that have very low degrees of Government Services are to be found in Estonia, Romania and Czech Republic and to a lesser degree in Hungary and other countries like Portugal, Poland, Ireland, Sweden, Finland, Italy, Austria, Bulgaria, Greece, the Netherlands and Hungary.

3.3 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**Error! Reference source not found.**[3]. Due to the lack of sufficient data that cover the 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 it might not be a problem to use contemporaneous variables in this regression **Error! Reference source not found.** 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.

[3] Appendix 1 provides more details about the regression methodology.

The four factors also explain part of the variance in the unemployment rates of the 219. Both Young Learning Dynamics and Private Knowledge have a positive impact on unemployment[4], Public Knowledge has no significant impact and Government Services has 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 both Young Learning Dynamics and Private Knowledge 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. It therefore seems that for regions wanting to improve their economic performance, investing in these two factors is the best option.

Table 4: Regression results

	F1 Public Knowledge	F2 Young Learning Dynamics	F3 Private Knowledge	F4 Government Services	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

** Significant at 1%; * Significant at 5%; N=219

4. Results of the cluster analysis

4.1 A statistical defined regional typology based on the factors

Using the four factors in a cluster analysis brings us to 10 clusters of regions. Table 5 exhibits the clusters and their statistical properties measured with the average factor scores and the two target variables. The targets are the level and growth rate of per capita GDP and the level and change in the unemployment rate**.**

Table 5: Cluster averages

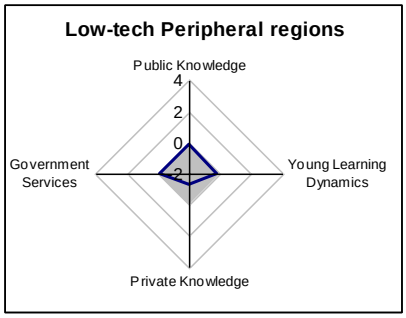
Regions	GDP per capita 2002	GDP per capita growth	Unemploy-ment rate 2003	Unemploy-ment rate change	Public knowledge	Young learning dynamics	Private knowledge	Government services
All regions	18888	4.85	9.48	0.07	0.000	0.000	0.000	0.000
Low-tech peripheral regions	12769	6.21	13.22	-0.05	-0.096	-0.274	-1.290	-0.119
Capital service regions	19930	6.46	9.97	0.05	0.854	-0.075	-0.364	0.749
Medium-tech regions	16470	4.51	10.98	0.07	-0.708	0.035	-0.011	0.453
Ageing Educated regions	20369	4.76	10.08	0.14	0.713	-1.056	0.343	-0.230
Branch Plant regions	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 regions	27921	3.81	7.10	-0.02	0.501	-0.033	2.308	0.655

[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.

Public Services regions	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

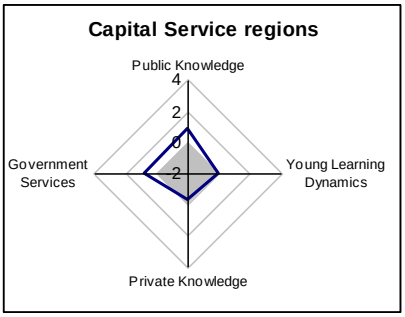
Note: For "All regions" values equal the unweighted mean of all 220 regions. GDP growth equals the annual average growth rate between 1996 and 2002. The change in unemployment equals the difference between the unemployment rate in 1996 and 2003.

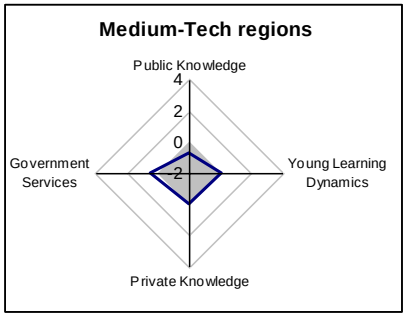
Based on the cluster averages we can describe each group of regions as a certain type of region. For each cluster performance on each of the factors is shown in a radar graph. The shaded area in that graph represents the average performance of all regions.



1) Low-tech Peripheral regions
In these regions private knowledge and young learning dynamism is 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 region is 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.

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, and Athens, and two French regions. They score above average on the factors public knowledge and government services. These regions have on average the highest growth in GDP per capita of all the types. These service economies have a rather large share of high tech services.



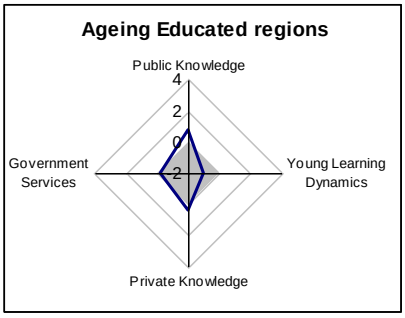


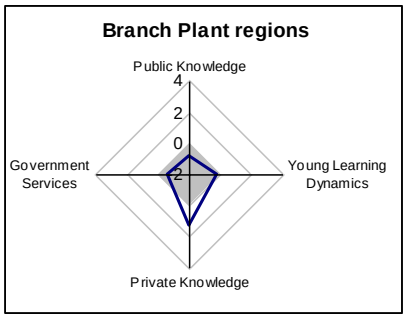
3) Medium-Tech regions
This group includes some old, central European regions that have not succeeded yet in finding their competitive advantage in the knowledge economy. They are still performing at an acceptable level, regarding GDP per capita and unemployment, but their evolution away from old industries and activities is not completed yet. Being more industry-driven, their trajectory leads them more towards a high tech region than towards learning regions, but with relatively low R&D intensities and 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.

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 10 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.



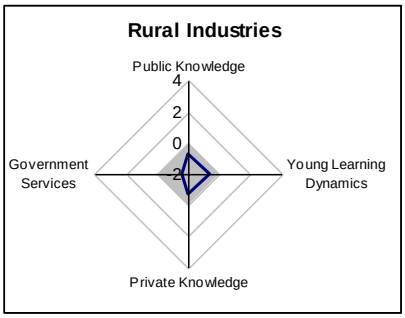


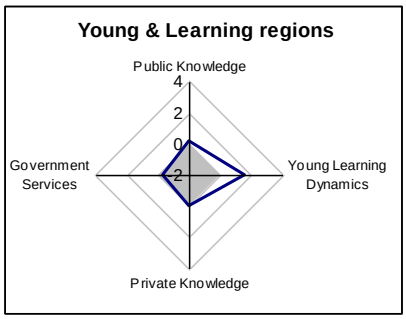
5) Branch Plant regions

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 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 Czech Republic.

6) Rural Industries

These rural regions are still very heavily focussed 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, two of Greece, Poland and Portugal 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 grand transformation need towards the knowledge economy.

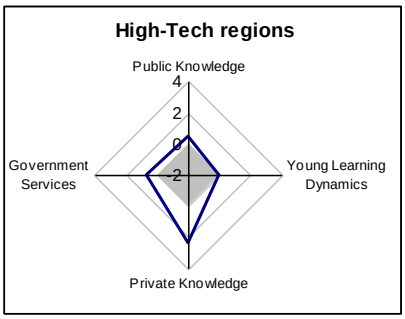




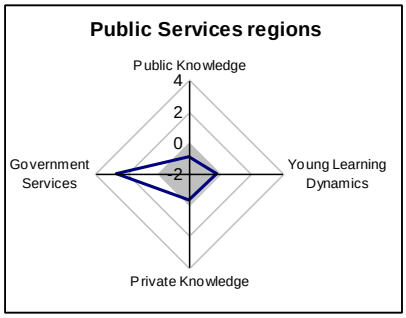
7) Young & Learning regions

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 year 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 Europe" regions (not considering the catching-up ones). They base their success on life long learning and involvement of all 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.

8) High-Tech regions



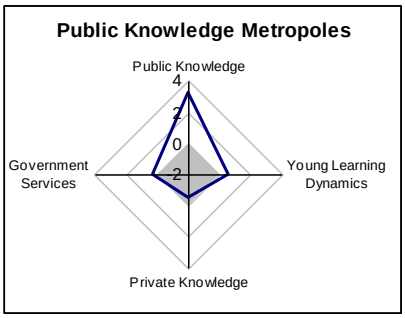
Wealth in High-tech regions comes from the private knowledge factor and its major components: private R&D expenditures, high- and medium-high-tech manufacturing activities and human resources in science and technology. These regions also invest in public R&D. So, in a sense, they conform to the traditional 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 life-long learning is notably less intensive than cluster number 7, manufacturing activities are relatively foot-loose and these regions are aging societies.



9) Public Services regions

This type of regions have 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 such as Sicily and Sardinia are Italian, but also included is for instance Northern Ireland, Walonia, and Notio Aigaio, which consists of many Greek islands. On average employment in public administration is with 13.4 percent 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 consist 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 was below average. They do not correspond to the classical view of innovation based on high-tech manufacturing so policy-makers should be aware not to follow classical policy instruments, which are largely based on this view. Still, they are less able than the learning regions (see cluster 7) to give employment to their population.

4.2 Testing the typology and translation to policy options

Analyzing for a number of clusters some concrete regions 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.

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Cluster 1: Low-tech peripheral regions

The 30 regions of this type have a very low score on 'Private Technology'. 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 regions, seem 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, such as 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 environmental friendly production methods, including environmental friendly tourism, and promoting cooperation between the agriculture and tourism sector is important for this type of regions, since environmental issues are a major concern in these vulnerable regions.

Information Society technologies 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.

Strengths	Weaknesses
Education level of population	Low income
Tourism	Low and declining population density

	Little high-tech and very limited business R&D
Opportunities	**Threats**
Innovative (eco-)Tourism	Environmental Vulnerability
Promote urban networking	Marginalisation of economy
Information Society developments	
Innovation in traditional industries and services	

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 percent of foreign tourists to Austria choose Tirol as their holiday destination claims that 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 for the concept of an Ecoregion, e.g. the "Bioregion Wilder Kaiser", which is based on the cooperation between tourism and agriculture (Schermer, 2005).

Also in the Algarve (PT15) the geographical conditions relate to both the peripheral characteristics as well as the strength and prospects in tourism. Here the beaches, landscape and weather explains why the Algarve hosts 39 percent 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 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 4 National Parks, 4 landscape parks and the Augustowska primeval forest are of a special historic, recreation and ecological value (Capire Consulting AB, 2006).

Also for Voreio Aigaio (EL41) which consists of the mountainous islands of Lesvos, Chios and Samos, the geographical conditions have lead to peripheral characteristics, shortage of land, limited natural resources and particular communications problems, but on the other hand also with 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 Centers (RBBC) will be set up. They will operate with three offices (sub centers), 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.

Cluster 2: Capital Service regions

This type of agglomerated region is strong in the factors 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 EU25, 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 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 suggest that a further specialisation 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.

Strengths	Weaknesses
Agglomeration of public knowledge Growth in R&D intensity High-tech services	Life-long-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

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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 the four factors these regions have close to average scores, and this can also be witnessed 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 Appendix 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 they have labeled them 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, and was part of the Hanseatic League and it is one of the richest cities of the Republic.

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 Specialised knowledge intensive clusters Public knowledge investments could boost Triple	Further loss of jobs in the manufacturing, especially the more traditional industries

Cluster 4: Ageing Educated regions

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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 10 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 because the number of students and new graduates are decreasing. Transition is the buzzword in these regions. In Germany transition is related to both the shift from heavy industries to the weightless industries and unification. In Italy it is connected with 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 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 the heavy industries to the weightless industries. 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 located 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. It 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 Meckelenburg-Vorpommern (DE8) were merger and acquisition target regions during the restructuring of the East German economy in the wake of the German unification (Zademach, 2006). The former three regions are also objective 1 regions (i.e. regions with income per head below 75% of the average EU15).

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 is to reverse the decline of their public R&D activities by improving linkages with industry and enhancing entrepreneurship. The problems related to an ageing society are also a major challenge for these regions.

Strengths	Weaknesses
High educated population	Demographics (ageing and decreasing population)
Increased GDP and improved unemployment	Life-long-learning
	High (long-term) unemployment

Opportunities	Threats
Growth in high-tech services	The strength in public knowledge is very vulnerable
Academic Spin-off	Increased negative impact from demographic development

Cluster 5: Branch Plant regions

The 21 regions of this type are mostly located in Germany and Czech Republic, and two in Hungary and France each. This type of regions has on average the largest manufacturing sector of all the 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, Munchen and Paris, and in the case of 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 percent at an even higher level than in Oberbayern (DE21), but the business R&D intensity is 10 times smaller in Niederbayern then 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 (Ile De France, FR1) may be a disadvantage (Carrincazeaux and Lung, 2005). Franche-Comté (FR43) is highly specialised in car manufacturing and metal work which employ 43 percent of employees in the region's industrial sector. The region is very dependent on big companies (Hancké, 2002), 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).

The Czech and Hungarian regions belong to the Branch Plant type of cluster, because of there success in attracting Foreign Direct Investments in automotive and other manufacturing industries (see also Horváth, 2004). But, so far, the shift of manufacturing production from regions in the west towards regions in Central and East European countries did not bring many research intensive activities. One of the challenges of these regions is in trying to increase the embeddedness of the existing foreign plants, e.g. by promoting and upgrading of local buyer-supplier networks. These regions are dependent on the head quarters 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 the Branch Plant regions with the profile of the High-Tech regions indeed suggest that investing in public knowledge could be a good opportunity for upgrading.

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

Cluster 6: Rural Industries

Rural industry regions have a strong industrial-agricultural tradition, 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 subject to improvement and modernisation. This lack in of governance capabilities is hampering the efficient use and absorption of funds to restructure the local economy, despite the 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 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 the regional economy. These regions are considered as the satellites of Athens. Transition towards modernisation 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 & 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. On the one hand employment is growing by the good prospects for prolonged high economic growth in the years to come, driven by foreign direct investment[5], but employment declines also under the impact of labour productivity gains, the result still is declining employment. Most foreign direct investment projects are in the regional specialisation of food, beverages and tobacco industry as well as the transport vehicle industry.[6]

The Polish region of Slaskie (PL22) is a relatively developed industrial-agricultural region in the South-West of Poland with income per capita above the Polish average. The region is an attractive one for new initiatives: it is highly urbanised, relatively

[5] http://www.factbook.net/countryreports/ro/Ro_InvestmentClimate.htm

[6] http://www.locomonitor.com/index.cfm?page_title=FDI%20By%20Country&child_page=Europe%20%28Developing%29&c=Romania&showClusters=1#a

well endowed with public and private knowledge and proximate to the EU markets. The region is well positioned for a modernisation of the (traditional) heavy 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 and Learning regions

These 40 regions are strong in the factor young learning dynamics and the main components: the variables on life-long-learning, youth and female participation rate. The score on the Public Knowledge factor is above EU regional average. These regions are strong in knowledge creation. When added-up 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.

Employment in the government administration is with an average of 6 % the lowest of all types of regions. GDP per capita is rather high, but GDP growth has (on average) been very weak. Employability 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 and strong science-industry linkages. Besides these science-industry linkages, the main challenging policy options concern: the trend towards more market-oriented R&D in government labs, the promotion of innovative SME's and innovation in service industries. A continued threat is the loss of jobs in manufacturing industries, due to labour cost differentials.

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

The activity rate for women has increased dramatically in Sydsverige (SE04). With 67 percent the female participation rate is now close to the rate for men (75 percent). Better infrastructure, communication technology and increasing car ownership have helped commuter catchment areas to expand, e.g. there is now commuting between Malmö and Copenhagen thanks to the bridge over the Strait of Öresund. The area's shipyard and textile industries have almost totally disappeared. Nowadays, the economy of Malmö is more diversified and the small and middle-sized companies 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 Portrait of the Regions, 2004).

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 is rather low, but the dynamics in ICT is rather high. Unemployment in the province Noord-Holland (NL32) is lower than both the national and European average with only 2 percent of the working population. For the many that belong to an ethnic minority and 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). This type is very strong in Private Technology and has a high level of GDP per capita and labour productivity. The factor Young Learning Dynamics shows a relative weakness, e.g. in life-long learning. Growth in terms of GDP per capita has been the lowest of all of the 10 types and unemployment did not improve much in the previous years. The major challenges for these high-tech regions are 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 more high-tech service based production structure, that can counter off-shoring forces.

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

Cluster 9: Public Services regions

This type of region is characterised by a very low score on Public Knowledge combined with a high score on the factor Government Services. Especially the share of employment in the Public Administration is very high. Unemployment is the most important weakness, 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 indicated by a very low female participation rate. Opportunities for

improvement could therefore be in investments in higher education and in the promotion of female participation, entrepreneurship and an innovation friendly environment. Other opportunities and appropriate policy priorities for these regions include the support to technology transfer and innovation in local SMEs, creation of innovative enterprises, and attracting foreign investment. Upgrading of human resources and innovation in the service industry are main challenges for the Public Services regions.

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

This type of region is mostly located in Italy. Not only southern regions are of this type, but also Lazio (IT6) and Valle d'Aosta (IT12) are Public Services regions. This is 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.

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 the Public Knowledge and the Government Services factor. Population density is extremely high. This type also has the highest GDP per capita and productivity. A weakness is the relatively low presence of high- and medium-high-tech manufacturing and the business R&D expenditures. The dominant sectors in these regions are usually financial 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', but a threat could be their dependence on public resources. Since, a common characteristic of these regions is the high concentration of public R&D expenditure and Higher Education Institutes. Based on the popularity among international students most regions in this group will be able to increase this concentration of human resources, but such a concentration in the public sector could enhance the existing gap between science and industry in the respective regions and even countries.

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

5. 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 in to which each of the 220 regions of the EU27 can 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 at the country level data availability is relatively good, at the regional level data availability is much more limited. Regional data on R&D expenditures and Science & Technology workers are available from EUROSTAT for most of the EU27 regions, but for most countries regional data measuring the innovation process and the impact of innovations are not (yet) available[7]. Future research would benefit from more and better quality indicators at the regional level, starting with regional data from the innovation surveys.

The four factors however, are distributed very unevenly, and especially for the regions with the lowest scores, there could be other indicators that might be more relevant to characterise their potential and identify feasible policy options. The need and relevance of additional data also differs per cluster of regions. Especially the situation in the less innovative, less developed, traditional and peripheral regions is 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 assumption is that either all regions are unique and therefore need their own unique policy, or 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 the theories on regional innovation provides 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

[7] Harmonised regional data were not available from the 3rd Community Innovation Survey, but it is expected that from the 4th CIS regional data for a large number of European countries will become available.

embracing conceptual framework (e.g.: cluster, agglomeration, regional innovation system, learning region, etc.) that absorbs all potential differences, and therefore does not really tell anything. Not only the geographical concepts, but also innovation itself has been described very differently: 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), emphasise 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-industrialisation but also at 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 re-distribution 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 future potential.

The identified factors and the diversity among the clusters could be interpreted as differences in locational preferences in an increasingly footloose society. In this respect we point at the regional difference in the possibilities to attract 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 are more similar to each other; 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 much more risks than improving the within-cluster position of a region.

A broad range of policies emerge from the analysis
Confronting the statistical results (in paragraph 4.2) 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 cosmopolite people. 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 specialisation 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 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 type of regions justifies different innovation policies.

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Appendix 1 Description of Methodology[8]

If X= [x_1,x_2,…x_n] is the collection of variables we distinguish, then Z=[z1,z2,…zn] is the collection of standardised variables. Standardisation of a variable is done by scaling the values by subtracting the mean and dividing the result by the standard deviation. The whole collection of data is reduced to a smaller subset by means of factor analysis[9] in the following way:

Equation 1:

$z_j = \sum_{k=1}^{k=m} l_{jk} f_k + \varepsilon_j$ or for all j=1,2,…n or written in matrix notation: $Z = LF + E$,

Under the assumptions that the f_k are independent normal variables with zero mean and unit variance and each ε_j is independent of all other ε's and all the f_k

The number of factors (m) is determined by the number of eigenvalues of Z that are at least almost one or above. Where Z is the matrix of standardised explanatory variables, L is a matrix of factor loadings and F is a matrix of the unknown factors. Thus Z is linearly related to the factors F by means of a transformation matrix L. The problem of this analysis is to find m in such a way that the number of factors is (much) smaller than the number of variables or in other words to reduce the dimensions of the variables. Furthermore, the usual statistical assumptions are that the diagonal elements of E are independent of each other and of all of the F's. The contribution of factor analysis is that we can express (almost all) the information that is contained in X (which might be a quite large matrix) with the help of a very limited number of F's.

Benchmarks try to capture a target variable. In this chapter we propose to use the factors that remain in a dynamic factor model representation to capture the target variables: GDP per capita and unemployment. The Lisbon strategy and the current and new cohesion policy target these two variables.

Equation 2 Regression equation for target variable

$t = \sum_{i=1}^{m} \alpha_i F_i + \eta_i$, with m determined by the eigenvalue rule in equation 1 and t the target variable.

This equation connects the factors with the ultimate policy target. The basic idea behind the model (equation 2) is that if Z is thought to be the relevant measure of factors that are related to the capacity to innovate, to develop and to grow, then we can limit the analysis to the factors (F) derived from equation 1. We can use these factors to explain the current value of the target variable in a region and come up with

[8] This appendix draws very much upon Kendall et al. (1983), in particular par. 43.28 Factor Analysis, par. 44.44 Cluster Analysis and par 44.50 Multidimensional Scaling.

[9] Using the SPSS 14.0. version of factor analysis based on principal components analysis with equamax rotation in order to arrive at a minimum number of factors and variables within these factors. The factors scores have been calculated by regression and might be correlated despite orthogonality of the factors.

possibilities to move the target in the desired direction by adjusting the F's. Obvious target variables are growth (i.e growth of gross regional product per capita) and jobs (i.e. a diminishing rate of unemployment). Convergence can be measured by the parameter β in equation 2.

Our main hypothesis is that with the use of benchmarks it is not desirable to focus on one aspect or one dimension, e.g. innovation or knowledge. Therefore we use the factors F in a multi dimensional scaling to reveal dissimilarities. These dissimilarities can be derived from:

Equation 3 Dissimilarities based on the factors

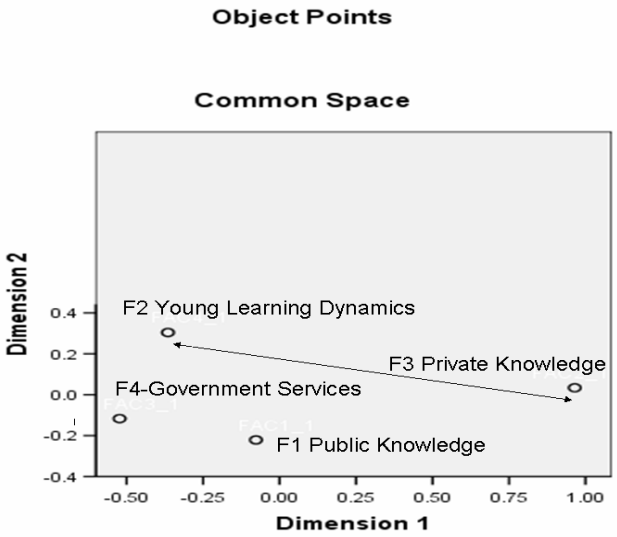
$$D = F^{'}F = (L^{-1}Z + L^{-1}E)^{'}(L^{-1}Z + L^{-1}E)$$

Taking expectations we derive $D = Z^{'}(L^{-1})^{'}L^{-1}Z$

In multidimensional scaling the aim is to construct an Euclidian t- dimensional space, which adequately reflects the magnitudes of elements in D. Proximities are defined as the distances between entities i and j in this t-dimensional space while the coordinates are selected to minimize the following expression for all i not equal to j:

$$\sum\sum(d_{ij} - \beta\delta_{ij})^2$$

From our data the largest of the three proximities δ_{ij} is δ_{23} and this one is exhibited as the length of the shortest line between dots F2 and F3 in the figure below, its length actually is 1.35. Dimension 1 is thus largely determined by F3- Private Knowledge and Dimension 2 mainly by F2- Young Learning Dynamics. The other factors in the figure are projected in the figure but determine on their turn the third and fourth dimensions. The position of these two forces in the graph is close to the origin because the four forces are orthogonal to each other, but their significance is less than the dimensions drawn in the graph.



Based on these proximities and the four factors not more than $\binom{4}{2}$ =12 clusters can be found, by construction this ensures that all distances between pairs of entities in the group are less than this maximum. The dissimilarity between two clusters C_a and C_b is:

$$W = \sum_{i \in C_a} \sum_{i \in C_b} z_i z_j \delta_{ij} / \sum \sum z_i z_j$$

Hierarchical clustering[10] yielded 10 clusters that delivers a reasonable good dispersion of the cases (=regions) over the clusters.

[10] Using SPSS 14.0 Hierarchical clustering using between groups Euclidean distance as a measure.

Appendix 2: Ten clusters of EU regions, membership organised by performance in terms of growth and unemployment

	Above EU25 GDP growth, below EU25 unemployment rate	Above EU25 GDP growth, above EU25 unemployment rate	Below EU25 GDP growth, below EU25 unemployment rate	Below EU25 GDP growth, above EU25 unemployment rate
#1	Tirol (AT33)	Illes Balears (ES53)	Algarve (PT15), Voreio Aigaio (EL41), Kriti (EL43), Dél-Alföld (HU33)	Castilla-la Mancha (ES42), Comunidad Valenciana (ES52), Andalucía (ES61), Región de Murcia (ES62), Kentriki Makedonia (EL12), Dytiki Makedonia (EL13), Dytiki Ellada (EL23), Estonia (EE), Extremadura (ES43), Anatoliki Makedonia, Thraki (EL11), Thessalia (EL14), Ipeiros (EL21), Ionia Nisia (EL22), Lithuania (LT), Latvia (LV), Lódzkie (PL11), Malopolskie (PL21), Swietokrzyskie (PL33), Podlaskie (PL34), Wielkopolskie (PL41), Warminsko-Mazurskie (PL62), Yugoiztochen (BG06), Severoiztochen (BG03), Lubelskie (PL31)
#2	Lisboa (PT17), Bratislavský (SK01)		Attiki (EL3), Limousin (FR63)	Mazowieckie (PL12), Languedoc-Roussillon (FR81)
#3	Kärnten (AT21), Centre (FR24), Bourgogne (FR26), Alsace (FR42), Rhône-Alpes (FR71), Vlaams Gewest (BE2), Kassel (DE73), Detmold (DEA4)	Champagne-Ardenne (FR21), Aquitaine (FR61)	Bretagne (FR52), Auvergne (FR72), Burgenland (AT11), Malta (MT), Picardie (FR22), Basse-Normandie (FR25), Lorraine (FR41), Poitou-Charentes (FR53), Abruzzo (IT71), Niederösterreich (AT12), Lüneburg (DE93), Weser-Ems (DE94), Münster (DEA3), Koblenz (DEB1), Trier (DEB2), Schleswig-Holstein (DEF), Dél-Dunántúl (HU23), Észak-Alföld (HU32), Alentejo (PT18)	Nord - Pas-De-Calais (FR3), Molise (IT72), Basilicata (IT92), Severozapaden (BG01), Észak-Magyarország (HU31), Podkarpackie (PL32), Zachodniopomorskie (PL42), Lubuskie (PL43), Dolnoslaskie (PL51), Kujawsko-Pomorskie (PL61), Pomorskie (PL63), Stredné Slovensko (SK03), Východné Slovensko (SK04), Opolskie (PL52)
#4	Comunidad Foral de Navarra (ES22), La Rioja (ES23), Aragón (ES24), Comunidad De Madrid (ES3), Steiermark (AT22), Piemonte (IT11), Liguria (IT13), Lombardia (IT2), Veneto (IT32), Friuli-Venezia Giulia (IT33), Emilia-Romagna (IT4), Toscana (IT51), Umbria (IT52), Marche (IT53), Hannover (DE92), Düsseldorf (DEA1), Saarland (DEC)	País Vasco (ES21), Cataluña (ES51), Bremen (DE5)	Közép-Magyarország (HU1), Slovenia (SI), Gießen (DE72), Bucuresti (RO08)	Galicia (ES11), Principado de Asturias (ES12), Cantabria (ES13), Castilla y León (ES41), Magdeburg (DEE3), Brandenburg (DE4), Mecklenburg-Vorpommern (DE8), Arnsberg (DEA5), Chemnitz (DED1), Dresden (DED2), Leipzig (DED3), Halle (DEE2), Thüringen (DEG), Severen Tsentralen (BG02), Yugozapaden (BG04), Dessau (DEE1)
#5	Oberösterreich (AT31), Freiburg (DE13), Niederbayern (DE22), Oberpfalz (DE23), Oberfranken (DE24), Mittelfranken (DE25), Unterfranken (DE26), Schwaben (DE27), Rheinhessen-Pfalz (DEB3)	Haute-Normandie (FR23)	Franche-Comté (FR43), Közép-Dunántúl (HU21), Nyugat-Dunántúl (HU22), Strední Cechy (CZ02), Jihozápad (CZ03), Severovýchod (CZ05), Jihovýchod (CZ06), Strední Morava (CZ07)	Západné Slovensko (SK02), Severozápad (CZ04), Moravskoslezko (CZ08)
#6		Sterea Ellada (EL24)	Peloponnisos (EL25), Vest (RO05), Nord-Vest (RO06), Centro (P) (PT16), Sud (RO03), Centru (RO07), Nord-Est (RO01), Norte (PT11), Sud-Est (RO02), Sud-Vest (RO04)	Yuzhen Tsentralen (BG05), Slaskie (PL22)
#7	Pays de la Loire (FR51), Southern and Eastern (IE02), Utrecht (NL31), Noord-Holland (NL32), Zuid-Holland (NL33), Noord-Brabant (NL41), Limburg (NL) (NL42), North West (UKD), Yorkshire & The Humber (UKE), West Midlands (UKG), Eastern (UKH), South West (UKK), Scotland (UKM), South East (UKJ), Salzburg (AT32), Denmark (DK), Groningen (NL11), Friesland (NL12), Overijssel (NL21), Gelderland (NL22), Sydsverige (SE04), Mellersta Norrland (SE07), Småland med öarna (SE09), Västsverige (SE0A), East Midlands (UKF), Vorarlberg (AT34), Zeeland (NL34)	Etelä-Suomi (FI18)	Border, Midland and Western (IE01), Flevoland (NL23), North East (UKC), Pohjois-Suomi (FI1a), Cyprus (CY), Östra Mellansverige (SE02), Norra Mellansverige (SE06), Övre Norrland (SE08) Wales (UKL), Drenthe (NL13)	Länsi-Suomi (FI19), Itä-Suomi (FI13)
#8	Île De France (FR1), Stuttgart (DE11), Karlsruhe (DE12), Tübingen (DE14), Oberbayern (DE21), Darmstadt (DE71), Köln (DEA2)	Braunschweig (DE91)	Midi-Pyrénées (FR62)	
#9	Valle d'Aosta (IT12), Lazio (IT6)	Provence-Alpes-Côte d'Azur (FR82)	Northern Ireland (UKN)	Notio Aigaio (EL42), Région Wallonne (BE3), Campania (IT80), Puglia (IT91), Sicilia (ITA), Sardegna (ITB), Calabria (IT93)
#10	Stockholm (SE01), London (UKI), Praha (CZ01) Wien (AT13)	Bruxelles/Brussels (BE1), Hamburg (DE6)		Berlin (DE3)

Appendix 3: The clusters and their average scores on the variables

CLUSTER	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
POPULATION	1639105	2572646	1866874	2237992	1414623	2575698	2406389	4010545	2153808	2575458
GDP	19960903	46859101	33270675	49136825	25387209	20512163	56771456	122810302	40543513	91189290
GDP PER CAPITA 1996	8916	13726	12864	15656	14178	6966	17377	22284	14795	27545
GDP PER CAPITA 2002	12769	19930	16470	20369	17527	9194	23198	27921	19153	36055
GDP PER CAPITA GROWTH	6.21	6.46	4.51	4.76	3.71	5.16	4.93	3.81	4.55	4.56
UNEMPLOYMENT 1996	13.7	10.9	11.9	11.7	7.1	7.8	7.6	7.3	15.1	9.5
UNEMPLOYMENT 2003	13.2	10.0	11.0	10.1	7.6	8.3	5.2	7.1	13.3	9.6
UNEMPLOYMENT CHANGE	-0.05	0.05	0.07	0.14	-0.07	-0.08	0.28	-0.02	0.03	-0.18
PRODUCTIVITY	2226	3398	3625	4303	3270	1203	4938	6249	4895	7615
KNOWLEDGE_WORKERS	8.7	12.9	9.0	11.4	8.8	6.0	14.2	15.1	8.1	17.2
VALUE ADDED AGRICULTURE	8.1	2.2	4.5	2.8	3.0	12.1	2.9	1.0	3.5	0.1
F-1										
HIGH-TECH SERVICES	1.5	4.1	2.5	2.8	2.6	1.2	3.6	4.5	2.6	5.9
HIGHER EDUCATION	16.2	21.2	15.7	21.9	15.0	9.6	24.6	25.7	13.9	29.5
PUBLIC R&D	0.39	0.82	0.32	0.64	0.29	0.13	0.53	1.09	0.54	0.94
POPULATION DENSITY	79	440	150	270	144	105	242	387	171	3315
F-2										
LIFELONG LEARNING	3.8	6.0	5.4	5.0	5.2	1.7	16.6	6.6	4.9	12.9
YOUTH	10.5	10.0	11.2	8.1	10.6	10.2	12.3	10.8	11.1	10.5
FEMALE ACTIVITY RATE	42.9	49.0	45.4	44.6	50.3	46.6	55.0	50.5	36.4	53.9
F-3										
HIGH-TECH MANUFACTURING	2.4	4.0	6.8	7.7	12.0	4.6	5.9	13.4	3.4	4.3
BUSINESS R&D	0.15	0.34	0.54	0.65	1.10	0.24	1.29	3.07	0.49	1.56
S&T WORKERS	13.5	21.8	18.2	20.0	21.1	11.1	23.9	27.6	16.4	30.2
F-4										
VALUE ADDED INDUSTRY	23.9	21.7	29.6	29.7	40.1	37.6	29.2	29.7	19.1	15.8
VALUE ADDED SERVICES	67.9	76.1	65.9	67.5	56.9	50.3	67.2	69.3	77.2	82.6
GOVERNMENT EMPLOYMENT	6.5	8.9	8.7	7.5	7.0	4.6	6.2	8.2	13.4	7.9
F-1 PUBLIC KNOWLEDGE	-0.096	0.854	-0.708	0.713	-0.783	-0.705	0.204	0.501	-0.891	3.201
F-2 YOUNG LEARNING DYNAMICS	-0.274	-0.075	0.035	-1.056	-0.221	-0.581	1.514	-0.033	-0.256	0.593
F-3 PRIVATE KNOWLEDGE	-1.290	-0.364	-0.011	0.343	1.202	-0.757	-0.036	2.308	-0.330	-0.496
F-4 GOVERNMENT SERVICES	-0.119	0.749	0.453	-0.230	-0.607	-1.613	-0.348	0.655	2.597	0.282