Muller, Emmanuel; Jappe-Heinze, Arlette; Héraud, Jean-Alain; Zenker, Andrea

Working Paper

A regional typology of innovation capacities in new member States & candidate countries

Arbeitspapiere Unternehmen und Region, No. R1/2006

Provided in cooperation with:
Fraunhofer-Institut für System- und Innovationsforschung (ISI)

Fraunhofer Institute Systems and Innovation Research

Working Papers Firms and Region
No. R1/2006

A regional typology of innovation capacities in New Member States & Candidate Countries

Emmanuel Muller[*+]
Arlette Jappe[*]
Jean-Alain Héraud[✧]
Andrea Zenker[*]

[*] Fraunhofer ISI Karlsruhe
[+] University of Applied Sciences, Heidelberg
[✧] Université Louis Pasteur, Strasbourg I

ISSN 1438-9843

Contact:

Fraunhofer Institute for Systems
and Innovation Research (Fraunhofer ISI)
Department "Regions and Market Dynamics"
Breslauer Strasse 48
D-76139 Karlsruhe

Telephone:	+49 /721 /6809-138
Telefax:	+49 /721 /6809-176
e-mail:	c.schaedel@isi.fraunhofer.de
URL:	www.isi.fraunhofer.de/r/departm.htm

Karlsruhe 2006
ISSN 1438-9843

Contents

Page

1. Introduction: why a regional typology of innovation capacities in NMS & CC? ... 1

2. Measuring regional innovation capacity ... 2

3. Establishing the typology ... 6

4. The five types of regions ... 11

5. Conclusion: possible futures and policy implications ... 16

References ... 20

Appendix: List of the 55 regions ... 22

Tables

Table 1: The individual variables ... 5
Table 2: Model CATPCA ... 7
Table 3: Component loadings ... 7
Table 4: Total variance explained ... 8
Table 5: Component loadings on three main factors ... 9

Figures

Figure 1: Regional innovation capacity – a conceptual framework ... 3
Figure 2: Synthetic variable "knowledge creation " ... 6
Figure 3: The 38 remaining regions plotted on factors 2 and 3 ... 10
Figure 4: Schematic representation of the five groups of regions ... 12
Figure 5: The five types of regions ... 15

1. Introduction: why a regional typology of innovation capacities in NMS & CC?

Considering New Member States and Candidate Countries (in short NMS and CC) from a regional perspective[1], one can only be impressed by the huge heterogeneity of the regions under scope. This heterogeneity does not only result from diversity at national level but also – and this is one of the hypotheses of this paper – reflects some clear differences in terms of local situations. This seems particularly true when considering innovation capacities, and it is one of the reasons why it seems important to introduce a sub-national level in the analysis.

Three main reasons plead in favour of a regional typology of innovation capacities in NMS & CC. First of all, only few analyses investigated so far the emergence of regional innovation systems (RIS in the meaning given for instance by Cooke 1998) in the considered countries. Until now the detection of (well-functioning) RIS in NMS & CC was the object of only a very limited amount of investigations by comparison to regions belonging to EU 15. As a consequence, establishing such a typology could constitute a first step towards the identification of RIS in NMS & CC.

The second reason is more directly linked to the innovation policy agenda, since the issue of regional capacities in NMS & CC is clearly interrelated with the question of the possible (future) contributions of those regions to the European Research Area (ERA). More generally regions and regional systems are at the core of the reflections and debates dealing with the definition of innovation-related policy priorities, the question of multi level governance and the issue of a possible convergence at European level. In other words, such a typology may help at detecting some regional dynamics and at the same at identifying the ones which should be particularly encouraged in NMS and CC in the framework of the ERA.

Finally and as a third reason, this analysis provides an opportunity to pursue the methodological work done so far dealing with innovation and types of regions. Considering regional typologies related to innovation such as i) the typology of Clarysse/Muldur (2001) used in the production of the second European report on S&T indicators, ii) the typology of regions developed by PWC Consulting and Tsagaris Consult (2002) con-

1 In the frame of this paper, the two following Candidate Countries: Bulgaria and Romania are under scope in addition to the ten New Member States. The ideas developed in this paper are originally based on a project corresponding to a call of tender by the DG research entitled: "Enlarging the European Research Area: identifying priorities for regional policy focusing on Research and Technological Development in the Candidate Countries". The authors wish to thank Mr. David Uhlíř who was the Scientific Officer in charge of the project on the side of the European Commission for his support. The project associated contributors from Fraunhofer ISI, MERIT, Université Louis Pasteur, Strasbourg I, University College London and Technopolis Belgium. The detailed results are documented in Muller/Nauwelaers (2005).

sult for DG Research, and iii) the typology of regional innovation needs by Muller et al. (2001) (on behalf of the DG research) different challenges can be identified when trying to extend the scope of typologies beyond EU-15 regions[2]. In particular, one can distinguish between three types of challenges: the measurability of the observed phenomena, the availability of data and the morphological work leading to the formation of groups.

The next section depicts the process leasing at the measurement of the different dimensions constituting the regional innovation capacity. In particular, it makes the link between the conceptual framework adopted for the analysis and the variables selected in order to allow the typology process. The third section is devoted to the establishment of the typology resulting from a principal components analysis based on two successive steps. The outcome of this process, i.e. the five types of regions which are identified, is displayed and discussed in the fourth section. Finally, the last section of the paper attempts at concluding the analysis in portraying possible futures of these groups of regions regarding the way they may integrate themselves in the (enlarged) European Research Area.

2. Measuring regional innovation capacity

The approach adopted in the analysis aims at integrating the different components of innovation capacity at regional level. In other words, in this paper an innovation system perspective is deliberately chosen which corresponds mainly to the evolutionary vision of innovation activities in the continuation of works by authors such as Nelson/Winter (1974), Freeman (1982) or Lundvall (1988) for instance.

As a result, the socio-economic development of a (national or regional) territory is seen as driven - at least partly - by its innovation capacity. However, in this approach, innovation capacity should not be reduced to R&D investments and related activities only but should be understood also as depending on (i) the capability to absorb and (ii) to diffuse knew knowledge and on (iii) the demand for its generation and utilisation. Expressed differently this means that even if R&D activities sometimes constitute the core of innovation processes, the understanding of innovation capabilities –in particular when adopting a regional perspective – should not be reduced to the sole examination of R&D expenses or more generally to the isolated observation of knowledge generation.

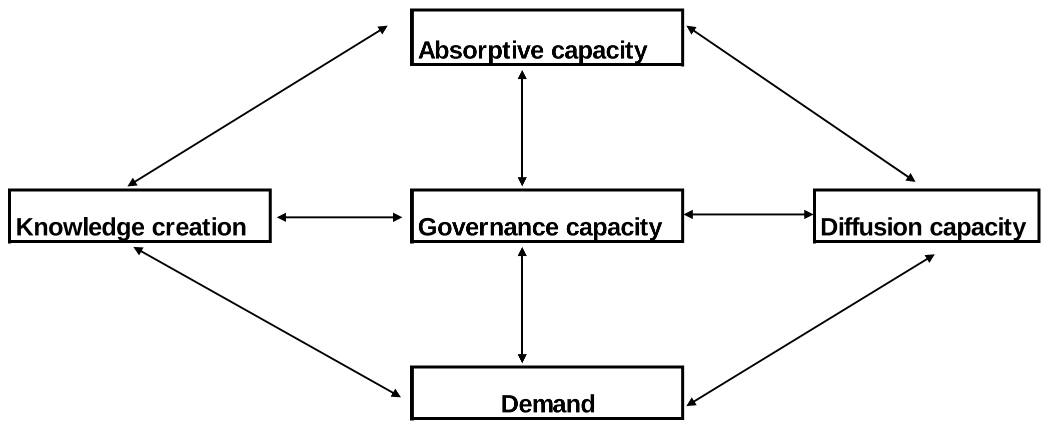
2 For a more detailed overview of regional innovation related typologies see Muller/Nauwelaers (2005: 34-35 and 159-165).

Consequently, the analysis relies on a theoretical basis initially developed at European level by Radosevic (2004). Its further elaboration and application at regional level for NMS and CC allows the establishment of a multi-dimensional innovation capacity framework along following five dimensions (cf. Muller/Nauwelaers 2005: 31-34):

- knowledge creation,
- absorptive capacity,
- diffusion capacity,
- demand,
- and governance capacity.

In figure 1 the five dimensions of the innovation capacity conceptual framework are displayed. In line with the systemic approach adopted, all individual elements of the framework appear as interrelated and consequently the overall regional innovation capacity results from their aggregation.

Figure 1: Regional innovation capacity – a conceptual framework



NUTS2 level has proven to be the meaningful levels for regional policy analysis in the area of RTD in the EU15 (cf. Muller/Nauwelaers 2005: 35-36) and has been chosen as of reference of the analysis. Consequently 55 NUTS2 ″regions″ (some of them being countries) are examined (the detailed list of the NUTS2 regions is displayed in the appendix).

One of the main challenges faced for the development of the typology was the constitution of a data base containing relevant indicators and covering these 55 NUTS2 regions. The analysis is based on an original set of variables resulting from an intense data search and drawing on a collection of data from a variety of sources (cf. Muller/Nauwelaers 2005: 37-38 and 167-168; the different individual variables are displayed along the five dimensions in table 1).

The capacity of knowledge creation is important not only to generate new knowledge but also as a mechanism to absorb it (Cohen/Levinthal 1990). This is a crucial component of innovation capacity which could be (at least partially) described in the frame of this investigation with indicators such as: R&D expenditures and employees, the concentration of patent inventors or the concentration of publications in the fields of biosciences and nanotechnology.

Absorptive capacity is the ability to absorb new knowledge and to adapt imported technologies (Cohen/Levinthal 1989). Indicators such as the level of education of the population, the performance of life long learning (LLL) activities as well as the degree of achievement of the "e-society"(to be understand as the propensity of internet use by the population) help measuring absorptive capacities at regional level.

Diffusion is the key mechanism for benefiting from investment in R&D and for increasing absorptive capacities. This component of innovation capacity depends particularly from the existence and strength of networks-based relations as well as from the activity of Knowledge-Intensive Business Services (KIBS) (Muller/Zenker 2001). This dimension is approached – at regional level - with the help of some selected indicators: infrastructure devoted to technology diffusion, employment structure (share corresponding to manufacturing industries vs. agriculture), high-tech services and the use of internet by firms (as a proxy).

Demand for innovation is the key economic mechanism that initiates wealth generation processes in R&D, absorption and diffusion activities. The economic relevance of innovation will depend on the extent to which new products, processes and services have been diffused throughout the economy. Socio-economic factors support the (indirect) assessment of the level of demand for innovation at regional scale: level of GDP/capita and cumulated growth, unemployment rate, population density and its evolution.

Successful regional innovation systems are characterised by good coordination between these four components. In particular, each of the four components is driven by governance regimes that operate at different levels – local, regional, national, supranational or global. Hence, it is necessary to bring in governance capacity or capacity to coordinate four dimensions of innovation capacity so that they generate complementarities and synergies. The governance capacity is extremely difficult to measure at regional level (as well as national level). Nevertheless indicators such as the participation of regions to EU initiatives, the degree of achievement of e-government tasks as well the type of (regional) web presence give indications and are used as proxies in this matter.

Table 1: The individual variables

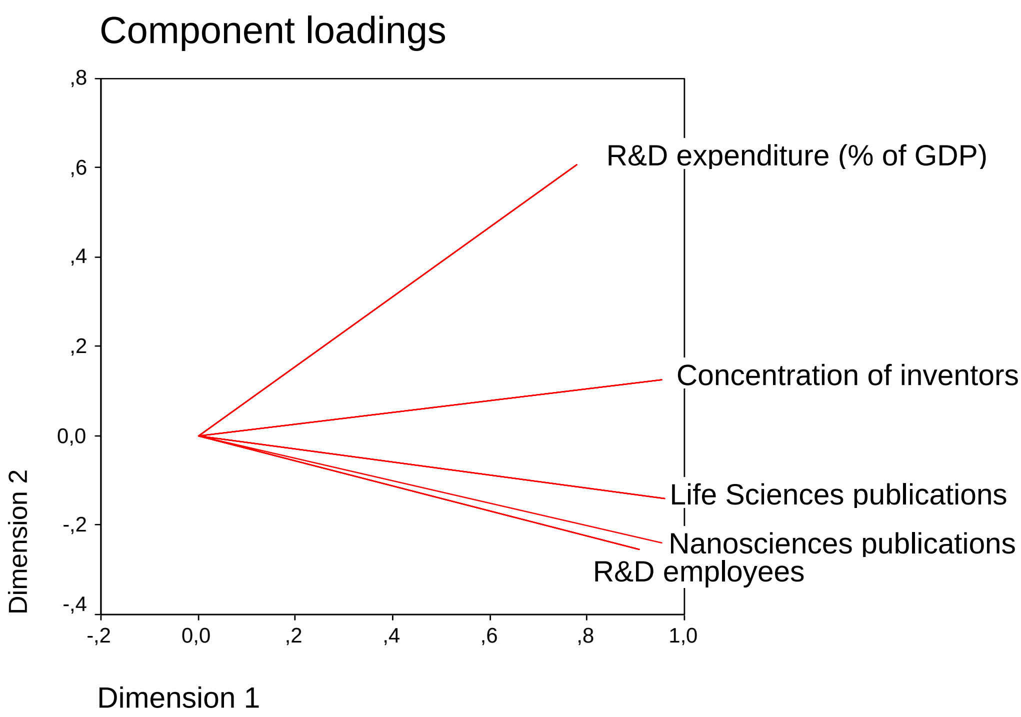
Variables	Year	Type	Source
1 Knowledge creation			
R&D expenditures (% of GDP)	2001	metric	New cronos regio database
R&D employees (fte per 1000 empl)	2001	metric	New cronos regio database
Concentration of patent inventors	2001	ordinal	PATDPA; Fraunhofer ISI
Concentration of publications in biosciences	1996-2001	ordinal	SCI; Fraunhofer ISI/CWTS
Concentration of publications in nanotechnology	1996-2001	ordinal	SCI; Fraunhofer ISI/CWTS
2 Absorptive capacity			
R&D expenditures by firms BERD (% of GDP)	2001	metric	New cronos regio database
R&D expenditures for higher education HERD (% of GDP)	2001	metric	New cronos regio database
Population with tertiary education (% of 25-64 age class)	2002	metric	New cronos regio database
Population with secondary education (% of 25-64 age class)	2002	metric	New cronos regio database
Population with secondary and tertiary education (sum in % of 25-64 age class)	2002	metric	New cronos regio database
Population with lifelong learning (% of 25-64 age class)	2002	metric	New cronos regio database
Information society: population (% of households using www)	2003	metric	eEurope + database ; Fraunhofer ISI
3 Diffusion capacity			
Technology diffusion infrastructure	2004	ordinal	Document search, MERIT
Employment in high-tech services (%)	2002	metric	New cronos regio database
Employment in manufacturing industries (%)	2001	metric	New cronos regio database
Employment in agriculture (%)	2001	metric	New cronos regio database
Information society: enterprises (% of firms using e-banking)	2003	metric	eEurope + database ; Fraunhofer ISI
4 Demand			
GDP in Euro per capita	2001	metric	New cronos regio database
Cumulated growth of GDP	1995-2001	metric	New cronos regio database
Unemployment rate (%)	2003	metric	New cronos regio database

Variables	Year	Type	Source
Population density (persons/square km)	2001	metric	New cronos regio database;
Change in population density	1995-2001	metric	New cronos regio database;
5 Governance capacity			
Participation to EU initiatives	2004	ordinal	Document search, MERIT
E-Government (% of firms using e-administration)	2003	metric	eEurope + database ; Fraunhofer ISI
Web-presence of regions (availability of website)	2004	ordinal	Internet search; Fraunhofer ISI

3. Establishing the typology

The typology results from a principal components analysis which has been employed in two successive steps. In a first step, regions are categorized according to their potential in terms of knowledge creation. To this goal, a synthetic factor "*knowledge creation*" has been constructed that integrates the following five original variables: *R&D expenditure*, *R&D personnel*, *concentration of inventors*, *bioscience publications*, *and nanotechnology publications*.

Figure 2: Synthetic variable "knowledge creation "



Because three out of five original indicators are ordinal measures, a variant of principal components analysis had to be used that can be applied to ordinal data (this procedure is called CATPCA in SPSS 11.0). The result of the CATPCA-procedure is a new metric variable (cf. figure 2). Since all five indicators show very strong inter-correlations, a high level of the original variance (83.3 %) is maintained by the synthetic variable "knowledge-based potential " (dimension 1 in table 2).

Table 2: Model CATPCA

	Cronbachs Alpha*	variance explained	
Dimension		total (eigenvalue)	% of variance
1	,950	4,165	83,3
2	-1,123	,527	10,5
total	,984	4,691	93,8

* The sum of Cronbachs Alpha is based on the sum of eigenvalues.

In order to differentiate between groups, two cut criteria are defined on the resulting dimension, which allows for the following divisions:

- regions with "knowledge creation" equal or above 1 are regarded as regions with strong capacities;
- regions with "knowledge creation" above -0.3 are defined as "moderate";
- regions with values equal or below -0.3 are considered as showing low capacity on this dimension .

Although the capacity for innovation cannot simply be equated with the potential to create new knowledge, other innovation related indicators show moderate to strong correlations with this synthetic measure so that it seems adequate to place superior weight on "knowledge creation" in defining typological distinctions (cf. table 3). Seven regions belong to this "upper" group (this group, which will be called A-group (or "capital regions") will be described in more detail in the following sections)

Table 3: Component loadings

	Dimension	
	1	2
R&D expenditure (% of GDP)	,778	,607
R&D employees (fte per 1000 empl)	,907	-,254
Concentration of patent inventors	,952	,127
Concentration of publications in biosciences	,958	-,139
Concentration of publications in nanotechnology	,954	-,241

In contrast, the "lower" end of the typology is defined as a group of 10 regions with low "knowledge creation" values (< -0.3) and a high proportion of employment in agriculture (> 30 %). Ten regions belong to this "lower" group (this group of regions, which will be called E-group (or "lagging-behind agricultural regions") will be described in more detail in the following sections.).

After the identification of the two groups at the opposite extremes of the typology, 38 regions remain, 19 of which have moderate and 9 have low knowledge creation capacity. In order to further differentiate among those remaining regions, in a second step a principal components analysis has been conducted using a set of twenty-one variables, including the synthetic measure "knowledge creation ". From this analysis, six factors emerge the first three of which can be used – due to their relative weight - to distinguish the remaining regions. The first factor is called "innovation potential", the second "level of general education" and the third factor "economic dynamics and structure". Together, all three factors account for 54,2 % of the variance on the twenty-one dimensions, considering the 38 remaining regions (table 4).

Table 4: Total variance explained

	rotated sum of square loadings		
component	total	% of variance	cumulated %
1 Innovation potential	5,081	24,197	24,197
2 General education	3,782	18,007	42,204
3 Economic dynamics and structure	2,517	11,986	54,190

Table 5 shows the original variables that have the strongest component loadings on each factor (only component loadings > +/- 0.40 are indicated). The variable "innovation potential" represents many elements apart from "knowledge creation" (which has a very high loading on this variable), the highest loadings among them are carried by: *GDP/capita, employment in high-tech services, internet use by households, HERD as % of GDP, population with lifelong learning, and population with secondary or tertiary education (sum).*

It is necessary to notice that gross expenditure on R&D (GERD) is composed of BERD (business expenditure on R&D), HERD (higher education expenditure on R&D), GOVERD (government expenditure on R&D) and PNP (private non-profit expenditure on R&D). The variation of the aggregated measure across regions is not identical with the variation of partial measures. This means, although the variable "R&D as % of GDP" is part of the synthetic indicator "knowledge creation", the inclusion of the two variables BE R&D as % of GDP and HE R&D as % of GDP does not represent an autocorrelation or redundancy.

In contrast, the variable "level of general education" represents *population with secondary education* as the highest level of formal education. This variable shows a moderate negative correlation with tertiary education as the highest level of formal education ("general" as opposed to "university" education). Moderate correlations exist with *employment in manufacturing* and *E-banking use by firms*. Finally, the variable "economic dynamics and structure" distinguishes between, on the one hand, regions that have a high proportion of *employment in manufacturing industries* and on the other hand regions that are characterised by strong *GDP growth*. *Employment in agriculture* and the *level of unemployment* also load positively on this factor.

Table 5: Component loadings on three main factors[3]

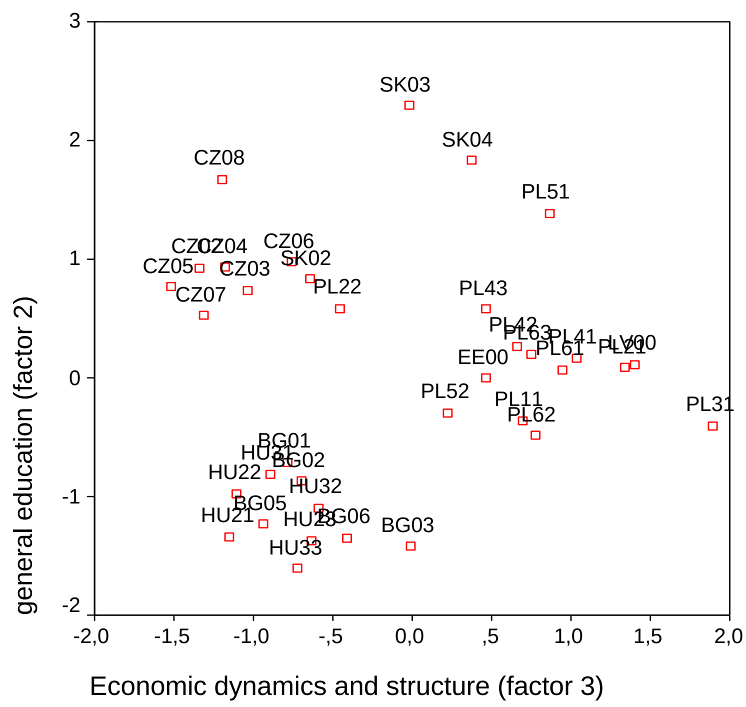
	innovation potential	**general education**	**economic dynamics & structure**
	1	2	3
Knowledge creation (synthetic variable)	,801		
HERD (% of GDP)	,724	-,535	
BERD (% of GDP)	,427		
Employment in high-tech services (%)	,807		
Employment in manufacturing industries (%)		,554	-,713
Employment in agriculture (%)			,758
Population with tertiary education (%)	,421	-,837	
Population with secondary education (%)		,903	
Population with secondary or tertiary education (sum) (%)	,696	,455	
Population with lifelong learning (%)	,717		
IS_population (%)	,788		
IS_enterprises (%)	,547	,654	
E-government s (%)	,533		

3 Considering the total sample of 55 regions, 11 regions had to be excluded from this PCA because of missing values on one or several of the 21 dimensions: Kypros, Malta, Lietuva, and the eight Romanian regions. However, these exclusions do not significantly impair the power of the analysis to differentiate among the middle range regions, because seven of the Romanian regions belong to the agrarian group E, whereas Kypros and Malta must be considered as special cases due to the heavy weight of tourism in their regional economies. Methodologically, the exclusion of cases with missing data is to be preferred over an estimation of missing values for cases where reliable information is lacking.

	innovation potential	general education	economic dynamics & structure
GDP in Euro per capita	,872		
Cumulated growth of GDP			,765
Unemployment rate (%)	-,443		,567
Population density (persons/km^2)	,656		
Change in population density		,631	
Participation to EU initiatives	,448	,411	
Web presence of regions (availability of web site)			
Technology diffusion infrastructure	,654	-,429	

Plotting the remaining middle range regions on the second and third factor (3), three different groups of regions are readily apparent. On the upper left part a group can be identified encompassing regions which are characterised by "level of general education" > 0.5 and "economic dynamics and structure" below 0 (above average employment in manufacturing industries). Regions grouped on the right display intermediate values of "general education" and "economic dynamics and structure" above 0, (below average employment in manufacturing industries). At the lower left pole, there is a group with "general education" < -0.7 and economic structure equal or below 0.

Figure 3: The 38 remaining regions plotted on factors 2 and 3



In sum, the typology emphasizes different patterns that emerge from the available data, allowing several dimensions to be combined. Firstly, the dominant criterion is the synthetic factor "knowledge creation", which is used to distinguish three levels. Secondly, the lower end of the typology is defined by a low level of knowledge-related potential and a proportion of employment in agriculture that is very high by European standards. Thirdly, the definition of the three remaining groups combines the dimension "knowledge creation" (moderate and low level) with the factors "general education" and "economic dynamics and structure". As a result five types of regions can be distinguished: the A and E groups (respectively 7 and 10 elements) in the first step and the B, C and D groups (respectively 9, 10 and 19 elements) in the second step (these five types of regions will be described more in details in the following sections).
As an overall result, the set of regions under scope is best differentiated by the three following factors:

- innovation potential (strongly determined by knowledge creation),
- level of general education, and
- economic dynamics and structure.

It is important to stress that five dimensions of the conceptual model were used for structuring the data collection in the heuristic approach adopted in the investigation. The principal component analysis shows that three independent factors capture most of the variation and suffice to create meaningful groups among the set of regions. This result is plausible as one would expect that the original dimensions of knowledge creation, absorptive capacity and diffusion capacity are not independent dimensions but have at least moderate correlations.

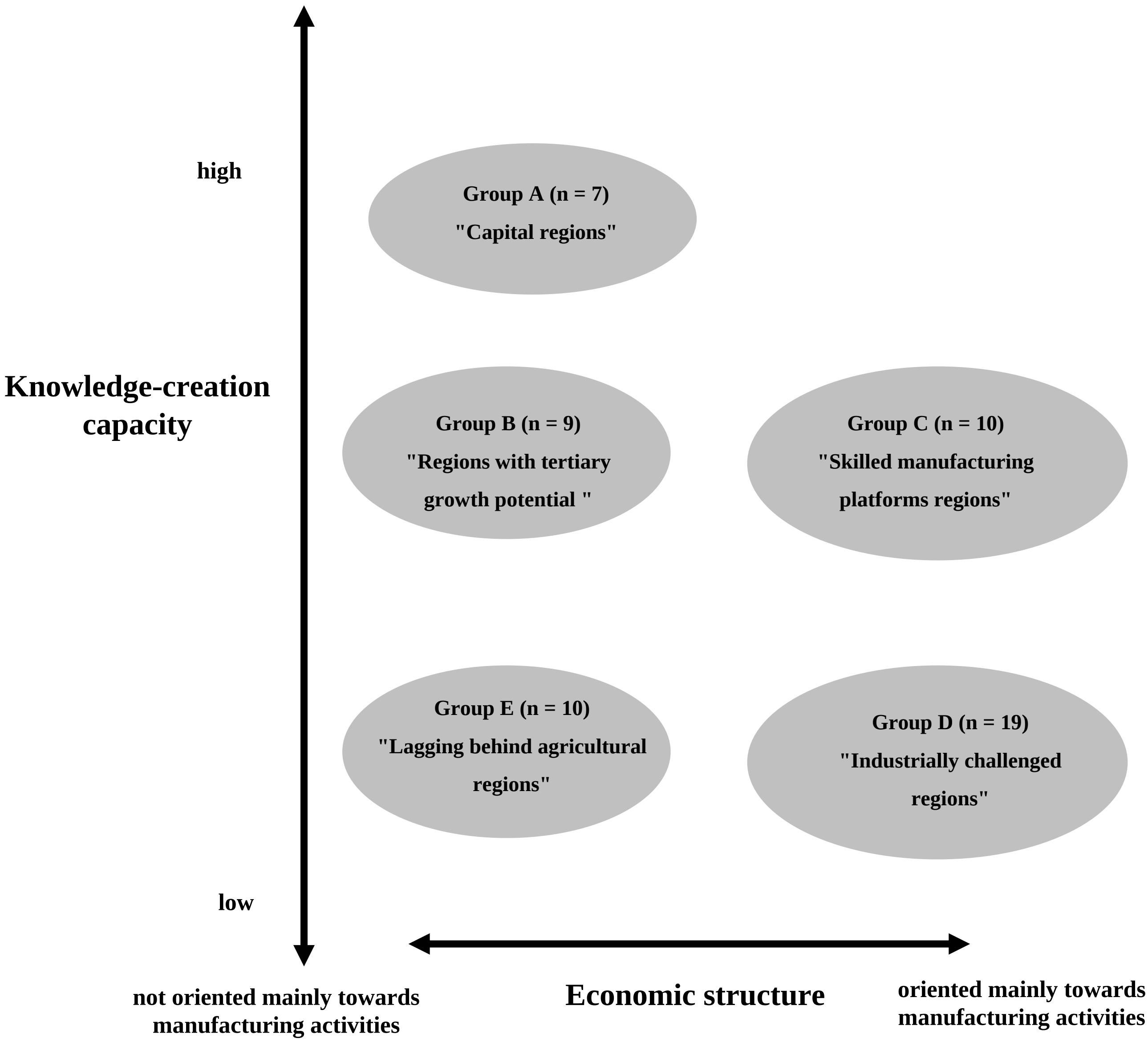
4. The five types of regions

Five different types of regions result from this statistical analysis, each group gaining a specific appellation (cf. Muller/Nauwelaers 2005: 46-51):

- capital regions (group A),
- regions with tertiary growth potential (group B),
- skilled manufacturing platforms regions (group C),
- industrially challenged regions (group D), and
- lagging-behind agricultural regions (group E)

A schematic representation (see figure 4) allows typifying the dominant characteristics of the regional innovation systems identified in terms of position along two main dimensions: the capacity in terms of knowledge creation and the type of economic structure.

Figure 4: Schematic representation of the five groups of regions



The "capital regions" or regions clustered in the A-group concentrate the best potential amongst NMS and CC for a coherent development within EU. Consequently these regions could typically constitute elements of the future knowledge-based Europe. However, they have developed this role by providing services to other local regions and by operating as intermediary between national and global economy. In that respect, most of these regions have not yet developed as knowledge locations which provide services to global economy or which are plugged into the knowledge based Europe. This group is defined by high levels on the synthetic variable knowledge creation (> 1). Apart from their strength in R&D indicators, these regions are characterised by a proportion of employment in high-tech services unmatched in any other group (> 3.5 % except SI00), a high share of population with tertiary education (> 20 % with the exception of

PL12 and SI00) and a much higher level of GDP/capita than any other group (> 8.000 Euro except RO08 and BG04). The level of HERD (higher education investment in R&D) is higher than in any other group (> 4 % except SI00). Evidently, Slovenia as an entire small country diverges somewhat from the picture of the other capital regions but is included in this category because of its high values in knowledge creation. Capital regions can be seen as "service centres" of the other regions (at the exception of Slovenia where the whole country operate as region).

Regions in group B appear as relatively well developed areas not organised around a real capital or a centre of excellence. The group "tertiary-based potential growth regions" is defined by intermediate strength in knowledge creation (between +1 and – 0.3), intermediate levels of general education and comparatively low employment in manufacturing industries (≤ 35 %). Regions in this group display at least intermediate dynamics in terms of economic growth (cumulated growth of GDP 1995-2001 > 180)[4]. In total, the Baltic States are leading in GDP growth (together with PL41: Wielkopolskie). The growth rates in regions of this group are most likely to be explained by a higher proportion of dynamic service sectors; however, their dynamism is largely endogenous and thus likely to be less robust when compared to regions belonging to the A-group.

The third group of regions, called "skilled production platform regions" or C-group, is defined by intermediate strength in knowledge creation (between +1 and – 0.3) in combination with negative values on the factor economic structure, meaning a high proportion of employment in manufacturing industries (≥ 34 % for all regions, ≥ 40 for Czech and Polish regions in this group), and a small share of employment in agriculture (< 10 %). Furthermore, these regions are characterised by only moderate unemployment rates (< 9 % except SK04 and PL 22). Except for the Hungarian cases, all regions in this group attain high levels on the factor general education, which means a proportion of population with secondary education > 77 %, and population with either secondary or tertiary as highest level of education > 88 %. Czech and Slovakian regions in this group also reach high levels on E-indicators (internet-use by households > 30 %, E-banking use by firms > 50 %).

Regions of group D can be seen as decline-endangered regions with very limited knowledge and technology-related activities. This fourth group is defined by low knowledge creation (< -0.3) in combination with strong employment in manufacturing industry (30-46 %) and less employment in agriculture (< 20 % for Polish regions, ≤ 10 % for all others in group D). Of all five groups, this one is the largest. Regarding the level of general education, a mixed picture emerges. Bulgarian regions reach middle values in population with tertiary education (16-21 %), while the other regions in

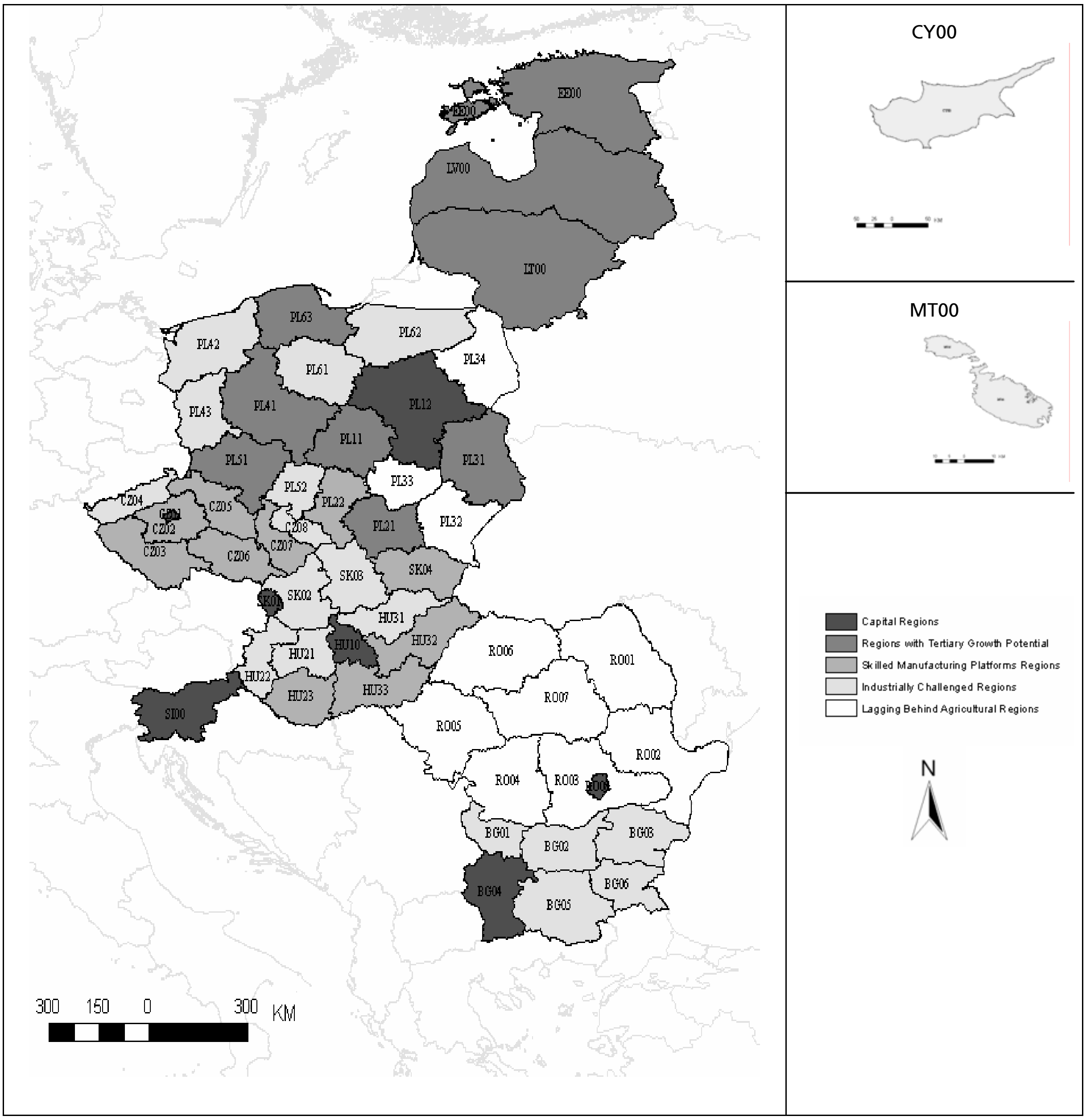
4 Cumulated growth is indexed to values of 1995 = 100.

this group are at the low end of the spectrum. In secondary education, there is a broad range from 50 to 80 % of population. Except for the Czech and Slovakian regions, internet-use as measured by web-based indicators is low (10-30 % of internet use by households, 0-38 % E-banking use by firms). CY00 and MT00 are part of this group because of their relative low level of knowledge creation activities, yet these tourism-oriented regions are exceptional in terms of much higher GDP/capita and population density.

Regions belonging to the E-type and defined as "lagging behind agricultural regions" can be seen as disadvantaged due to a relative economic underdevelopment comparatively to regions belonging to the other groups. "Lagging behind agricultural regions" appear as suffering from specific structural problems caused by the weakness of links to both national and global economies. At the same time, they do not benefit from relatively diversified economic structure. This group is clearly dominated by Romanian regions. "E-type regions" are characterised by low levels of knowledge creation (< -0.3) in combination with a high share of employment in agriculture (> 30 %) and lower employment in manufacturing industry compared with group D (20-30 % except for RO07). The unemployment rate – in relative terms - is moderate for Romanian (<9 %) and high for Polish regions in this group (17-19 %). Differences are also found for GDP/capita, where Romanian regions reach less than 2.300 Euro per capita, while the Polish regions attain around 4.000 Euro per capita, while still pertaining to the lower end of all NMS regions. Relating to the share of population with secondary education, no strong disadvantages are observed in this group compared with Hungarian, Baltic, or Bulgarian regions. However, the percentage of population with tertiary education ranks at the lower end of the spectrum (7-13 %) and Romanian regions are at the bottom end considering all three E-indicators as well as the share of population engaged in lifelong learning.

A map (figure 5) displays the geographical dispersion of the 55 considered regions according to the five types identified.

Figure 5: The five types of regions



5. Conclusion: possible futures and policy implications[5]

Capital regions (or regions belonging to the A-group) carry potential to become building blocks for the future knowledge-based Europe. They concentrate all the ingredients for a coherent development within EU and will not be so different from their equivalent in the EU-15 countries. The past development of metropolitan areas like Lisbon and Porto in the years after adhesion of Portugal is a good illustration.

From a macro-economic perspective, regions of the A-group are well situated for benefiting from economic growth. At the same time and comparatively to regions belonging to the four other types they may show a greater ability to integrate themselves in the ERA. In terms of EU policy instruments, one may assume such regions will in general take profit from a better position in terms of finding access to national and/or supranational funding and being capable to administer funds. In demographic terms, even if the current situation is rather worrying, they may appear as less endangered in the future as most NMS and CC regions since they may be seen as (national) gravity centres to which mobility flows tend to converge. Furthermore, their present average level of education (typically in terms of percentage of population of higher education level) is strikingly higher than the other regions of their country.

General recommendations aiming at reinforcing their (relative) favourable position with regards to innovation and research could be formulated as follows:

- To put an emphasis on foresight activities, in particular trying to identify key technologies and to establish distinctive profiles of regional strengths (in order to upgrade those strengths selectively);
- To invest in the development of regional identity and vision as global location in parallel to the development of infrastructure (to invest in image not only in brick and mortar);
- To maintain and develop a high regional educational level, which may constitute the most important long-term asset;

Regions with tertiary growth potential (or B-regions) appear as relatively developed areas that are not organised around a real capital or a centre of excellence. They are often secondary development poles of their country (being geographically close to the capital region, and/or hosting a historical university, etc.). However, the B-group is not homogenous: some of these regions are relatively well prepared in terms of level of

---

5 Most of the ideas expressed in this section were originally formulated at the occasion of a workshop held at the premises of the German Science Association in Brussels on Feb. 2. 2005 in the frame of the project "Enlarging the European Research Area: identifying priorities for regional policy focusing on Research and Technological Development in the Candidate Countries". See also Muller/Nauwelaers (2005), 51-61.

education, some are not. The process of inclusion in the larger European system may not endanger their internal organisation. Nevertheless they can be sensitive to economic recession or limited growth and possibly high unemployment rate if human capital and material assets are not ideally profiled for the integration.

These regions, potentially capable of becoming tertiary areas and even "knowledge-relays" could play the role of second nodes in the national systemic organisation. They often combine university functions with the presence of high-tech services, both elements being crucial factors for enhancing the capacity to attract some high-tech intensive foreign direct investments (FDI). As a consequence, the focus of RTDI investment should be put mainly on diffusion capacities. B-regions correspond probably to the one type of regions which could most benefit from European integration, in particular considering the potential for inter-regional co-operations (with regions from EU-15 countries as well as with other NMS and CC regions). The main danger for this type of regions lies probably in a possible growing gap comparatively to capital regions, especially in the case of national (re-)centralisation movement of different functions affecting their governance capacity. In this respect, the (national and regional) communication infrastructure may constitute a crucial element in the development of such regions: if not appropriate, it will lead to the persistence and even reinforcement of the domination of central places (i.e. typically A-regions).

Considering the demographic evolution of these regions, a trend reversal could be hoped under the condition of a successful tertiary development. In other words, one of the challenges for those regions is to attract and/or maintain "young talents". For fulfilling the promising role of secondary centres of development, this type of regions must realise the tertiary potential they have. Consequently, the establishment of policy priorities in B-regions should result from the identification of distinctive profiles in terms of regional strengths. Moreover, a regional vision – leading in the best cases to a kind of regional consciousness – may favour a regional evolution along three main features:

- An increasing emphasis on education in business skills and entrepreneurship in order to foster "value added" and "high-skills based" development paths. In other words, the regional environment and particularly education-related resources should be strongly oriented towards business support.
- A relative positioning in the respective national innovation systems based on the development of new (but not obligatory high-tech oriented) products and services and/or infrastructures like for instance (regional) airports.
- A strengthening of the (critical) regional ability to ensure access to national and/or supranational funding for RTDI activities (and more generally for all types of development activities).

C-regions or skilled manufacturing platforms regions could be seen as belonging to the "production platform" type. They are lagging behind in economic and sometimes technological terms, but can benefit from potentially huge off-shoring from different regions of EU-15. In the long run, they could converge towards the rest of Europe in every respect, but for the time being their model of integration is based on "static" relative advantages (lower cost in all production factors: work, land, environmental perception, etc.).

One of the main factors potentially influencing the evolution of C-regions may lie in their ability to take advantage of economic growth periods for regional development. More generally, the challenge is to seize the opportunity of an intermediate phase of exogenous development (world FDI and industrial re-localisation from the rest of EU) to create the internal sources of genuine (economically) sustainable development. If not, benefits of lower production costs might only be transitory. At the same time, the perspectives are not very good in demographic terms. The trend towards an ageing and declining population may be reinforced through growing unemployment rates and outwards flows of population (affecting in particular younger people). Therefore, the stakes are relatively high: these regions have just a limited period to win in the game indicated above.

In order to allow a manufacturing-based "upgrading" of their capabilities (taking the form of absorption of new production technologies and of an adaptation to regional means and markets), regions in this group should primarily put the emphasis on investments in absorptive capacities and knowledge creation. In this respect, some "mixed strategy" combining exogenous (FDI) and endogenous development should be pursued. On the whole, C-regions are confronted by a clear danger: to become D-regions. It remains nevertheless an open question in how far the perception of such a danger may become a driving force for strengthening regional consciousness.

Industrially challenged regions or regions belonging to the D-group seem relatively close to E-regions in some respects. But a strong distinctive feature relates to the share of agricultural activities in the local economy, which is higher in regions belonging to the E-type. It means that regions belonging to the D-group could be considered as being in a dead-end situation since they do not even show a strong agricultural specialisation. From a general point of view, the issue of the future integration of D-regions within the ERA should rather be addressed in terms of cohesion priorities than in terms of scientific excellence.

This type of region is the most widespread in the NMS and CC and hence the EU policy actions could benefit from economies of scale in policy provisions and could benefit from learning in project implementation. D-regions are suffering – for different reasons and in different respects – from their peripheral situations. They may additionally suffer from lacking regional vision and have often not developed regional consciousness in terms of governance capacities. As a consequence, the participation of regions belonging to this group in European regional initiatives and more generally their integration within inter-regional networks should be strongly encouraged. From a general point of view, D-regions can be seen as decline-endangered regions with rather low educational level and very limited technology-related activities.[6] But in terms of educational level, the situation is not completely homogenous. In fact, differences between D regions are due to national differences in levels of development.

Keeping those characteristics of industrially challenged regions in mind, a more precise evaluation should be done region by region in order to evaluate the relative chances to escape the dead-end situation. As a result, some "niches strategies" could be followed by D-regions (e.g. improvement of service related technologies, introduction and development of environmental technologies, tourism, etc.). This group requires clearly attention and creativity in policy approaches as their structural problems seem to be the most complex. However, the following priorities seem crucial for their development:

- A reinforced access to know-how. The main supporting effort should be devoted at regional level to lifelong learning (LLL).
- A stronger mobilisation of endogenous capacities and a collective effort of self-assessment (using for instance "participative" foresight procedures within the region).
- A strengthening of industrial logistics.

Regions belonging to the lagging-behind agricultural regions group (or E-type) can be seen at the same time as hindered due to a relative economic underdevelopment and as suffering from specific structural problem linked to the loss of systemic integration. They appear clearly as requiring cohesion policy efforts (at EU and national levels).

What is the future of such peripheral areas? One possible trend is demographic breakdown and migration to the central regions. More optimistic perspectives correspond to complete redevelopment strategies (after possibly socially painful transition) through planning operations: rural tourism, large public programmes in industry and other ex nihilo establishments. Since E-regions are more homogenous than D-regions, sharing notably traditional rural characteristics, it can be assumed that the key issue is development and growth more than restructuring. Therefore, it could be easier to find some general schemes of development. It is difficult to imagine bottom up processes leading to any sort of RTDI-based development. Nevertheless, different development paths like for instance a shift to organic-food-based tourism could be envisaged.

---

6 This does not fully apply to Cyprus and Malta though.

In this respect not only better infrastructure but also a reinforced access to know-how should be strongly supported at national and EU level. In terms of general recommendationsthe following suggestions can be made:

- Taking advantage of rural environment to foster specific new activities like tourism, innovative agricultural practices, etc.
- Upgrading educational level, an imperious condition for any significant re-orientation of activities.
- Devoting clear efforts to lifelong learning (LLL), which may in the middle and long run affect positively the regional productivity.

More generally, one should keep in mind that within the United States, GDP/capita gaps between States are lower than between European regions but RTDI gaps are often as extreme. This may allow concluding that even in the frame of an enlarged European Research Area regional (relative) wealth should not necessarily be linked to high tech profile in all regions, but with balanced development. This implies nevertheless efficient and balanced European, national and regional policies integrating and respecting the diversity of local situations as a necessary condition.

References

Clarysse, B./Muldur, U. (2001): Regional cohesion in Europe? An analysis of how EU public RTD support influences the techno-economic regional landscape, *Research Policy*, 30, 275-296.

Cohen, W.M./Levinthal, D. (1989): Innovation and Learning: The Two Faces of R&D, *Economic Journal*, 99, 569-96.

Cohen, W.M./Levinthal, D. (1990): Absorptive Capacity: A new perspective on learning and innovation, *Administration Science Quarterly*, 35, 128-152.

Cooke, P. (1998): Introduction: origins of the concept. In: Braczyk, H.-J./Cooke, P./Heidenreich, M. (eds.): *Regional Innovation Systems*. London: UCL Press, 2-25.

Freeman, C. (1982): *The Economics of Industrial Innovation*. Pinter Publishers, London

Lundvall, B.A. (1988): Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation. In: Dosi, G./Freeman, C./Nelson, R./Silverberg, G./Soete, L. (Eds.) (1988): *Technical Change and Economic Theory*. Pinter Publishers, London, 349-369.

Muller et al. (2001): *RETINE (REgional Typology of Innovation NEeds). Report to the European Commission DG Research*. Karlsruhe: Fraunhofer Institute for Systems and Innovation Research.

Muller, E./Nauwelaers, C. (2005): *Enlarging the ERA: identifying priorities for regional policy focusing on research and technological development in the New Member States and Candidate Countries*. Collective report Fraunhofer ISI/MERIT prepared for the European Commission, DG Research.

Muller, E./Zenker, A. (2001): Business Services as Actors of Knowledge Transformation: the Role of KIBS in Regional and National Innovation Systems, *Research Policy*, 30, 1501-1516.

Nelson, R./Winter, S. (1974): Neoclassical vs Evolutionary Theories of Economic Growth. Critique and Prospectus, *Economic Journal*, December, 886-905

PWC Consulting and Tsagaris Consult (2002): *Involving regions in the European Research Area*, Final Report to the European Commission.

Radosevic, S. (2004): A Two-Tier or Multi-Tier Europe?: Assessing the Innovation Capacities of Central and East European Countries in the Enlarged EU, *Journal of Common Market Studies*, 42, 641-66..

Appendix: List of the 55 regions

NUTS code	Name	Type
BG01	Severozapaden	D
BG02	Severen tsentralen	D
BG03	Severoiztochen	D
BG04	Yugozapaden	A
BG05	Yuzhen tsentralen	D
BG06	Yugoiztochen	D
CY00	Kypros /Kibris	D
CZ01	Praha	A
CZ02	Stredni Cechy	C
CZ03	Jihozapad	C
CZ04	Severozapad	D
CZ05	Severovychod	C
CZ06	Jihovychod	C
CZ07	Stredni Morava	C
CZ08	Moravskoslezsko	D
EE00	Eesti	B
HU10	Kozep-Magyarorszag	A
HU21	Kozep-Dunantul	D
HU22	Nyugat-Dunantul	D
HU23	Del-Dunantul	C
HU31	Eszak-Magyarorszag	D
HU32	Eszak-Alfold	C
HU33	Del-Alfold	C
LT00	Lietuva	B
LV00	Latvija	B
MT00	Malta	D
PL11	Lodzkie	B
PL12	Mazowieckie	A
PL21	Malopolskie	B
PL22	Slaskie	C

NUTS code	Name	Type
PL31	Lubelskie	B
PL32	Podkarpackie	E
PL33	Swietokrzyskie	E
PL34	Podlaskie	E
PL41	Wielkopolskie	B
PL42	Zachodniopomorskie	D
PL43	Lubuskie	D
PL51	Dolnoslaskie	B
PL52	Opolskie	D
PL61	Kujawsko-Pomorskie	D
PL62	Warminsko-Mazurskie	D
PL63	Pomorskie	B
RO01	Nord-Est	E
RO02	Sud-Est	E
RO03	Sud	E
RO04	Sud-Vest	E
RO05	Vest	E
RO06	Nord-Vest	E
RO07	Centru	E
RO08	Bucuresti	A
SI00	Slovenija	A
SK01	Bratislavsky kraj	A
SK02	Zapadne Slovensko	D
SK03	Stredne Slovensko	D
SK04	Vychodne Slovensko	C

The series "Working Papers Firms and Region" presents research work of the department "Innovation Services and Regional Development" of Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI), Karlsruhe, Germany. The former "Arbeitspapiere Regionalforschung", published between 1995 and 1999, was merged in this new series.

No.	Authors	Title
R1/2006	Emmanuel Muller Arlette Jappe Jean-Alain Héraud Andrea Zenker	A regional typology of innovation capacities in New Member States & Candidate Countries
R1/2005	Björn Wolf Birgit Ossenkopf	Kapitalschonende Entwicklungswege - Ansätze zur Lösung der Finanzierungsprobleme junger innovativer Unternehmen
R2/2004	Thomas Stahlecker Knut Koschatzky	On the significance of geographical proximity for the structure and development of newly founded knowledge-intensive business service firms
R1/2004	Thomas Stahlecker Andreas Koch	On the Significance of Economic Structure and Regional Innovation Systems for the Foundation of Knowledge-Intensive Business Services A Comparative Study in Bremen, Munich, and Stuttgart, Germany
R1/2003	Bodo Kubartz	Wirtschaftliche, soziale und geographische Aspekte in Innovationsnetzwerken – Eine Untersuchung des Nähekonzeptes am Beispiel von Forschungs- und Entwicklungsdienstleistern
R2/2002	Knut Koschatzky	Innovationsorientierte Regionalentwicklungsstrategien: Konzepte zur regionalen Technik- und Innovationsförderung
R1/2002	Ralph W. Bruns Jens Görisch	Unternehmensgründungen aus Hochschulen im regionalen Kontext – Gründungsneigung und Mobilitätsbereitschaft von Studierenden
U1/2001	Rana Adib Frank Gagelmann Knut Koschatzky Klaus Preiser Günter Hans Walter	An Integrated Microfinancing Concept for Rural Electrification by Photovoltaics in Developing Countries
R3/2001	Knut Koschatzky	The role of higher education institutions for entrepreneurship stimulation in regional innovation systems – Evidence from the network-oriented "EXIST: Promotion of university-based start-ups" programme in Germany
R2/2001	Emmanuel Muller Andrea Zenker	Business services as actors of knowledge transformation and diffusion: some empirical findings on the role of KIBS in regional and national innovation systems

No.	Authors	Title
R1/2001	Knut Koschatzky Casper Merkle Martin Berger Volker Meyer	Innovation und Kooperation bei unternehmensnahen Dienstleistern in Baden, Gironde und Südholland - Ein Vergleich zwischen jungen und alten Betrieben
R2/2000	Ulrike Broß Günter H. Walter	Socio-economic Analysis of North Rhine-Westphalia Joint Research Project INCO-COPERNICUS
R1/2000	Knut Koschatzky	The regionalisation of innovation policy in Germany – Theoretical foundations and recent experience
R4/1999	Knut Koschatzky Ulrike Broß	Struktur und Dynamik von regionalen Innovationsnetzwerken unter Transformationsbedingungen – das Beispiel Slowenien
R3/1999	Emmanuel Muller	There is no territorial fatality! (or how innovation interactions between KIBS and SMEs may modify the development patterns of peripheral regions)
R2/1999	Knut Koschatzky Andrea Zenker	The Regional Embeddedness of Small Manufacturing and Service Firms: Regional Networking as Knowledge Source for Innovation?
R1/1999*	Ulrike Broß Knut Koschatzky Peter Stanovnik	Development and Innovation Potential in the Slovene Manufacturing Industry First analysis of an industrial innovation survey * Already published as "Arbeitspapier Regionalforschung" No. 16

Address to order:
Fraunhofer Institute for Systems
and Innovation Research
Library
Breslauer Strasse 48
D-76139 Karlsruhe
Tel. +49 /721 /6809-217 /-219
Fax: +49 /721 /689152
e-mail: bibl@isi.fraunhofer.de