Preliminary draft

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Regional Learning Dynamics and Institutional Context: A European Comparison

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1. Introduction

In previous papers co-authored with Bengt-Aake Lundvall and other colleagues I have explored the links between styles of learning and work organisation on the one hand, and innovative performance and institutional context on the other. In Arundel et al (2007) we presented evidence for the EU-15 showing that in nations where work is organised to support high levels of discretion in solving complex problems firms tend to be more active in terms of innovations developed, at least to some degree, through their creative in house efforts. In countries where learning and problem-solving on the job are more constrained, and little discretion is left to the employee, firms tend to engage in a supplier-dominated innovation strategy. Their technological renewal depends more on the absorption of innovations developed elsewhere. Based on these results we argued that European policy efforts to improve innovation performance as part of the revised Lisbon strategy would benefit from organisational indicators that could be directly linked to innovation performance. The bottleneck to improving the innovative capabilities of European firms might not be low levels of R&D, which are strongly determined by industry structures and difficult to change, but the widespread use of forms of work organisation that are unable to provide a fertile environment for innovation.

In Holm et al. (2010) we extended this analysis using multi-level regression in order to explore the relation between forms of work organisation and institutional context for the EU-27 and Norway. The results pointed to systemic relations between differences in labour market mobility and regulation on the one hand, and the adoption of different forms work organisation on the other. National systems combing high levels of labour market mobility with high levels of expenditure on both unemployment protection and active labour market policies designed to move the unemployed into employment are associated with high adoption rates of the discretionary learning forms of work organisation characterised by high levels of autonomy and

learning on the job. The more bureaucratic lean forms of organisation are favoured by systems characterised by an absence of measures designed to protect jobs and greater reliance on the market mechanism to assure the movement of the inactive into active employment.

In this preliminary draft I make an effort to extend the approach to the regional level using the regional breakdown of data according to the NUTS nomenclature available in Fourth European Survey on Working Conditions (EWCS) carried out in 2005. Before presenting and discussing the results there are a number of important qualifications I need to make regarding this exercise. First, only the regions of nineteen of the 27 EU member nations and the regions of Norway have been included for the simple reason that a NUTS breakdown of regions is not available, or was not available in 2005, for eight nations. These include Cyprus, Denmark, Estonia, Lithuania, Luxembourg, Latvia, Malta and Slovenia.

Secondly, the EWCS was designed to conduct national-level comparisons and while the sampling design involved stratification according to region and urbanisation level and the sample is representative of persons in employment,[1] the size of the sample is relatively small, with approximately 1000 observations per nation. In the case of the nations with relatively large populations this makes analysis at the NUTS-2 level unrealistic and for fourteen of the 20 nations included the results presented here are based on an analysis at the NUTS-1 level. In the cases of the Czech Republic, Slovakia, Finland, Ireland, Norway and Portugal the NUTS-1 level corresponds to the entire nation or to the entire mainland, and for these six nations the analysis is carried out at the NUTS-2 level. The total number of regions on which the analysis is based is 111. Still, the small number of observations per region means that the estimates, even if not biased, are relatively imprecise.[2] Correspondingly the conclusions are to be taken as indicative rather than as definitive, and they are presented in the spirit of illustrating of how the method we have developed for international comparisons can be applied at the inter-regional level.

[1] The sampling design had the following stages: stratification of primary sampling units (PSUs) according to region and urbanisation level; random selection of starting addresses within each PSU; and a 'random walk' procedure for the selection of the household. For details, see Parent-Thirion, et.al., 2007, p. 94.

[2] In order to enhance the representativeness of the results cross-national weights are applied. While these weights adjust for in the proportion that each country represents in the total employed population they do not adjust for differences in the proportion of the population that each region represents within a nation. See Parent-Thirion, et.al., 2007, pp. 96-97.

According to Eurostat, while different criteria may be used in subdividing national territory into regions, for practical reasons to do with data availability and the implementation of regional policies, the NUTS nomenclature is based primarily on the institutional divisions currently in force in the Member States. Be this as it may, it is clear that even at the NUTS-2 level one can find considerable intra-regional heterogeneity both in terms of performance and structural characteristics. This is illustrated for the case of Norway in Table 1, which presents figures on GDP per capita, GDP per employed person and the rate of unemployment at the NUTS-3 or county-level. In the case of the Agder-Rogaland region, for example, the figures show that the standard of living and the level of productivity are relatively high in Rogaland, especially in comparison to Aust-Agder. The unemployment rate is relatively low in Rogaland and in fact it is the lowest across the 19 counties. Table 2 points to significant differences in industrial structure within the Agder-Rogaland region and in particular to the importance of oil and gas production in Rogaland.

Table 1: Regional Economic Indicators: Norway 2007

County	GDP per capita (Norway = 100)	GDP per employed person (Norway= 100)	Unemployment rate
NO011: Oslo	191	120	2.5
NO012: Akershus	89	103	1.4
NO021: Hedmark	72	88	2.0
NO022: Oppland	74	86	1.4
NO031: Østfold	75	90	2.0
NO032: Buskerud	85	95	1.8
NO033: Vestfold	77	90	2.0
NO034: Telemark	85	98	2.1
NO041: Aust-Agder	74	85	1.9
NO042: Vest-Agder	95	102	1.8
NO043: Rogaland	111	106	1.2
NO051: Hordaland	104	104	1.8
NO052: Sogn og Fjordane	84	89	1.3
NO053: Møre og Romsdal	95	102	1.5
NO061: Sør-Trøndelag	93	96	2.2
NO062: Nord-Trøndelag	67	80	2.1
NO071: Nordland	79	90	2.5
NO072: Troms Romsa	76	82	2.1
NO073: Finnmark Finnmárku	75	81	

Source: Statistics Norway's electronic data base

More generally, at the NUTS-2 level intra-regional differences can be observed elsewhere in Norway. For example in the Vestlandet region manufacturing employment in relatively

important in Møre og Romsdal, and in the Trøndelag region business services are relatively important in Sør-Trøndelag. The impact of these differences in industrial structure at the NUTS-3 level are necessarily glossed over in the analysis of work organisation and learning that follows.

Table 2: Structural Indicators: Norway 2007

County	Manufacturing employment share of total	Agricultural employment share of total	Oil and gas employment share of total	Business services employment share of total
NO031: Østfold	16.9	2.3	0.0	8.6
NO012: Akershus	7.1	1.0	0.1	1.4
NO011: Oslo	5.8	0.0	0.0	1.8
NO021: Hedmark	12.2	6.0	0.0	7.5
NO022: Oppland	11.7	8.4	0.0	6.6
NO032: Buskerud	15.0	2.7	0.0	9.5
NO033: Vestfold	14.7	2.0	0.0	9.4
NO034: Telemark	16.1	2.3	0.0	8.3
NO041: Aust-Agder	13.9	2.3	0.0	7.8
NO042: Vest-Agder	15.4	2.0	0.0	8.3
NO043: Rogaland	15.2	3.8	6.1	9.7
NO051: Hordaland	12.4	1.9	1.5	10.0
NO052: Sogn og Fjordane	14.9	9.3	0.0	4.8
NO053: Møre og Romsdal	18.9	4.3	0.0	6.2
NO061: Sør-Trøndelag	9.4	3.3	0.1	11.6
NO062: Nord-Trøndelag	12.1	9.5	0.1	5.7
NO071: Nordland	8.9	3.8	0.0	6.3
NO072: Troms Romsa	5.7	2.5	0.0	7.4
NO073: Finnmark Finnmárku	6.6	1.7	0.0	5.4

Source: Statistics Norway's electronic data base

2. Comparing regional learning dynamics

In Lorenz and Valeyre (2006) we worked with a part of the entire sample of the EWCS restricted to persons working in private sector establishments employing 10 or more persons. To restrict the population studied in this manner for the analysis of regions would aggravate the problems linked to the small size of the sample I discussed above, and the analysis presented here is based on the responses of all salaried employees including those working in establishments employing less that 10 employees in both the private and public sector. This in

turn implied making some changes to the choice of variables used in Lorenz and Valeyre (2006) to identify different forms of work organisation, since indicators of the use of job rotation schemes or the use of autonomous team organisation have little or no relevance to micro-enterprises. The seven indicators used in the analysis are presented in Table 3 below. The variables were chosen to capture differences in the importance of creative learning and problem-solving activity at work.

Table 3: Variables for types of learning

	Percent of occupied persons affected
Problem solving activities	79.8
Learning new things in work	68.5
Using one's own ideas in work	58.2
Undertaking complex tasks	56.1
Discretion in fixing work methods	65.1
Discretion in setting work pace	67.0
Repetitiveness of tasks	37.5
N	*19,531*

Source: Fourth Working Conditions survey, European Foundation for the Improvement of Living and Working Conditions

Based on a factor analysis and cluster analysis three distinct clusters are identified corresponding to different styles or forms of learning within establishments (see Table 4). The first, which I refer to as the "creative learning" cluster, is characterised by relatively high level of learning, use of one's own ideas, problem-solving and discretion in work. Complexity is above the population average while repetitiveness is below average. This cluster accounts for 53 percent of the population. The second cluster, accounting for 22 percent of the population, is referred to as the "constrained learning" group since while learning and problem-solving are as high, or almost as high, as in the first cluster, employees exercise below average levels of discretion and they make very little use of their own ideas. As in Lorenz and Valeyre (2006), this points to two different forms of learning at work, one in which the employee enjoys considerable autonomy and scope for exploring novel solutions to problems encountered, and one in which learning is relatively constrained and monitored. The third cluster is a "low learning" cluster and presumably groups both taylorised forms of work organisation and traditional forms of work organisation found especially in smaller establishments.

Table 4: Learning Clusters: 20 European Nations

Variable	Creative learning	Constrained learning	Low learning	Average
Problem solving activities	**95.2**	**89.2**	37.0	79.8
Learning new things in work	**85.3**	**85.6**	14.5	68.5
Complexity of tasks	**73.0**	**78.9**	6.7	58.2
Using one's own ideas	**79.2**	34.4	24.7	56.1
Discretion in fixing work methods	**96.7**	22.1	34.6	65.1
Discretion in setting work rate	**94.7**	26.5	43.0	67.0
Repetitiveness of tasks	30.8	**50.6**	**40.4**	37.5
Total share of employees	*53,6*	*22.2*	*24.2*	

Source: Fourth Working Conditions survey, European Foundation for the Improvement of Living and Working Conditions

Table 5 presents a breakdown of the different forms of learning by broad industrial sector. The creative learning forms are overrepresented in business and financial services, in pubic administration, in education and health and in personal and community services. They are under-represented in manufacturing and in related and other services. Interestingly, agriculture, forestry and fishing, while accounting for a very small share of the total population, appears to be relatively learning intensive sector. The constrained learning forms are reptively present in manufacturing, construction and utilities, while the low learning forms are most frequent in retail and other services.

Table 6 gives the occupational breakdown. As expected, the creative learning forms are relatively high for managers, senior officials, professionals and technicians. They are at about average levels for clerks and the craft trades, and they are underrepresented amongst those occupied in sales and service jobs, plant and machine operator jobs and unskilled jobs. Thez constrained learning forms are relatively present amongst machine operators and the skilled trades, while the low learning forms are overrepresented amongst machine operators and the unskilled or elementary occupations.

Table 5: Types of Learning by Sector of Activity: 20 European nations

	Percent of occupied persons by sector of activity and type of learning			
	Creative learning	**Constrained learning**	**Low learning**	**Total**
Agriculture, forestry, fishing	61.05	13.64	25.31	100
Manufacturing, construction and utilities	46.96	26.94	26.10	100
Retail and other services	46.13	21.26	32.61	100
Business and financial services	63.70	20.22	16.08	100
Public administration, education, and health and social work	62.57	22.09	15.34	100
Community, social and personal services	58.60	16.98	24.42	100
Average	53.58	22.17	24.24	100

Source: Fourth Working Condition survey. European Foundation for the Improvement of Living and Working Conditions

Table 6: Types of Learning by Occupation: 20 European nations

	Percent of occupied persons by occupation and type of learning			
	Creative learning	**Constrained learning**	**Low learning**	**Total**
Managers and senior officials	75.61	13.47	10.92	100
Professionals	76.10	17.30	6.60	100
Technicians	64.14	24.58	11.28	100
Clerks	50.29	23.97	25.74	100
Sales and service	45.56	22.41	32.03	100
Craft and related trades	50.71	26.10	23.19	100
Plant and machine operators	25.40	29.10	45.50	100
Elementary occupations	34.90	18.22	46.88	100
Average	53.58	22.17	24.24	100

Source: Fourth Working Condition survey. European Foundation for the Improvement of Living and Working Conditions

Table 7 presents the breakdown for nations. The figures show that the creative learning forms are most widely adopted in the Scandinavian nations, the Netherlands, Belgium and Italy, while and the constrained learning forms are most present in Czech Republic Austria, Bulgaria and Austria and Finland. The low learning forms tend to be more frequent in the southern and new member nations and they are most present in Spain, Bulgaria and Romania.

Table 7: Differences between countries in types of learning: 2005
(weighted percent of employees by learning class)

	Creative learning	Constrained learning	Low learning	Total
Belgium	**62.12**	18.05	19.84	100
Czech Republic	43.59	**30.24**	26.16	100
Germany	51.74	23.19	25.06	100
Greece	48.14	23.79	**28.07**	100
Spain	40.32	24.67	**35.01**	100
France	58.22	21.58	20.20	100
Ireland	59.02	17.22	23.76	100
Italy	**60.91**	14.54	24.54	100
Hungary	57.67	20.69	21.64	100
Netherlands	**64.50**	24.24	11.26	100
Austria	54.36	**28.09**	17.55	100
Poland	50.69	24.54	24.77	100
Portugal	49.85	24.45	25.70	100
Slovakia	46.62	24.19	**29.19**	100
Finland	58.45	**30.70**	10.84	100
Sweden	**71.08**	21.52	7.40	100
United Kingdom	52.89	20.87	26.24	100
Bulgaria	43.08	**26.78**	**30.15**	100
Romania	46.29	23.69	**30.02**	100
Norway	**71.71**	18.01	10.28	100
Average	53.58	22.17	24.24	100

Source: Fourth Working Condition survey. European Foundation for the Improvement of Living and Working Conditions

Table 8 identifies regions which rank high in terms of the importance of creative learning, constrained learning and low learning regions. As regards regions with high levels of creative

learning, what stands out is the dominance of the Scandinavian nations with all three of Sweden's NUT-1 regions figuring amongst the top 10 regions for the 20 European nations, and five of the seven NUTS-2 Norwegian regions figuring amongst the top 10.

Table 8: Types of Learning by Region

	Percent of occupied persons by region and type of learning			
	Creative learning	**Constrained learning**	**Low learning**	**Total**
High creative learning regions				
Trøndelag, Norway	**75.01**	22.70	2.29	100
Norra Sverige, Sweden	**73.91**	19.00	7.09	100
Agder og Rogaland, Norway	**73.66**	18.57	7.77	100
Sud-Ouest, France	**73.64**	17.80	8.56	100
Oslo og Akershus, Norway	**73.64**	16.34	10.03	100
Vestlandet, Norway	**73.52**	17.31	9.17	100
Nord-Norge, Norway	**72.24**	12.36	15.41	100
Östra Sverige, Sweden	**72.00**	22.13	5.86	100
Oost-Nederland, Netherlands	**69.73**	18.47	11.81	100
Södra Sverige, Sweden	**69.45**	22.49	8.06	100
High constrained learning regions				
Lisboa, Portugal	32.63	**41.93**	25.43	100
Nordhein-Westfalen, Germany	33.62	**41.25**	25.13	100
Jihozápad, Czech Republic	40.84	**39.87**	19.29	100
Alentejo, Portugal	32.54	**39.79**	27.67	100
Canarias, Spain	51.72	**35.86**	12.42	100
Praha, Czech Republic	51.28	**35.38**	13.34	100
Ostösterreich, Austria	50.49	**35.18**	14.33	100
Severovýchod, Czech Republic	32.24	**34.97**	32.8	100
Baden-Württemburg, Germany	35.03	**33.21**	31.76	100
Sur, Spain	35.43	**32.99**	31.58	100
Itä-Suomi, Finland	58.68	**32.47**	8.85	100
High low learning regions				
Thüringen, Germany	36.55	12.74	**50.71**	100
Centro, Spain	29.98	20.2	**49.83**	100
Brandenburg, Germany	29.36	22.75	**47.89**	100
London	41.23	16.79	**41.98**	100
Noroeste, Spain	44.6	13.7	**41.71**	100
Este, Spain	39.59	22.25	**38.16**	100
Bayern, Germany	37.94	24.1	**37.96**	100
Macroregiunea doi, Romania	39	23.09	**37.91**	100
North-East (England)	41.39	23.08	**35.54**	100
Northern Ireland, UK	44.73	19.98	**35.28**	100
Yorkshire and the Humberland, UK	48.23	16.64	**35.13**	100
Average for 20 nations	53.58	22.17	24.24	100

Source: Fourth Working Condition survey. European Foundation for the Improvement of Living and Working Conditions

With respect to high levels of constrained learning, regions from the Czech Republic, Portugal, Germany and Spain count for most of the top 10. Regions with the highest frequency of low learning tend to be located in Germany, Spain or the UK. This is despite the case that at the national level the importance of the low learning forms is at about average levels in both Germany and the UK. The results reflect the high level of variance in the frequency of the low learning forms across NUTS-1 regions in the UK and Germany. In the case of the UK, the figures range from a low of about 14 percent of the employed workers in the East and West Midland to a high of about 42 percent in inner and outer London. In the case of Germany, the figures range from a low of about 10 percent in Sachsen and Sachsen-Anhalt to a high of about 51 percent in Thüringen.

3. Links between learning and innovation

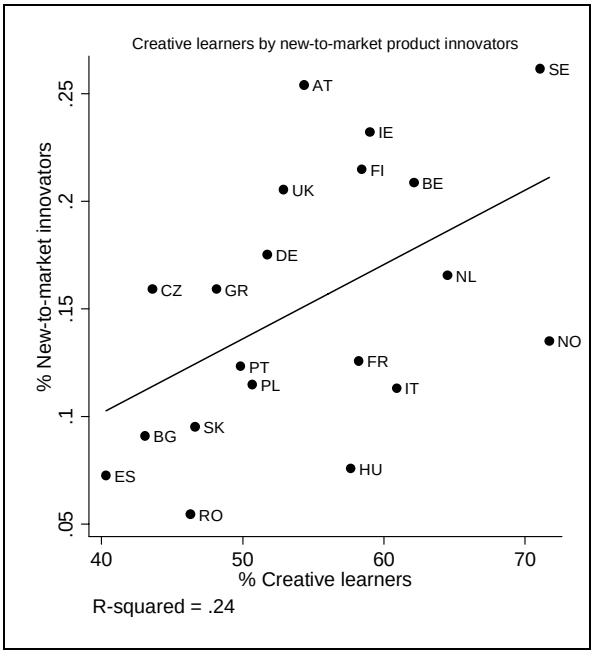
In Arundel et al. (2007) we explored the relation between work organisation and innovation style at the national level using a typology of innovators at the firm level developed by Arundel and Hollanders (2005), in collaboration with Paul Crowley of Eurostat. The typology classifies all innovative CIS-3 respondent firms into three mutually exclusive innovation modes, according to the level of in-house creative effort. Although our data could only show correlations rather than causality, and were aggregated at the national level, they supported the view that how firms innovate is linked to the way work is organised to promote learning and problem-solving.

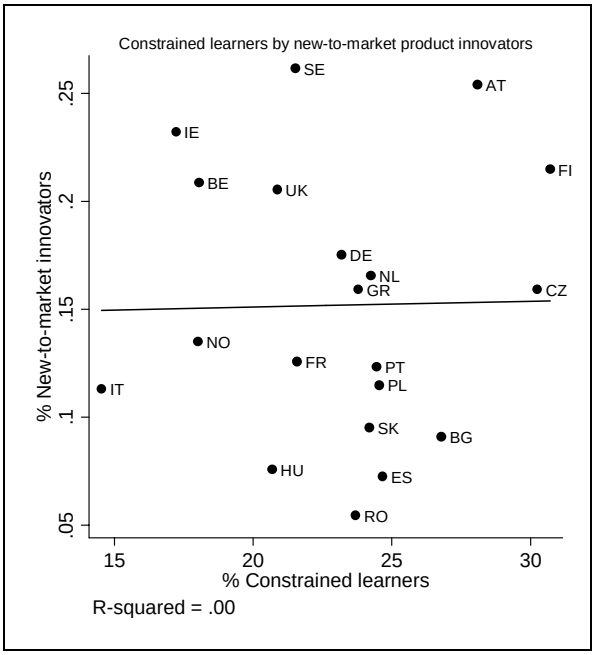
While this typology is not available for CIS-5, which concerns the innovative activities of firms over the period 2004-2006, the exercise can be repeated to a certain extent by using an indicator of the share of all enterprises that have innovated new-to-the market products (goods and services).[3] Figures 1-3 present the correlations between our aggregate measures of the national frequency of learning forms for the 20 EU nations and the share of firms having introduced new-to-the market products. The results show a positive and statistically significant relation between the frequency of such innovators and the importance of the creative learning

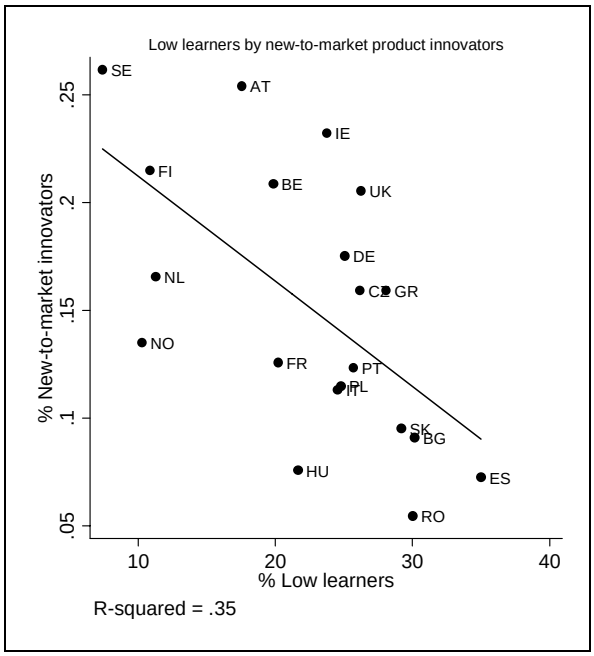
[3] The CIS estimates of the percentage of innovative firms are based on a very broad definition of innovation ranging from intensive in-house R&D to develop a new-to-market product or process to minimal effort to introduce manufacturing equipment purchased from a supplier. Consequently, a broad all-encompassing definition of an innovative firm is both misleading in international comparisons and fails to provide a clear picture of the structure of innovation capabilities within individual countries.

forms, and a clear negative relation between their frequency and the importance of the low learning forms. There is no discernable relation between the frequency of new-to-the market innovators and the importance of the constrained forms of learning.

Figures 1 – 3: Correlation between new-to-market product innovators and forms of learning at the national level

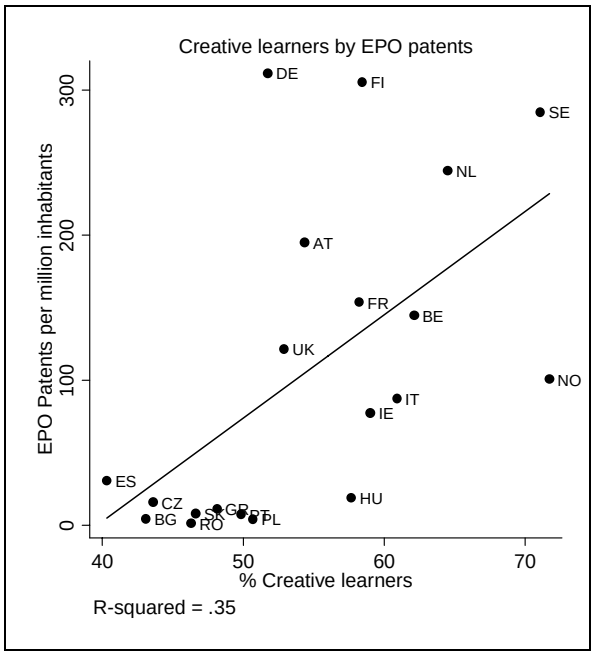


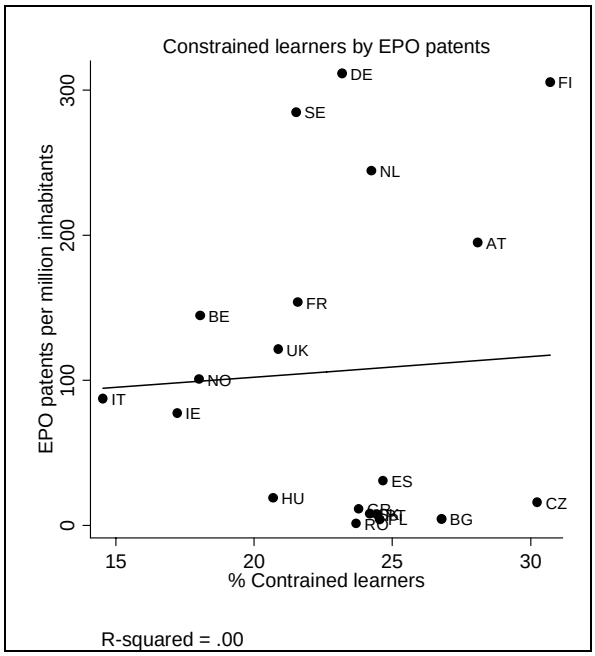


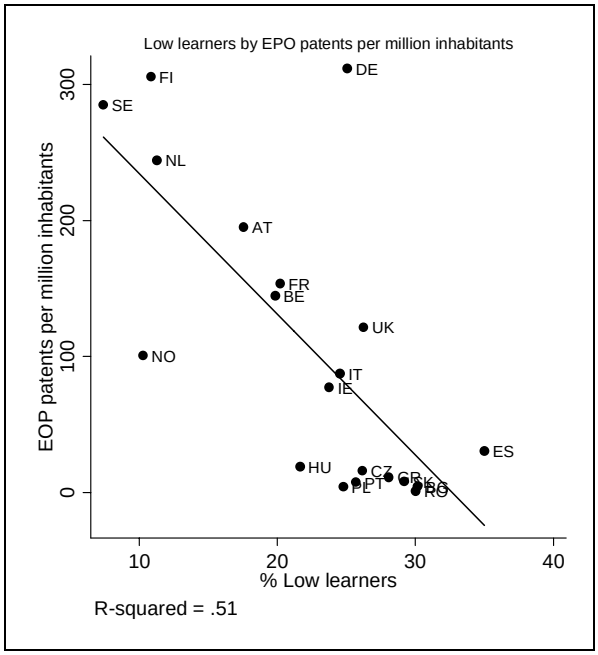


Figures 4 through 6 repeat the exercise using another indicator of innovativeness, EPO patents applications per million inhabitants. The results show an even stronger positive relation with the importance of the creative forms of learning and a stronger negative relation with the importance of low forms of learning. Germany, with a very high rate of patenting, is a clear outlier.

Figure 4 – 6: Correlations between EOP patents per million inhabitants and forms of learning at the national level

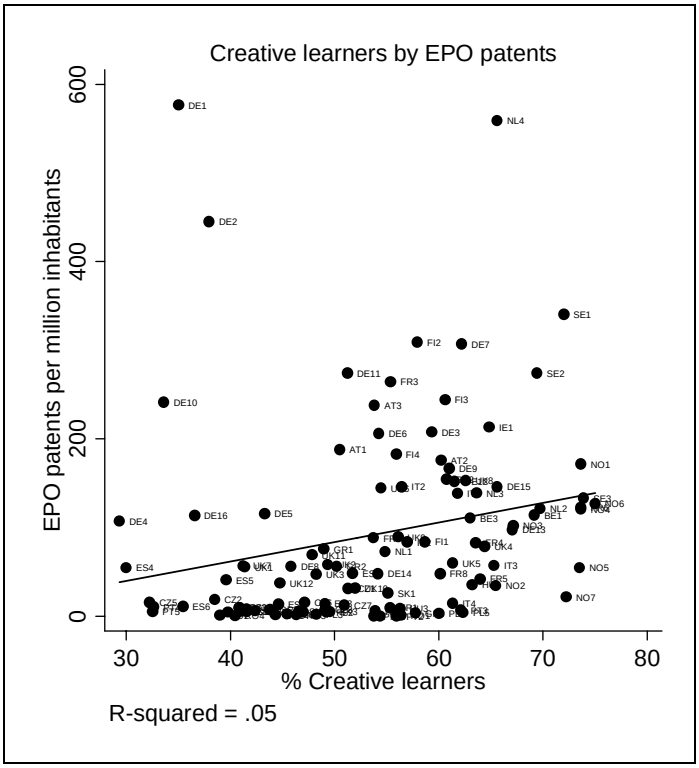


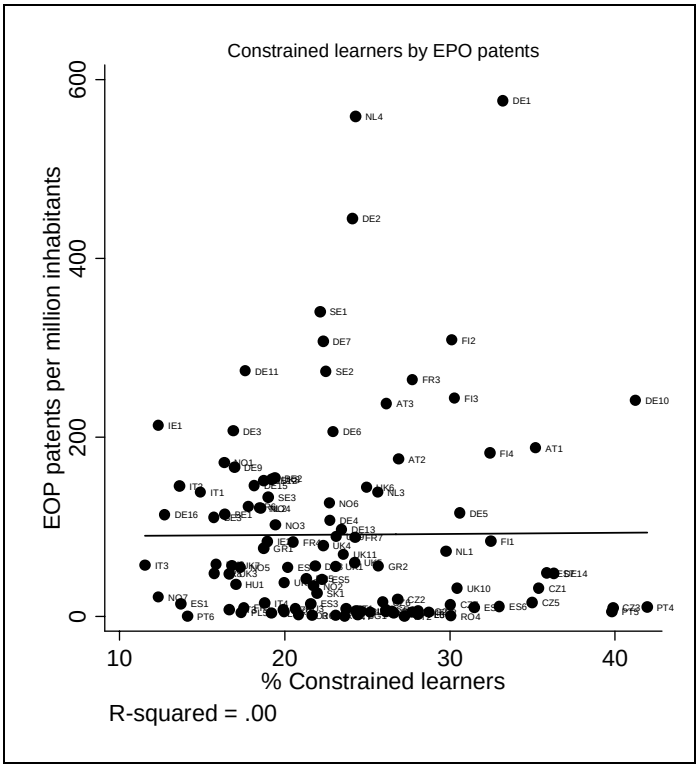


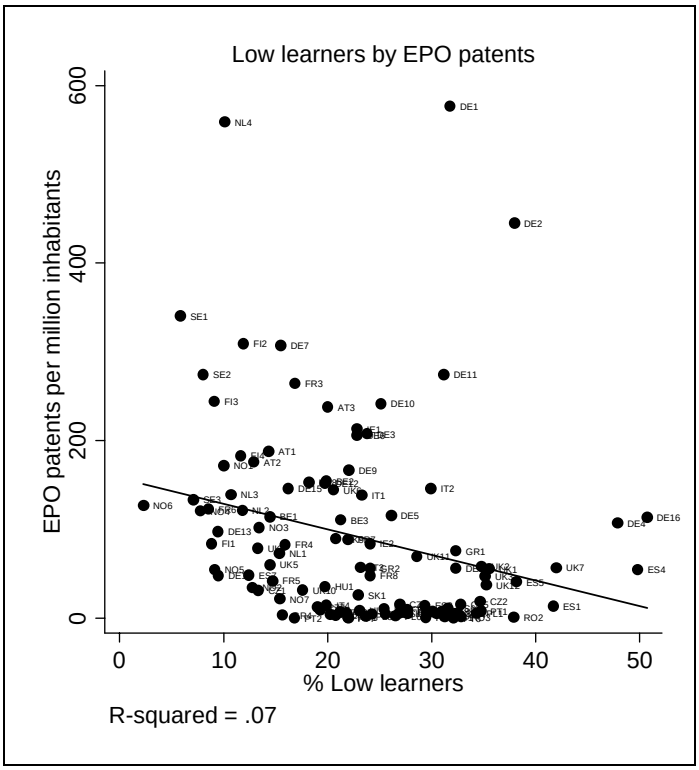


Unfortunately only the second part of this exercise can be repeated at the regional level since a regional breakdown of CIS-5 data is not available. Using patent statistics, however, a case can nevertheless be made for the relation between forms of learning and creativeness or innovativeness at the regional level. The results presented in figures 7-9 show a positive and statistically significant relation between patenting at the regional level and the importance the creative forms of learning, and a negative and statistically significant relation between patenting and the importance of the low forms of learning. There is no evident relation at the regional level between patenting and the constrained forms of learning.

Figure 7 - 9: Correlations between EOP patents per million inhabitants and forms of learning at the regional level.







A number of German regions stand out as outliers, especially Baten-Württembe and Bayern. The Zuid region of the Netherlands, with an exceptionally high rate of patenting, is also an outlier.

4. Learning and regional institutional context

In this section I repeat at the regional level the sort of analysis we have carried out at the national level exploring the impact of the institutional context on the likelihood of the different forms of learning. To do this I use multi-level logistic regression analysis which is a technique that allows one to separate the part of the total variance in the population attributable to differences in individual characteristics and the part due to differences in the regional context in which they work. Multi-level modelling responds to the criticism often made of single-level models that too much emphasis is placed on the individual's characteristics to the neglect of the social or institutional context. By simultaneously modelling at multiple levels it is possible to determine where and how effects are occurring including possible interaction effects between individual attributes and the institutional context. (Rasbash, et al. 2005). Here the technique is used to determine whether measurable differences in the importance of regional-level context conditions over the 20 European nations have a statistically significant impact the likelihood that an employee is engaged in a particular form of learning at work.

In the national level analysis (Holm et al. 2009) we examined the impact differences in labour mobility and labour market policies on the likelihood of the different forms of work organisation. Comparable data are not available at the regional level and in any case labour market policies will be determined, at least in many nations, at the national level. Here I use two kinds of indicators that are available on Eurostat's electronic datrabase, the importance of life-long learning (LLL) at the regional level measured by the percentage of adults aged 25-64 involved in some form of further training or education[4], and the number of persons with a human resource for science and technology education (HRST ED) as a percentage of the active population. It should be pointed out that HRST education is defined broadly to include all persons having successfully completed a third-level education, including those in the humanities and social science, and hence the indicator is a measure of the share of active persons in a region with a third-level education.

[4] Life-long learning is broadly defined to include formal, non-formal and informal or self-learning. Formal life-long learning is defined as that provided by the degree conferring institutions of the formal educational system and contributes to up-grading of formal scientific and technical knowledge. Non-formal education and training refers to all forms of taught learning, including that provided by employers, that occurs outside the formal degree-conferring educational system. This captures the on-going acquisition of both industry and firm-specific knowledge. Informal learning refers to self-taught learning including the use of printed materials and on-line computer based learning. See:
http://circa.europa.eu/irc/dsis/employment/info/data/eu_lfs/LFS_MAIN/Adhoc_modules/2003/ExplanatoryNotes/Final_Report_Ahm2003_EN.pdf

Table 9: Regional Institutional Indicators

LLL		HRST ED	
High LLL regions		**High HRST regions**	
Etelä-Suomi, Finland	24.2%	Région de Bruxelles, Belgium:	45.5
Pohjois-Suomi, Finland:	23.6	Oslo og Akershus, Norway:	44.8
Länsi-Suomi, Finland :	22.2	Centro, Spain:	44.0
Oslo og Akershus, Norway:	20.0	London, UK:	42.5
Itä-Suomi, Finland:	19.8	Nord - Pas-de-Calais, France :	41.4
All UK regions with the exception of Northern Ireland >= 18 %			
Low LLL Regions		**Low HRST regions**	
Noreste, Spain:	1.1%	Severozápad, Czech Rep.	8.5%
Východné Slovensko, Slovakia:	1.8	Açores, Portugal	9.0
Západné Slovensko, Slovakia :	2.6	Alentejo, Portugl	9.6
Noroeste, Spain :	2.7	Macroregiunea doi, Romania	10.2
Alföld és Észak, Hungary :	3.0	Centro, Portugal:	10.9
All Bulgarian and Romanian regions,	< 2 %		
All Greek regions,	< 3 %		

Norway		
Region	**LLL**	**HRST ED**
Oslo og Akershus	20.0%	44.8%
Hedmark og Oppland	17.0	26.4
Sør-Østlandet	17.0	28.3
Agder og Rogaland	16.4	29.7
Vestlandet	19.8	31.1
Trøndelag	19.5	33.9
Nord-Norge	18.3	29.1

Eurostat's regional data set

Table 9 identifies high and low LLL regions and high and low HRST ED regions. The highest LLL regions are located in Finland, Norway and in the UK, while the lowest are located in Spain, Greece, Bulgaria and Romania. The highest HRST ED regions include the Brussels region, the Central region of Spain, the Nord-pas-de-Calais region in France, London, and the Oslo and Akershus region in Norway. The lowest HRST ED regions are located in Portugal, Romania and the Czech Republic.

Table 10: Multi-level logistic models with random intercept and random coefficients

	Creative learners	Constrained learners	Low learners
Fixed: Level 1			
Constant	-.61***	-1.00***	-.60***
EDUC2	.32***	.27***	-.57***
EDUC3	.89***	-.07	-1.44***
EXPRC2	.17***	-.10	-.13**
EXPRC3	.33***	-.18***	-.26***
EXPRC4	.41***	-.26***	-.29***
MANAGERS, SENIOR OFFICIALS	.90***	-.71***	-.68***
PROFESSIONALS	.94***	-.45***	-1.23***
TECHNICANS	.44***	-.04	-.86***
CLERKS	-.07	.03	.06
SERVICE WORKERS	-.22***	-.13*	.40***
SKILLED TRADES			
PLANT, MACHINE OPERATORS	-.76***	.21***	.68***
UNSKILLED	-.61***	-.33***	.98***
AGRICULTURE, FORESTRY, FISHING	.61***	-.81***	-.10
MNFCT, CNSTRCT & UTIL			
RETAIL, OTHER SERVICES	.09*	-.25***	.14*
BUSINESS, FINANCIAL SERVICES	.26***	-.14**	-.24***
PUBLIC ADMN, EDUC, HEALTH	.16***	-.12**	-.10*
COMMUNITY, PERSONAL SERVICES	.22***	-.40***	.13*
Random			
Intercept	.12 (.02)	.05 (.01)	.23 (.04)
N	*19531*	*19531*	*19531*
LR test vs logistic regression	Chibar2(01) = 333.98	Chibar2(01) = 76.22	Chibar2(01) = 424.23

*** = sig. at .01 level, ** = sig. at .05 level, * = .10 level

Tables 10 and 11 present the results for a very simple model where the likelihood of the different form of learning is determined by the level of a person's formal education and the number of years of experience at the level-1 or employee level, and by the two regional context

variables, LLL and HRST ED at the level-2 or regional level. Table 10 shows the results of the model with random intercepts but without regional contextual effects. The level-1 fixed effects show the impact of the employee-level variables on the likelihood of the different forms of learning much as in a standard logistic regression. EDUC2 and EDUC3 refer to the person's level of education with EDUC2 indicating that the person has a secondary or post-secondary education but not tertiary, and EDUC3 indicating that the person as a tertiary education. The reference case for the regression is having primary or no education. EXPRC2, EXPRC3 and EXPRC4 refer to the number of years of working experience an employee has since completing formal education. EXPRC2 refers to between 5 and 10 years, EXPRC3 to between 10 and 25 years, and EXPRC4 to over 25 years of experience. The reference case for the estimations is having less than 5 years of working experience. The regressions includes controls for broad industrial sector and occupation. There are few surprises in the first level results. They indicate a positive impact of having a third-level education on the likelihood of the creative learning forms and a smaller positive effect of having a secondary or post secondary education. The results show that there is a positive relation between the number of years of working experience and the likelihood of creative work activity. For constrained learning, there is a positive impact of having a secondary or post secondary education while the impact of having between 10 and 25 or over 25 years of experience is negative and significant. For the low learning forms, the impact of the education and experience variables are all negative and significant.

With respect to occupation controls, managers, senior officials, professionals and technicians are more likely to be involved in creative learning relative to skilled workers and less likely to be involved in constrained and low learning at work. Service and sales workers; operators and the unskilled are are less likely than the skilled to be involved in creative learning and more likely to be involved in low learning. The results are mixed for these occupations in the case of constrained learning, with operators being more likely than the skilled to be engaged in the forms while sales workers and the unskilled are less likely. The sector control variables show that relative to manufacturing, construction and utilities creative learning is more likely in agriculture and fishing, in the public sector and in community and personal services. The constrained learning forms are especially characteristics of manufacturing, construction and utilities. Relative to manufacturing, low learning is less likely in business and financial services, in public administration, education and health, and in community and personal services than in manufacturing but not in the other broadly defined sectors.

The results for the random part of the model provide estimates of the importance of the variance across regions in the intercept term. Statistically significant variance in the size of the intercept term across regions simply means that when we compare persons with the same individual characteristics across regions those working in regions with a higher (lower) value for the intercept term will have a higher (lower) probability of the particular forms of learning, after controlling for sector and occupational category. The results presented in Table 10 show that the estimated variance in the importance of the low learning forms across regions (.17) is higher than it is for the creative learning forms (.10) or constrained learning forms (.05). The variance across regions is the lowest for the constrained learning forms.

Table 11: Multi-level logistic models with contextual effects[1]

	Creative learners	**Constrained learners**	**Low learners**
Fixed: Level 1			
Constant	.56***	.28***	-.61***
EDUC2	.30***	-.06	-.55***
EDUC3	.88***	.26	-1.43***
EXPRC2	.17***	-.10	-.13**
EXPRC3	.32***	-.18***	-.26***
EXPRC4	.40***	-.26***	-.28***
Fixed Level 2			
LLL	.16***	.04	-.25***
HRST ED	-.01	-.07**	.07
Random			
Intercept	.10 (0.2)	.05 (.01)	.17 (.03)
N	*19531*	*19531*	*19531*
LR test vs logistic regression	Chibar2(01) = 239.22	Chibar2(01) = 70.48	chibar2(01) = 238.62

*** = sig. at .01 level, ** = sig. at .05 level, * = sig. at .10 level

1. Includes controls for sector and occupation.

Table 11 presents the results including the impact of differences across regions in the development of life-long learning and in the share of the active population with a third level education. These variables LLL and HRST ED have been standardized with mean 0 and standard deviation 1 which allows for a comparison of the size of the context effects. These results show the impact of differences in regional context conditions on the likelihood of the different forms of learning for persons with the same individual characteristics. The level-2

context condition variables should help to account for some of the observed variance in the intercept terms and to the extent that this is the case the estimated value of the variance in the intercept term will decline. The results show a slight decline in the estimated intercept variance across regions for the regressions estimating the likelihood of the creative and low learning forms.

From the point of view of regional policy the most important results shown in Table 11 concern the different impacts of the two regional context variables on the likelihood of the creative and low learning forms of work organisation. The column one results show a positive and statistically significant impact of the level of adult participation in life-long learning on the likelihood of creative learning, and the column three results show an even stronger negative impact of life-long learning on the likelihood of the low learning forms. In sharp contrast to this, the results show that there is no significant impact of the share of active persons with a third level education on the likelihood of either the creative or low learning forms.

These contrasting results for the effects the impact of the level of participation in life-long learning and share of the active population with a third-level education at the regional level may seem paradoxical, given that at the employee level there is a strong positive relation between having a third level education and the likelihood of being involved in the creative learning forms. However, what needs to be appreciated here is that employee level effects and regional level context effects need not move in the same direction. Thus, it is quite possible that having a third-level education will increase everywhere a person's likelihood of having access to work with higher levels of learning and autonomy, while increasing the overall regional stock of active persons with a third-level education will not uniformly increase the likelihood that employees in a region will have access to work settings with high levels of learning and autonomy. The regression analysis presented here does not provide the basis for investigating this result. However, an explanation that is consistent with the results is that increasing the level of participation in further education and training including that provided by the degree conferring educational system can compensate to some extent for a region's lack of active persons with an initial formal education at the third-level. However a large stock of persons with a initial formal education at the third-level can not compensate for the failure to make investments in the forms of further education and training that serve to renew and further develop both the formal and the practical work-related skills needed for solving the organisational and technical problems employees confront in work.

Conclusion

This paper has focused on cross regional variations in the relation between individual learning within public and private sector establishments and the characteristics of regional education and training systems. The descriptive statistics have identified considerable variation in the frequency of the different forms of learning not only across nations but also across regions within a nation. A *prima facie* case has been made for the positive relation between the development of the creative forms of learning and regional innovative performance. This raises the issue of policies to promote creative learning and the regression analysis suggests that progress can be made at the regional level by increasing investments in further vocational training and other forms of life-long education and training.

These conclusions need to be qualified in important respects. Firstly, there are the limitations in the regional data available on Eurostat's electronic data base. The problems with using patent statistics as a proxy for innovativeness are well known, and the variables available for capturing differences in the regional institutional context are limited. The analysis of institutional determinants has been limited to indicators of the education and training system and only a small part of the observed inter-regional variance in the likelihood of the different forms of learning has been accounted for. Secondly, as discussed in the introduction, the sample sizes on the basis of which the measures of forms of learning at the regional level have been constructed are relatively small and this means that the statistical estimates, even if unbiased, are relatively imprecise. For all these reasons the analysis presented here must be taken as both tentative and incomplete. Nonetheless I hope that the paper will generate some useful discussion and serve to encourage empirical research adopting similar methodologies.

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ANNEX

List of NUTS Regions

BELGIUM (NUTS1)
- BE1: RÉGION DE BRUXELLES-CAPITALE
- BE2: VLAAMS GEWEST
- BE3: RÉGION WALLONNE

CZECH REPUBLIC (NUTS2)
- CZ1: Praha
- CZ2: Střední Čechy
- CZ3: Jihozápad
- CZ4: Severozápad
- CZ5: Severovýchod
- CZ6: Jihovýchod
- CZ7: Střední Morava
- CZ8: Moravskoslezsko

GERMANY (NUTS1)
- DE1: BADEN-WÜRTTEMBERG
- DE2: BAYERN
- DE3: BERLIN
- DE4: BRANDENBURG
- DE5: BREMEN
- DE6: HAMBURG
- DE7: HESSEN
- DE8: MECKLENBURG-VORPOMMERN
- DE9: NIEDERSACHSEN
- DE10: NORDRHEIN-WESTFALEN
- DE11: RHEINLAND-PFALZ
- DE12: SAARLAND
- DE13: SACHSEN
- DE14: SACHSEN-ANHALT
- DE15: SCHLESWIG-HOLSTEIN
- DE16: THÜRINGEN

IRELAND (NUTS2)
- IE1: BORDER, MIDLAND AND WESTERN
- IE2: SOUTHERN AND EASTERN

GREECE (NUTS1)
- GR1: VOREIA ELLADA
- GR2: KENTRIKI ELLADA
- GR3: ATTIKI
- GR4: NISIA AIGAIOU, KRITI

SPAIN (NUTS1)

- ES1: NOROESTE
- ES2: NORESTE
- ES3: COMUNIDAD DE MADRID
- ES4: CENTRO
- ES5: ESTE
- ES6: SUR
- ES7: CANARIAS

FRANCE (NUTS1)

- FR1: ÎLE DE FRANCE
- FR2: BASSIN PARISIEN
- FR3: NORD - PAS-DE-CALAIS
- FR4: EST
- FR5: OUEST
- FR6: SUD-OUEST
- FR7: CENTRE-EST
- FR8: MÉDITERRANÉE

ITALY (NUTS1)

- IT1: NORD-OVEST
- IT2 : NORD-EST
- IT3: CENTRO
- IT4: SUD

HUNGARY (NUTS1)

- HU1
- HU2
- HU3

NETHERLANDS (NUTS1)

- NL1: NOORD-NEDERLAND
- NL2: OOST-NEDERLAND
- NL3: WEST-NEDERLAND
- NL4: ZUID-NEDERLAND

AUTSTRIA (NUTS1)

- AT1: OSTÖSTERREICH
- AT2: SÜDÖSTERREICH
- AT3: WESTÖSTERREICH

POLAND (NUTS1)

- PL1: REGION CENTRALNY

PL2: REGION POŁUDNIOWY
PL3: REGION WSCHODNI
PL4: REGION PÓŁNOCNO-ZACHODNI
PL5: REGION POŁUDNIOWO-ZACHODNI
PL6: REGION PÓŁNOCNY

Portugal NUTS2)
PT1: Norte
PT2: Algarve
PT3: Centro
PT4: Lisboa
PT5: Alentejo
PT6: Região Autónoma dos AÇORES
PT7: Região Autónoma da MADEIRA

SLOVAKIA (NUTS2)
SK1: Bratislavský kraj
SK2: Západné Slovensko
SK3: Stredné Slovensko
SK4: Východné Slovensko

FINLAND (NUTS2)
FI1: Itä-Suomi
FI2: Etelä-Suomi
FI3: Länsi-Suomi
FI4: Pohjois-Suomi

SWEDEN (NUTS1)
SE1: Östra Sverige
SE2 : Södra Sverige
SE3: Norra Sverige

UNITED KINGDOM (NUTS1)
UK1: NORTH EAST (ENGLAND)
UK2: NORTH WEST (ENGLAND)
UK3: YORKSHIRE AND THE HUMBER
UK4: EAST MIDLANDS (ENGLAND)
UK5: WEST MIDLANDS (ENGLAND)
UK6: EAST OF ENGLAND
UK7 LONDON
UK8 SOUTH EAST (ENGLAND)
UK9: SOUTH WEST (ENGLAND)
UK10: WALES
UK11 SCOTLAND
UK12: NORTHERN IRELAND

BULGARIA (NUTS1)

BG1: SEVERNA I IZTOCHNA BULGARIA
BG2: YUGOZAPADNA I YUZHNA TSENTRALNA BULGARIA

ROMANIA (NUTS1)

RO1: Macroregiunea unu
RO2: Macroregiunea doi:
RO3: Macroregiunea trei
RO4: Macroregiunea patru

NORWAY (NUTS2)

NO1: Oslo og Akershus
NO2: Hedmark og Oppland
NO3: Sør-Østlandet
NO4: Agder og Rogaland
NO5: Vestlandet
NO6: Trøndelag
NO7: Nord-Norge