

Regional Learning Dynamics and Systems of Education and Training: A European Comparison

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Abstract This paper investigates regional differences in the relation between styles of employee learning within public and private sector establishments and the characteristics of regional education and training systems. The paper starts by developing a measure of creativity at work for a sample of 81 regions across 18 European nations. Using multi-level regression, the paper shows how differences in the level of development of a region's tertiary education system, and differences in the provision of formal and informal types of lifelong learning, impact on the development of creative forms of learning at work. The results show not only that well-developed regional systems of lifelong learning have a positive impact on the likelihood that employees on average will be involved in creative forms of work organisation, but also that systems of lifelong learning increase the relative chances that employees with only a secondary-level education will have access to creative work environments. This implies that lifelong learning policies can serve an important remedial purpose by helping to reduce inequalities in access to high-quality work environments for employees with different levels of initial education.

Keywords Regional innovation system · Creativity · Systems of education and training · Multi-level analysis

Introduction

The importance of systems of education and training for the innovative performance of regionally clustered enterprises has been a key theme in the literature on regional innovative systems (RIS). The early work on regional innovative systems [4, 8, 9] drew inspiration from seminal contributions to the research on national innovation systems, in particular work by Freeman [12] and Lundvall [17]. A central idea was

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that of two subsystems engaged in processes of interactive learning, one composed of private enterprises, often tightly clustered, and the other composed of the regional supportive infrastructure, composed of a variety of organisations responsible for processes of knowledge generation and transmission, including public research institutions, universities and vocational training providers.

A central issue addressed in this literature has been the relation between geographic distance and knowledge transmission. One strand of literature has focused on the role of knowledge spillovers in the performance of high technology sectors. It has provided evidence that the formal R&D activities of private sector enterprises benefit from their location in regions that are well endowed with university research or other public sector research institutions. Proximity favours the transfer scientific and technical knowledge both through the recruitment of university-trained scientists and through formal R&D collaboration [1, 14, 16]. At the same time, there has been an appreciation that the knowledge upon which the innovative performance of regionally clustered enterprises depends is not solely the result of formal R&D activity, but also the result of informal processes of learning by doing and learning by interacting [15, 18, 19, 27]. This emphasis on informal experience-based learning in turn has generated an interest in the regional foundations for the development of 'learning organizations', with a focus on the way the regional institutional structure can support processes of interactive learning within the firm ([5, 6, 7, 22]).

This paper contributes to this research agenda by drawing on survey data in order to investigate the links between styles of employee learning, the innovative performance of enterprises and the characteristics of regional education and training systems. One of the central contributions of the paper is to develop a measure of creative employee learning on the job and to compare differences in its frequency across a sample of 81 regions in 18 European nations. Using this measure, a multi-level regression analysis is undertaken in order to explore the relation between differences in the development of regional education and training systems and the characteristics of employee learning on the job. The analysis addresses the issue of how differences in the level of development of the region's tertiary education system, and differences in the provision of various forms of formal and informal lifelong learning, impact on the development of creative forms of learning at work at the regional level. By exploring the links between regional context conditions and individual-level characteristics and behaviour, the paper addresses important policy issues, such as whether robust systems of further education and lifelong learning can compensate for relatively low levels of initial formal education in promoting dynamic learning at the workplace.

The paper builds on a methodology for addressing these issues at the national level, as developed in a series of co-authored papers. In Lorenz and Valeyre [20] the basic methodology for developing a taxonomy of forms of work organisation and employee learning for the EU-15 is developed. Arundel et al. [3] build on this analysis and present 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.

In Holm et al. [13] the framework is extended through the use of multi-level regression analysis to explore the relation between forms of work organisation and institutional context for the EU-27 and Norway. The results point 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 combining 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 the adoption of forms of work organisation characterised by high levels of autonomy and learning on the job.

This paper builds on the approach developed in these papers in order to explore the relation between employee learning, innovation performance and systems of education and training at the regional level using the regional breakdown of data according to the European Union's NUTS nomenclature available in Fourth European Survey on Working Conditions (EWCS) carried out in 2005. The paper is structured in the following way. Section [Measuring Employee Learning Dynamics](#) describes the employee-level measures derived from the results of the 2005 EWCS that are used to characterise different forms of employee learning at the regional level, and presents differences across nations and regions. Certain limitations of the employee-level data entail limiting the analysis to 81 regions in 18 European nations. Section [Links Between Employee Learning and Innovation](#) examines the relation between the frequency of the different forms of learning and measures of enterprise innovative performance at both the national and regional levels. Section [A Multi-Level Analysis of Employee Learning and Regional Education and Training Systems](#) presents the results of a multi-level regression analysis used to explore the impact of the development of the regional education and training system on the likelihood of the different forms of learning. Section [Conclusion](#) concludes by drawing out some of the policy implications.

Measuring Employee Learning Dynamics

Although the 2005 EWCS was carried out in Norway and all 27 EU member nations, due to limitations with the data the analysis here is limited to the regions of 18 European nations. Firstly, eight of the 27 EU member nations have been excluded from the study for the simple reason that a NUTS breakdown of their regions is not available, or was not available, in 2005. These include Cyprus, Denmark, Estonia, Lithuania, Luxembourg, Latvia, Malta and Slovenia.

Second, 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 employment¹, the size of the sample is relatively small, with approximately 1,000 observations per nation. The small sample size has entailed excluding two of the more populous

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 [21], p. 94.

nations from the study, the UK and Germany, since their administrative breakdown into 12 and 16 regions at the NUTS-1 level respectively means that even at this level the number of observations per region is in many cases too small to make reliable point estimates.

For the majority of the remaining 18 nations included in the study, the small sample size has dictated carrying out the analysis at the NUTS-1 level in order to be assured of having a sufficient number of observations per region for making reliable estimates. The exceptions to this are the Czech Republic, Slovakia, Finland, Ireland, Norway and Portugal, countries with relatively small populations, where the NUTS-1 level corresponds to the entire nation. For these six countries the analysis is done at the NUTS-2 level.² The resulting sample on which the analysis is based is 81 regions located in 18 nations.³

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 in terms of structural characteristics. This can be illustrated by considering the case of Norway. Table 2 presents figures on the distribution of employment by broad industrial sector at the county or NUT-3 level. The figures point to significant differences in industrial structure within the Agder–Rogaland region and in particular to the importance of oil and gas production in Rogaland. More generally, intra-regional differences at the NUTS-2 can be observed elsewhere in Norway. For example, in the Vestlandet region, manufacturing employment is relatively important in Møre og Romsdal, and in the Trøndelag region business services are relatively important in Sør-Trøndelag. The impact of such intra-regional differences in industrial structure at the NUTS-2 level is necessarily glossed over in the analysis of work organisation and learning that follows (Table 1).

Learning at the National and Regional Levels

The analysis in Lorenz and Valeyre [20] drew on a part of the entire sample of the EWCS and was restricted to salaried employees working in private sector establishments employing ten 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 than ten employees in both the private and public sector establish-

² The Acores and Madeira islands of Portugal, each classified as separate NUT2 regions, have been excluded due to the number of observations being too small for reliable estimates.

³ In order to enhance the representativeness of the results of the EWCS three types of weights are applied: a selection probability weighting which corrects for the tendency of the ‘random walk’ to give greater probability of selection to individuals in smaller households; a post-stratification weight which adjusts the results of the survey to the results of the Labour Force Survey for the variables sex, age, region, occupation and sectors; and a cross-regional weighting which adjust for the proportion that each region represents in the total employed population for the 81 regions. The cross-regional weighting is used for the regional estimates of forms of employee learning presented in Table 7 and in Table 12 in the Appendix. For the aggregate frequencies presented in Tables 2, 3, 4, 5 and 6, cross national weightings are used.

Table 1 Structural indicators: Norway 2007

County	Manufacturing employment share of total	Agricultural employment share of total	Oil and gas employment share of total	Financial and business services employment share of total
NO031: Østfold	15.5	2.4	0.0	9.3
NO012: Akershus	6.3	1.2	0.6	13.3
NO011: Oslo	8.2	0.2	0.2	33.5
NO021: Hedmark	11.2	6.3	0.0	8.6
NO022: Oppland	11.4	6.7	0.0	7.4
NO032: Buskerud	13.6	2.2	0.0	10.4
NO033: Vestfold	13.4	2.1	0.0	10.0
NO034: Telemark	13.0	2.4	0.0	9.7
NO041: Aust-Agder	12.6	2.5	0.0	8.5
NO042: Vest-Agder	15.4	2.2	0.0	10.8
NO043: Rogaland	14.3	3.7	7.1	12.5
NO051: Hordaland	12.5	2.1	1.3	13.4
NO052: Sogn og Fjordane	15.1	8.0	0.1	6.7
NO053: Møre og Romsdal	18.7	5.4	0.2	7.9
NO061: Sør-Trøndelag	9.6	3.9	0.7	15.4
NO062: Nord-Trøndelag	12.0	9.0	0.8	6.4
NO071: Nordland	9.9	6.3	0.0	7.2
NO072: Troms Romsa	5.9	4.7	0.3	9.1
NO073: Finnmark Finnmark	6.8	6.8	0.0	7.4

Statistics Norway's electronic database

ments. This in turn implied making some changes to the choice of variables used in Lorenz and Valeyre [20] 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 2 below. The variables were chosen to

Table 2 Variables for types of learning

	Percent of salaried employees affected
Problem solving activities	81.0
Learning new things in work	69.1
Using one's own ideas in work	58.2
Undertaking complex tasks	55.5
Discretion in fixing work methods	64.5
Discretion in setting work pace	68.6
Repetitiveness of tasks	36.9
N	17,412

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capture differences in the importance of creative learning and problem solving activity at work.

Based on a factor analysis and cluster analysis, three distinct groups are identified corresponding to different styles or forms of learning within establishments. Table 3 presents the results, showing the percent of the persons grouped in each cluster that are characterised by each of the seven work organisations features. The first cluster, which I refer to as the “creative learning” group, is characterised by a 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 54.2% of the total population. The second cluster, accounting for 22.9% of the total 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 [20], 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. It accounts for 23.9% of the population.

Table 4 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 public administration, in education and health and in personal and community services. They are underrepresented in manufacturing and in related and other services. Interestingly, agriculture, forestry and fishing, while accounting for a very small share of the total population, appear to be a relatively learning-intensive sector. The constrained learning forms are overrepresented in manufacturing, construction and utilities, while the low learning forms are most frequent in retail and other services.

Table 5 gives the occupational breakdown. As expected, the creative learning forms are relatively high for managers, senior officials, professionals and

Table 3 Learning clusters: 18 European Nations (percent of salaried employees by learning cluster)

Variable	Creative learning	Constrained learning	Low learning	Average
Problem solving activities	95.5	88.6	40.5	81.0
Learning new things in work	85.4	86.8	15.2	69.1
Complexity of tasks	68.2	76.9	5.9	58.2
Using one’s own ideas	81.3	35.9	26.1	55.5
Discretion in fixing work methods	96.3	19.9	33.5	64.5
Discretion in setting work rate	95.0	30.1	44.4	68.6
Repetitiveness of tasks	30.5	50.0	39.3	36.9
Total share of employees	54.2	22.9	23.9	100.0

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Table 4 Types of learning by sector of activity: 18 European Nations

	Percent of salaried employees by sector of activity and type of learning			
	Creative learning	Constrained learning	Low learning	Total
Agriculture, forestry, fishing	61.0	12.2	26.8	100
Manufacturing, construction and utilities	46.0	27.0	27.0	100
Retail and other services	48.5	21.9	39.6	100
Business and financial services	65.1	19.6	15.3	100
Public administration, education, and health and social work	62.8	21.9	15.3	100
Community, social and personal services	59.7	17.8	22.5	100
Average	54.2	22.9	23.9	100

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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 elementary jobs. The 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 elementary occupations.

Table 6 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, Bulgaria, Austria and Finland. The low learning forms tend to be

Table 5 Types of learning by occupation: 18 European Nations

	Percent of salaried employees by occupation and type of learning			
	Creative learning	Constrained learning	Low learning	Total
Managers and senior officials	75.7	12.3	12.0	100
Professionals	76.5	16.1	7.4	100
Technicians	64.7	25.2	10.1	100
Clerks	51.0	25.4	23.6	100
Sales and service	51.3	22.3	25.4	100
Craft and related trades	50.7	24.2	25.1	100
Plant and machine operators	28.0	28.9	43.1	100
Elementary occupations	34.8	21.4	43.8	100
Average	54.2	22.9	23.9	100

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more frequent in the southern and new member nations and they are most present in Spain, Bulgaria and Romania.

Table 7 identifies regions which rank high in terms of the importance of creative learning, constrained learning and low learning. Table 12 in the Appendix presents the frequencies of the forms of learning for all 81 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 NUTS-1 regions figuring amongst the top ten regions for the 18 European nations, and five of the seven NUTS-2 Norwegian regions figuring amongst the top ten. The Sud-Ouest of France stands out for its high frequency of creative learning in a nation where the level of creative learning overall is about average.

With respect to high levels of constrained learning, regions within the Czech Republic, Portugal, Spain and Finland account for most of the top ten. The Itä Suomi and Pohjois-Suomi regions in Finland stand out for combining above average levels of constrained learning with some of the lowest reported levels of low learning. Most of the regions with the highest frequencies of the low learning forms are located in Spain, Portugal, Romania and the Czech Republic.

Links Between Employee Learning and Innovation

In Arundel et al. [3] 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 [2], in collaboration with Paul Crowley of Eurostat. Based on the results of the Third Community Innovation Survey (CIS-3) carried out in 2000/2001, the typology classifies all innovative 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 the Fifth Community Innovation Survey (CIS-5) carried out in 2006, the exercise can be repeated to a certain extent by using an indicator of the share of all enterprises that have innovated products (goods and services) that are not only new-to-the firm but also new-to-the market.⁴ Figures 1, 2 and 3 present the correlations between our aggregate measures of the national frequency of learning forms for the 18 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 forms, and a clear negative relation between their frequency and

⁴ The CIS estimates of the percentage of firms that have introduced products that are new-to-the firm is a very broad measure of innovation ranging from intensive in-house R&D to develop a new-to-market products to minimal effort to market a new product developed by an outside firm or organisation. This 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. In order to more accurately differentiate nations in terms of firms' innovative capabilities, I focus here on the percentage of firms that have introduced products that are new-to-the market.

Table 6 Differences between countries in types of learning: 2005 (percent of salaried employees by learning cluster)

	Creative learning	Constrained learning	Low learning	Total
Belgium	62.12	18.05	19.84	100
Czech Republic	43.59	30.24	26.16	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	49.66	24.70	25.64	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
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 for 18 nations	54.2	22.9	23.9	100

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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 4, 5 and 6 extend the exercise using another indicator of innovativeness, EPO patent applications per million inhabitants. An advantage in using patents as an indicator of innovation is that patents are granted for innovative technologies that both have commercial promise and that make a non-obvious advance in the state of the art.

Well-known disadvantages of this measure are that not all innovations are patented and that the use of patenting varies across industrial sectors. While the correlations presented above do not adjust for differences in the national industrial structure, they nonetheless provide further support for the view that firms are more innovative in nations where work activity is characterised by high levels of creativity.⁵

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

⁵ There is a strong positive and statistically significant correlation of 0.73 between the frequency of new-to-market product innovations and the number of EPO patent applications per million population.

Table 7 Types of learning by region

	Percent of salaried employees by region and type of learning			
	Creative learning	Constrained learning	Low learning	Total
Ten regions with the highest frequency of creative learning				
Trøndelag, Norway	75.05	22.66	2.29	100
Norra Sverige, Sweden	73.91	19	7.09	100
Oslo og Akershus, Norway	73.58	16.33	10.1	100
Vestlandet, Norway	73.55	17.24	9.21	100
Sud-Ouest, France	73.1	18.1	8.8	100
Agder og Rogaland, Norway	72.46	18.83	8.71	100
Nord-Norge, Norway	72.13	12.46	15.41	100
Östra Sverige, Sweden	72	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
Ten regions with the highest frequency of constrained learning				
Lisboa, Portugal	32.63	41.93	25.43	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
Sur, Spain	35.43	32.99	31.58	100
Itä Suomi, Finland	58.69	32.46	8.85	100
Pohjois-Suomi, Finland	55.91	32.43	11.66	100
Ten regions with the highest frequency of low learning				
Centro, Spain	29.98	20.2	49.83	100
Noroeste, Spain	44.6	13.7	41.71	100
Este, Spain	39.59	22.25	38.16	100
Macroregiunea doi, Romania	39	23.09	37.91	100
Norte, Portugal	41.55	23.72	34.73	100
Strední Čechy, Czech Republic	38.49	26.83	34.68	100
Centralny, Poland	41.05	24.62	34.33	100
Macroregiunea trei, Romania	46.33	20.83	32.84	100
Severovýchod, Czech Republic	32.24	34.97	32.8	100
Severozápad, Czech Republic	39.77	27.69	32.54	100

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statistics, a case can still be made for the relation between forms of learning and innovativeness at the regional level. The results presented in Figs. 7, 8 and 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

Fig. 1-3 Correlations between new-to-market product innovators and forms of learning at the national level: 18 European nations

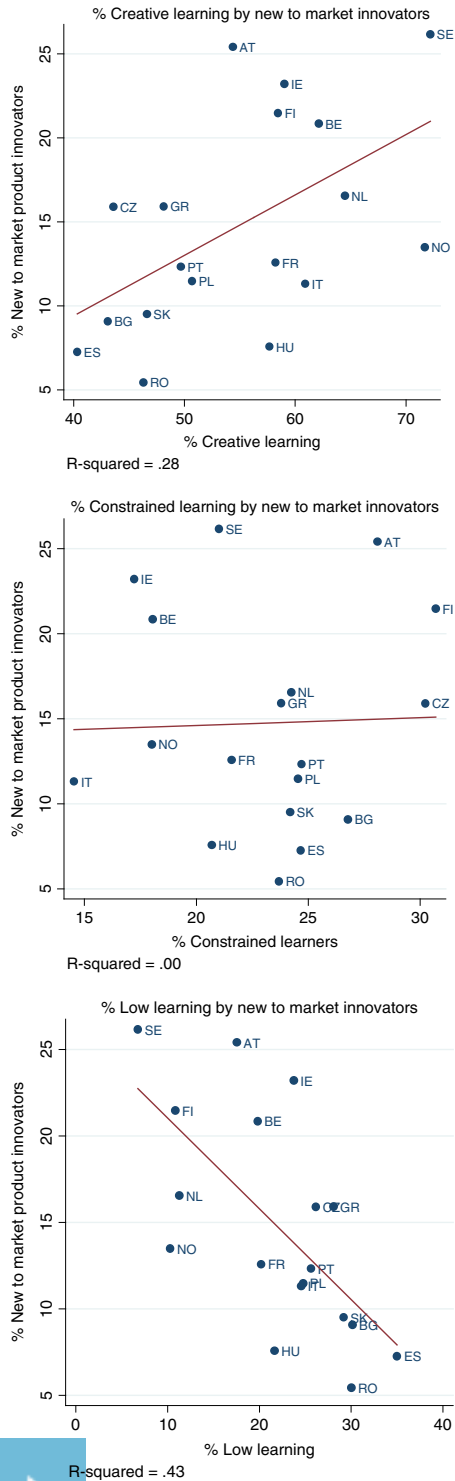


Fig. 4-6 Correlations between EPO patents per million inhabitants and forms of learning at the national level: 18 European nations

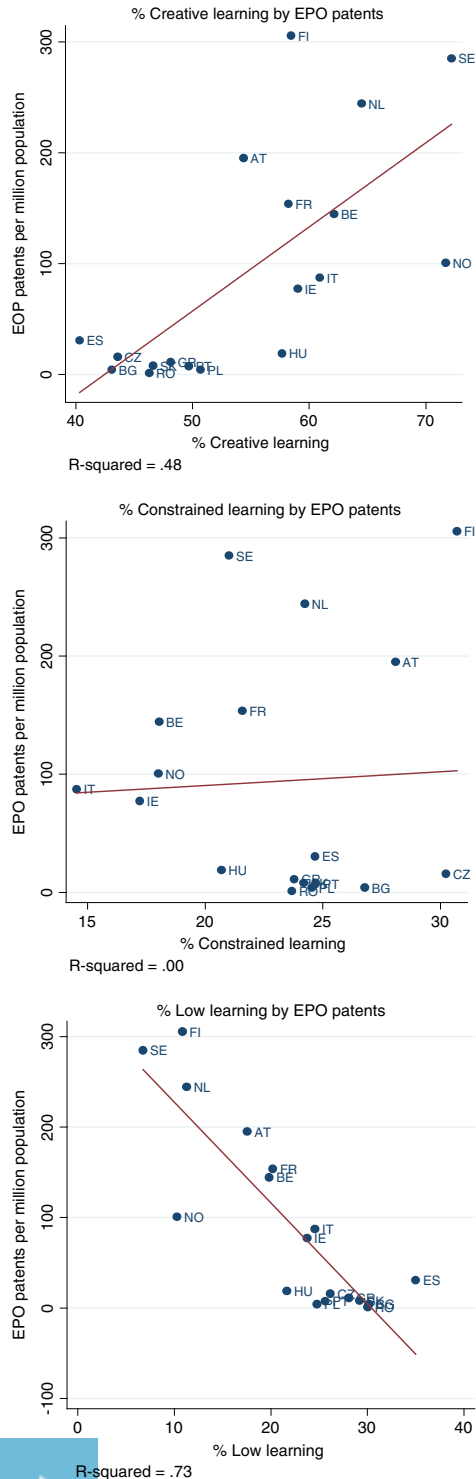
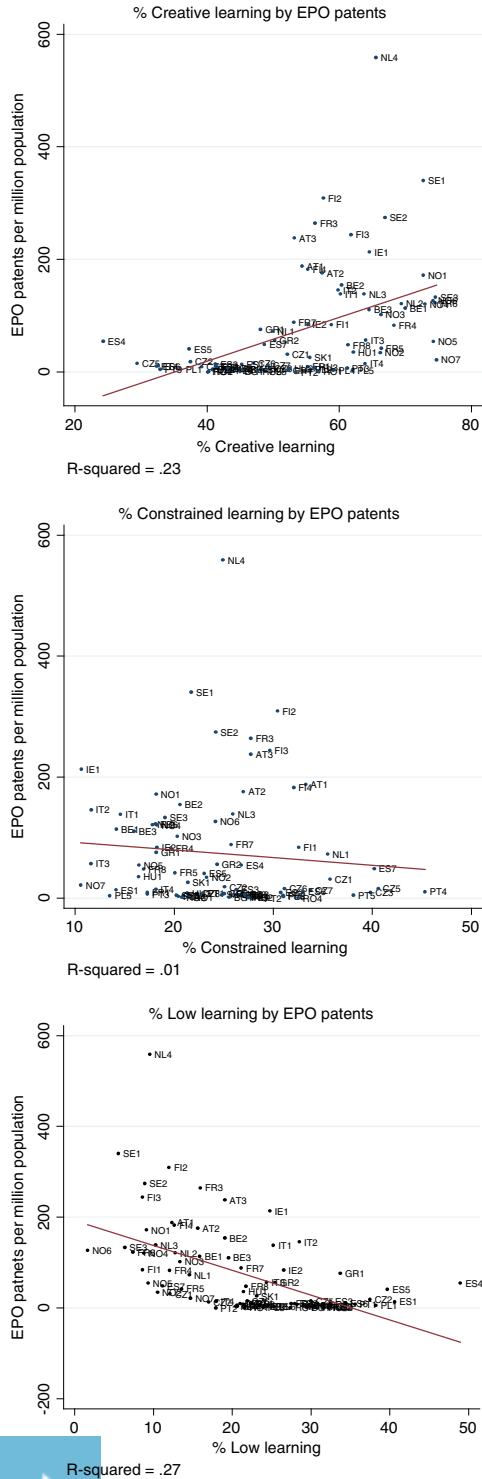


Fig. 7-9 Correlations between EPO patents per million inhabitants and forms of learning at the regional level: 81 regions in 18 European nations



significant relation between patenting and the importance of the low forms of learning. There is a very small negative and non-statistically significant relation between patenting and the constrained forms of learning. The Zuid region of the Netherlands, with an exceptionally high rate of patenting, stands out as an outlier.

A Multi-Level Analysis of Employee Learning and Regional Education and Training Systems

In this section I explore the impact of differences in regional education and training systems 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 residual variance in the population attributable to differences in individual characteristics from 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. [23]. Here, the technique is used for two purposes: firstly, to determine whether differences in the development of regional education and training systems over the 81 European regions have a direct and statistically significant impact on the likelihood that employees in general in the region are engaged in the different forms of learning at work; and second, by examining interaction effects, to determine whether the effect of the level of an employee's initial formal education on his or her likelihood of being engaged in the different forms of learning at work varies across regions as a function of the level of development of the regional education and training system.

Employee-Level Variables

In what follows, a very simple model specification is developed at level 1, or employee-level, with the likelihood of an employee being engaged in the different forms of learning being determined by the level of his or her initial formal education and the number of years of working experience. This perspective draws inspiration from the behavioural psychology literature which focuses on the importance of domain specific expertise for creativity [11, 26]. Expertise is seen as being based on the mastery of a body of codified knowledge as well as tacit knowledge based on experience. A variety of empirical evidence has been mustered to demonstrate that creativity is preceded by a number of years of working experience in the field possibly accompanied by formal education and training ([28, 29]). Although much of the anecdotal evidence focuses on eminent individuals characterised by exceptional creativity [25], the importance of expert thinking has also been supported by research focussing on everyday or 'local' creativity such as that displayed by group facilitators or teaching assistants in academic settings [10, 24].

In order to capture the acquisition of formal knowledge of the sort codified in academic texts and manuals, a three level categorical variable is defined measuring the level of a person's initial formal education. EDUC1 indicates that a person has at most a lower secondary education, EDUC2 that the person has an upper secondary or post-secondary education but not tertiary, and EDUC3 that the person has a tertiary education. The reference case for the regressions is EDUC1, having a lower secondary, primary or no education. Unlike codified knowledge acquired through formal education, the acquisition of informal experience-based knowledge cannot be captured on the basis of enrolments or degrees awarded. As a proxy for the importance of experience-based knowledge, I use a four-level categorical variable indicating the number of years of working experience a person has had since completing formal education. EXPRC1 refers to less than 5 years of experience, EXPRC2 to between 5 and 10 years of experience, EXPRC3 to between 10 and 25 years, and EXPRC4 to over 25 years of experience. The reference case for the estimations is EXPRC1, having less than 5 years of working experience. The regressions include controls for broad industrial sector and occupation.

Regional Level Context Variables

At level 2, or the regional level, differences in the development of regional systems of education and training are captured with two kinds of indicators that are available on Eurostat's electronic database: the importance of lifelong learning (LLL) at the regional level measured by the percentage of adults aged 25–64 involved in some form of further training or education during the 4 weeks prior to the survey⁶; and the percentage of the population aged 25–64 having completed tertiary education (TERT). Life-long learning is broadly defined to include formal, non-formal and informal or self-learning. Formal lifelong learning is defined as that provided by the degree-conferring institutions of the formal educational system and contributes to the upgrading 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.

Table 8 identifies high- and low-LLL regions and high- and low-TERT regions. The highest LLL regions are located in Finland, Norway and in Sweden, while the lowest are located in Spain, Greece, Bulgaria and Romania. The highest TERT regions include the Brussels region, the Madrid and Noreste regions of Spain, Ile de France, the Oslo region in Norway and the Itä-Suomi region in Finland. The lowest TERT regions are located in Portugal, Romania and the Czech Republic. For the 81 regions, there is a moderately high positive correlation between TERT and LLL of 0.68.

⁶ For a presentation of the of the survey methodology, see the Quality report for the 2003 version: http://circa.europa.eu/irc/dsis/employment/info/data/eu_ifs/LFS_MAIN/Adhoc_modules/2003/Explanatory_Notes/Final_Report_Ahm2003_EN.pdf

Table 8 Regional institutional indicators

LLL	TERT
High LLL regions	High TERT regions
Etelä-Suomi, Finland 24.2%	Oslo og Akershus, Norway: 44.9
Pohjois-Suomi, Finland: 23.6	Brussels Hoofdstedelijk Gwest, Belgium: 41.5
Länsi-Suomi, Finland : 22.2	Ile de France, France: 38.7
Oslo og Akershus, Norway: 20.0	Etelä-Suomi, Finland: 37.6
Itä-Suomi, Finland: 19.8	Comunidad de Madrid, Spain : 36.6
Vestlandet, Norway : 19.8	Noreste, Spain : 36.5
Trondelag, Norway : 19 0.5	West-Nederland, Netherlands : 33.2
Södra Sverige, Sweden : 19.3	Ostra Sverige, Sweden : 32.9
Nord-Norge, Norway : 18.4	Trøndelag : Norway : 32.8
Östra Sverige, Sweden : 18.3	Länsi-Suomi, Finland : 32.6
Low-LLL regions	Low-TERT regions
Severna I iztochna, Bulgaria: 0.1%	Macroregiunea doi, Romania: 6.5%
Macroregiunea doi, Romania: 1.1	Macroregiunea uno: Romania: 7.0
Nisia Aigaiou, Kriti, Greece 1.1	Severozápad, Czech Republic: 7.5
Noreste, Spain: 1.2	Macroregiunea patru, Romania: 7.9
Macroregiunea patru, Romania: 1.4	Alentejo, Portugal : 9.8
Macroregiunea uno: Romania: 1.4	Notre, Portugal: 9.9
Macroregiunea tre: Romania 1.5	Centro, Portugal: 10.2
Východné Slovensko, Slovakia: 1.8	Střední Čechy, Czech Republic: 10.5
Attiki, Greece: 1.8	Moravskoslezsko, Czech Republic: 10.6
Yugozapadna i yuzhna centralna Bulgaria: 1.8	Severovýchod, Czech Republic: 10.7

Eurostat's regional data set

Table 9 below shows the results for the basic model including both random intercepts and random coefficients for the variables measuring the employee's level of formal education and years of working experience. 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.

With respect to the variables measuring the level of an employee's initial education and years of working experience, the results are quite straight forward. Relative to persons having at most a lower secondary education, they show a positive impact of having a tertiary-level education on the likelihood of the creative learning forms and a smaller positive effect of having a upper secondary or post-secondary, non-tertiary 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. The likelihood of the low learning forms is decreasing in the level of education and years of experience and the coefficients are all statistically significant.

Table 9 Multi-level logistic models with random intercepts and coefficients at the regional level

	Creative learners	Constrained learners	Low learners
Fixed: Level 1			
Constant	-0.57 ^a	-0.91 ^a	-0.67 ^a
EDUC2	0.29 ^a	0.22 ^a	-0.56 ^a
EDUC3	0.96 ^a	-0.12	-10.42 ^a
EXPRC2	0.20 ^a	-0.12 ^c	-0.15 ^b
EXPRC3	0.37 ^a	-0.19 ^a	-0.31 ^a
EXPRC4	0.48 ^a	-0.28 ^a	-0.38 ^a
Managers, senior officials	0.68 ^a	-0.63 ^a	-0.42 ^a
Professionals	0.47 ^a	-0.29 ^a	-0.60 ^a
Technicians	0.25 ^a	0.02	-0.62 ^a
Clerks	-0.20 ^a	0.08	0.20 ^b
Service workers	-0.23 ^a	-0.11	0.41 ^a
Skilled trades			
Plant, machine operators	-0.72 ^a	0.22 ^a	0.62 ^a
Elementary	-0.57 ^a	-0.27 ^a	0.90 ^a
Agriculture, forestry, fishing	0.62 ^a	-0.76 ^a	-0.16 ^c
Mnft, Cnstrct & Util			
Retail, other services	0.15 ^a	-0.22 ^a	0.03
Business, financial services	0.23 ^a	-0.10	-0.25 ^a
Public admn, educ, health	0.12 ^b	-0.09	-0.07
Community, personal services	0.19 ^a	-0.33 ^a	0.11
Random			
Intercept	0.123 (0.027)	0.044 (0.014)	0.232 (0.049)
Coefficient EDU2	0.030 (0.009)	0.010 (0.015)	0.057 (0.029)
Coefficient EDU3	0.083 (0.035)	0.045 (0.030)	0.123 (0.042)
Coefficient EXPRC2	0.00 (0.00)	0.00 (0.00)	0.007 (0.037)
Coefficient EXPRC3	0.00 (0.00)	0.011 (0.017)	0.012 (0.024)
Coefficient EXPRC4	0.030 (.0.024)	0.00 (0.00)	0.047 (0.035)
N	17,412	17,412	17,412
LR test vs Logisitic regression:	chi2(6)=335.1 Prob>chi2=0.000	chi2(6)=76.78 Prob>chi2=0.000	chi2(6)=407.43 Prob>chi2=0.000

^a Significant at 0.01 level

^b Significant at 0.05 level

^c Significant at 0.10 level

With respect to the occupational and sector controls, while most of the results are also straightforward, there are a few surprises. As might be anticipated, managers, senior officials, professionals and technicians are more likely to be involved in creative learning relative to skilled workers and they are less likely to be involved in low learning at work. Service and sales workers, operators and the elementary occupations 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 service workers and the elementary occupations being less likely than the skilled to be engaged in these forms, while operators are more likely. The latter result is somewhat surprising and implies that the amount of problem solving, admittedly of a constrained sort, undertaken by machine handlers and operators is typically underestimated.

The sector control variables show, relative to manufacturing construction and utilities, that creative learning is more likely in agriculture forestry and fishing, in the public sector and in community and personal services. Somewhat surprisingly, the sector for which the difference is most pronounced is agriculture, forestry and fishing, suggesting that the amount of learning required of employees in what is usually classified as a traditional industry is considerably underestimated. 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, in education and health, and in community and personal services but not in retail and other services.

The results for the random part of the models shown in Table 9 provide estimates of the variance across regions in both the intercept term and in the coefficients for the variables capturing the level of initial education and years of working experience. These variance estimates capture different aspects of variability in the impact of regional context conditions on employee-level outcomes across the 81 regions. For example, in the case of the model predicting the likelihood of creative work, statistically significant variance in the intercept term means that in regions where the value of the intercept term is greater than the average value for the 81 regions, the likelihood that employees in general in the region are engaged in creative work will be above the average for the population as a whole. Statistically significant variance in the estimated coefficients on the variables capturing the level of initial education, or years of working experience, means that the size of the positive impact of having a higher level of initial education, or of having more years of working experience, on the likelihood of being engaged in creative work activity will vary across the 81 regions.⁷

The results presented in the first row for the random part of the model indicate that the estimated variance in the intercept for the model predicting creative work is 0.123. The estimated variance for the model predicting low learning is about twice that (0.232), while in the case of the model predicting constrained learning the estimated variance in the intercept term is considerably smaller (0.044). In general, the estimated variance in the coefficients of the variables measuring an employee's level of education and his or her years of working experience are lower than the estimated variance in the intercept terms. The results presented in rows 2 through 6 of the random part of the model show that there is very little difference across regions in the positive impact of having more years of experience on the likelihood of the different forms of learning at work, while there is more variability across regions in the impact of having more years of formal education on the likelihood of the different forms of learning at work.

⁷ Since the value of the variance is by definition greater than 0, standard tests of whether the estimated variance parameters are statistically different from 0 are inappropriate. The likelihood ratio (LR) test reported at the bottom of the table compares the multi-level model with the single-level model where the variances in the intercept and coefficients are constrained to be 0. The results show that there is statistically significant variation between regions.

In Table 10 below, the results of the extended model including level 2 fixed effects are shown. The level 2 fixed effects provide estimates of the direct impact of differences in the level of lifelong learning and in the percentage of the adult population having completed a third-level education on the likelihood that employees on average in a region will be engaged in the different forms of learning at work. To the extent that these level 2 regional context conditions have a statistically significant impact on the likelihood of the different forms of learning at work, their inclusion in the models will help to account for some of the unexplained variance in the intercept term shown in Table 9. The results presented in the first row of the random part of the model in Table 10 show that the estimated variance in the intercept for the model predicting creative work is reduced from 0.123 to 0.084, implying that differences in the level of development of the regional education and training system account for about one-third of the unexplained variance in the intercept term shown in Table 9. There is little change in the estimated variance of the intercept for the model predicting constrained learning, while the estimated variance in the intercept for the model predicting low learning is reduced by about 50%, from 0.232 to 0.118.

Table 10 Multi-level logistic models with regional contextual effects

	Creative learners	Constrained learners	Low learners
Fixed: Level 1			
Constant	-0.90 ^a	-0.93	-0.31 ^a
EDUC2	0.29 ^a	0.20 ^a	-0.57 ^a
EDUC3	0.96 ^a	-0.20 ^a	-1.59 ^a
EXPRC2	0.20 ^a	0.34	-0.16 ^b
EXPRC3	0.37 ^a	-0.12 ^c	-0.31 ^a
EXPRC4	0.48 ^a	-0.28 ^a	-0.37 ^a
Fixed Level 2			
LLL	0.03 ^a	0.01	-0.06 ^a
TERT	0.00	-0.01	0.00
Random			
Intercept	0.084 (0.019)	0.040 (0.014)	0.118 (0.029)
Coefficient EDU2	0.013 (0.014)	0.012 (0.015)	0.038 (0.023)
Coefficient EDU3	0.110 (0.038)	0.043 (0.030)	0.170 (0.073)
Coefficient EXPRC2	0.000 (0.000)	0.000 (0.000)	0.014 (0.039)
Coefficient EXPRC3	0.00 (0.00)	0.012 (0.017)	0.027 (0.027)
Coefficient EXPRC4	0.034 (0.019)	0.000 (0.000)	0.033 (0.031)
N	17,412	17,412	17,412
LR test vs Logisitic regression:	chi2(6)=252.80 Prob>chi2=0.000	chi2(6)=67.22 Prob>chi2=0.000	chi2(6)=199.84 Prob>chi2=0.000

Includes controls for sector and occupation

^a Significant at 0.01 level

^b Significant at 0.05 level

^c Significant at 0.10 level

From the point of view of regional policy the most important result shown in Table 10 concerns the different direct impacts of the two regional educational system 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 lifelong learning on the likelihood of creative learning, and the column three results show an even stronger negative impact of lifelong 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 the adult population having completed tertiary education on the likelihood of either the creative or low learning forms.

These contrasting results for the effects of the impact of the level of participation in lifelong learning and the share of the adult population with a third-level education at the regional level may seem paradoxical, given that at the individual-level there is a strong positive relation between having completed 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 the completion of a tertiary education will increase one's chances everywhere of getting access to work involving high levels of learning and autonomy, while an increase in the overall regional stock of adults with a third-level education will not increase the likelihood of employees in general being involved in creative work activity. The regression analysis presented here does not provide the basis for explaining this outcome. However, a possible explanation that is consistent with the results is that increasing the percentage of the adult population with access to further education and training contributes to the acquisition and renewal of practical and work-related skills that are highly complementary to the more theoretical knowledge and general skills acquired through formal initial education. Broad access to lifelong learning may thus serve to boost the level of expertise in general, regardless of one's level of initial education, and in this manner it increases the overall level of creativity in the region. By contrast, an increase in the level of investment in third-level education may well prove disappointing, since increasing the stock of persons coming onto the market with higher-level academic qualifications cannot compensate for the failure to make investments in the forms of further education and training that serve to renew and further develop the more practical and work-related skills needed for solving the organisational and technical problems employees confront in work.

While the above analysis focuses on the direct impact of differences in the level of development of the regional education and training system on the level of creative work activity in general, it leaves unaddressed the question of how regional policies may interact with and affect differently persons with different individual-level characteristics. In what follows, I focus on possible interaction effects between the indicators of the regional education and training system and differences in an individual's level of initial education. This can be justified by the importance attached to educational attainment levels at the secondary and tertiary levels in policy discussions, not least at the EU level.⁸

⁸ One of the five headline targets in the EU 2020 strategy is to, "Reduce the share of early school leavers to 10% from the current 15% and increase the share of the population aged 30–34 having completed tertiary education from 31% to at least 40%". See European Council 17 June, 2010 Conclusions, Brussels.

Table 11 below show the results for models including interaction terms between the level of initial formal education and the level of development of the regional education and training system. The results show a positive and statistically significant interaction effect between the level of development of the regional system of lifelong learning in the case of persons with an upper secondary or post-secondary but not tertiary education (EDU2), and a negative interaction effect in the case or persons with a tertiary education (EDU3). There are no significant interaction effects between the percentage of the persons in a region having completed a third-level education and the level of a person’s initial formal education.

In interpreting these results, it needs to be emphasized that the direction of the sign on the interaction term does not change the basic direction of the level 1 fixed effects for EDU2 and EDU3. Rather, the positive sign for $LLL \times EUD2$ should be interpreted as meaning that the positive effect of having a secondary education on

Table 11 Multi-level logistic models with interaction effects

	Creative learners	Creative learners
Fixed: Level 1		
Constant	-0.85 ^a	-0.97 ^a
EDUC2	0.23 ^b	0.29 ^a
EDUC3	0.96 ^a	10.44 ^a
EXPRC2	0.20 ^a	0.21 ^a
EXPRC3	0.37 ^a	0.37 ^a
EXPRC4	0.48 ^a	0.48 ^a
Fixed Level 2		
LLL	0.02 ^b	0.04 ^a
TERT	0.00	0.00
LLL x EUD2	0.02 ^b	
TERT x EDU2	0.00	
LLL x EDU3		-0.04 ^a
TERT x EDU3		-0.01
Random		
Intercept	0.082 (0.019)	0.089 (0.027)
Coefficient EDU2	0.009 (0.013)	0.010 (0.013)
Coefficient EDU3	0.081 (0.035)	0.026 (0.024)
Coefficient EXPRC2	0.000 (0.000)	0.000 (0.000)
Coefficient EXPRC3	0.000 (0.000)	0.000 (0.000)
Coefficient EXPRC4	0.034 (0.024)	0.035 (0.024)
N	17,412	17,412
LR test vs Logistic regression:	chi2(6)=222.61 Prob>chi2=0.000	chi2(6)=226.86 Prob>chi2=0.000

Includes controls for sector and occupation

^a Significant at 0.01 level

^b Significant at 0.05 level

^c Significant at 0.10 level

the likelihood of being involved in creative work activity is relatively higher in nations with well-developed systems of lifelong learning, while the negative sign on $LLL \times EUD3$ means that the positive effect of having a tertiary education is relatively lower in such nations. This result has policy implications from a social standpoint. It suggests that whatever disadvantages having only an upper secondary education may imply for a person in terms of getting access to opportunities for creative learning in work, these disadvantages can to some extent be compensated for by gaining access to further education and training later on in life. In short, well-developed policies of lifelong learning can serve a remedial purpose and can contribute to reducing inequalities in access to high-quality work environments for employees with different educational backgrounds.

Conclusion

This paper has focused on regional differences in the relation between employee 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 across a sample of 81 European regions, and 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 at work and the multi-level regression analysis has focussed on the impact of the development of opportunities for lifelong learning and increasing the stock of employees with a tertiary education. A significant implication of the analysis is that the educational bottleneck to increasing the learning capabilities of organisations is not at the level of investments in tertiary education. To be effective, such investments in higher-level education have to be accompanied by a strong commitment to further education and training in order to assure the continual renewal and upgrading of the skills of mid-career employees. Further, the results suggest that well-developed systems of lifelong learning may have an important equalising effect by improving the relative access of persons with only an upper secondary education to creative work environments.

These conclusions need to be qualified in important respects. First, there are the limitations in the regional data available on Eurostat's electronic database. The problems with using patent statistics as a proxy for innovativeness are well known and it can be hoped that future rounds of the Community Innovation Survey will include a regional breakdown. Second, the analysis has been restricted to the impact of measures of the regional education and training system. While this is clearly an important dimension of the regional innovation system, the multi-level analysis has shown that it only accounts for part of the unexplained variance in creative work activity across regions. Future studies could usefully extend the approach developed here to focus on other institutional dimensions and in particular to address the way labour market mobility and systems of employment and unemployment protection impact on the processes of knowledge generation transmission that support creative learning at the workplace.

Appendix

Table 12 Forms of learning by Nuts Region (percent of salaried employees)

Code	Region	Creative learning	Constrained learning	Low learning
Belgium (NUTS1)				
BE1	Brussels Hoofdstedelijk Gewest	69.32	16.37	14.32
BE2	Vlaams Gewest	60.80	19.31	19.90
BE3	Région Wallonne	62.87	15.75	21.39
Czech Republic (NUTS2)				
CZ1	Praha	51.28	35.38	13.34
CZ2	Střední Čechy	38.49	26.83	34.68
CZ3	Jihozápad	40.84	39.87	19.29
CZ4	Severozápad	39.77	27.69	32.54
CZ5	Severovýchod	32.24	34.97	32.80
CZ6	Jihovýchod	47.12	25.95	26.93
CZ7	Střední Morava	50.93	30.04	19.03
CZ8	Moravskoslezsko	49.10	19.92	30.98
Greece (NUTS1)				
GR1	Voreia Ellada	48.91	18.74	32.36
GR2	Kentriki Ellada	50.19	25.66	24.15
GR3	Attiki	43.79	26.14	30.07
GR4	Nisia Aigaiou, Kriti	57.85	26.47	15.69
Spain (NUTS1)				
ES1	Noroeste	44.60	13.70	41.71
ES2	Noreste	40.87	31.48	27.65
ES3	Comunidad de Madrid	49.07	21.57	29.35
ES4	Centro	29.98	20.20	49.83
ES5	Este	39.59	22.25	38.16
ES6	Sur	35.43	32.99	31.58
ES7	Canarias	51.72	35.86	12.42
France (NUTS1)				
FR1	Ile de France	55.36	17.55	27.10
FR2	Bassin Parisien	46.94	28.79	24.27
FR3	Nord—Pas-de-Calais	55.31	27.79	16.90
FR4	Est	63.56	20.50	15.94
FR5	Ouest	64.02	21.25	14.73
FR6	Sud-Ouest	73.10	18.10	8.80
FR7	Centre-Est	53.79	24.26	21.95
FR8	MÉditerranée	60.28	15.64	24.08
Ireland (NUTS2)				
IE1	Border, Midlands and Western	64.84	12.35	22.81
IE2	Southern and Eastern	56.96	18.95	24.09

Table 12 (continued)

Code	Region	Creative learning	Constrained learning	Low learning
Italy (NUTS1)				
IT1	Nord Ovest	61.80	14.91	23.29
IT2	Nord Est	56.46	13.62	29.92
IT3	Centro	65.31	11.54	23.15
IT4	Sud	61.33	18.77	19.90
Hungary (NUTS1)				
HU1	Közép-Magyarország	63.07	17.25	19.69
HU2	Dunántúl	54.02	24.29	21.69
HU3	Észak és Alföld	56.12	20.69	23.19
Netherlands (NUTS1)				
NL1	Noord-Nederland	54.87	29.76	15.37
NL2	Oost-Nederland	69.73	18.47	11.81
NL3	West-Nederland	63.65	25.63	10.72
NL4	Zuid-Nederland	65.60	24.28	10.12
Austria (NUTS1)				
AT1	Ostösterreich	50.49	35.18	14.33
AT2	Südösterreich	60.21	26.89	12.90
AT3	Westösterreich	53.82	26.15	20.03
Poland (NUTS1)				
PL1	Centralny	41.05	24.62	34.33
PL2	Poludniowy	49.22	25.19	25.59
PL3	Wschodni	48.24	28.07	23.69
PL4	Północno-Zachodni	60.01	19.19	20.80
PL5	Poludniowo-Zachodni	62.35	17.37	20.27
PL6	Północny	45.44	28.06	26.50
Portugal (NUTS2)				
PT1	Norte	41.55	23.72	34.73
PT2	Algarve	55.92	27.24	16.84
PT3	Centro	62.14	16.64	21.22
PT4	Lisboa	32.63	41.93	25.43
PT5	Alentejo	32.54	39.79	27.67
Slovakia (NUTS2)				
SK1	Bratislavský kraj	55.12	21.95	22.93
SK2	Západné Slovensko	41.56	26.14	32.30
SK3	Stredné Slovensko	49.56	19.96	30.49
SK4	Východné Slovensko	46.61	26.48	26.90
Finland (NUTS2)				
FI1	Itä Suomi	58.69	32.46	8.85
FI2	Etelä Suomi	57.96	30.12	11.92
FI3	Länsi Suomi	60.65	30.23	9.12
FI4	Pohjois-Suomi	55.91	32.43	11.66

Table 12 (continued)

Code	Region	Creative learning	Constrained learning	Low learning
Sweden (NUTS1)				
SE1	Östra Sverige	72.00	22.13	5.86
SE2	Södra Sverige	69.45	22.49	8.06
SE3	Norra Sverige	73.91	19.00	7.09
Bulgaria (NUTS1)				
BG1	Severna i iztochna Bulgaria	44.32	24.43	31.24
BG2	Yugozapadna i yuzhna centralna Bulgaria	42.38	28.08	29.54
Romania (NUTS1)				
RO1	Macroregiunea unu	56.37	21.66	21.97
RO2	Macroregiunea doi	39.00	23.09	37.91
RO3	Macroregiunea trei	46.33	20.83	32.84
RO4	Macroregiunea patru	40.46	30.07	29.46
Norway (NUTS2)				
NO1	Oslo og Akershus	73.58	16.33	10.10
NO2	Hedmark og Oppland	66.01	21.24	12.75
NO3	Sør-Østlandet	67.29	19.41	13.30
NO4	Agder og Rogaland	72.46	18.83	8.71
NO5	Vestlandet	73.55	17.24	9.21
NO6	Trøndelag	75.05	22.66	2.29
NO7	Nord-Norge	72.13	12.46	15.41

References

1. Acs Z, Audretsch D, Feldman M (1991) Real effects of academic research: comment. *Am Econ Rev* 82:363–367
2. Arundel A, Hollanders H (2005) EXIS: an exploratory approach to innovation scoreboards. <http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/EXIS.pdf>, March
3. Arundel A, Lorenz E, Lundvall B-A, Valeyre A (2008) The organisation of work and innovative performance: a comparison of the EU-15. *Ind Corp Change*
4. Asheim B (1996) Industrial districts as 'learning regions': a condition for prosperity. *Eur Plann Stud* 4 (4):379–400
5. Asheim B (2001) 'Learning regions as development coalitions', partnership as governance in European workfare states? *Concepts Transform* 6(1):73–101
6. Asheim B (2011) Learning, innovation and participation: Nordic experiences in a global context with a focus innovations systems and organisation of work. In: Ekmann M, Gustavsen B, Asheim BT, Palshaugen O (eds) *Learning regional innovation*. Macmillan, Palgrave, pp 15–50
7. Asheim B, Coenen L (2006) Contextualising regional innovation systems in a globalising learning economy: on knowledge bases and institutional frameworks. *J Tech Tran* 31(1):163–173
8. Cooke P (1992) Regional innovation systems: competitive regulation in the new Europe. *Geoforum* 23:945–974
9. Cooke P, Uranga M, Etzebarria G (1998) Regional systems of innovation: an evolutionary perspective. *Environ Plann A*(30):1563–584
10. Craft A (2005) *Creativity in schools: tensions and dilemmas*. Routledge, Oxford
11. Csikszentmihalyi M (1988) Society, culture, and person: a systems view of creativity. In: Sternberg R (ed) *The nature of creativity: contemporary psychological perspectives*. Cambridge University Press, Cambridge

12. Freeman C (1987) Technology policy and economic performance: lessons from Japan. Pinter, London
13. Holm R, Lorenz E, Lundvall B-A, Valeyre A (2010) I
14. Jaffe A (1989) Real effects of academic research. *Am Econ Rev* 79:984–1001
15. Lawson C, Lorenz E (1999) Collective learning, tacit knowledge and regional innovative capacity. *Reg Stud* 33(4):305–317
16. Link A, Rees J (1990) Firm size, university based research and the returns to R&D. *Small Bus Econ* 2:3–42
17. Lundvall BA (1992) National systems of innovation. Pinter, London
18. Lundvall BA, Johnson B (1994) The learning economy. *J Sci Ind* 1:23–42
19. Maskell P (1998) Competitiveness, localised learning and regional development. Routledge, London
20. Lorenz E, Valeyre A (2005) Organisational innovation, human resource management and labour market structure: a comparison of the EU-15. *J Ind Relat* 47(4):424–442
21. Parent-Thirion A, Fernandez Macias E, Hurley J, Vermeulen G (2007) Fourth European Working Conditions Survey. European Foundation for the Improvement of Living and Working Conditions, Luxembourg, Office for Official publications of the European Communities
22. Qvqle T (2011) Participative democracy and the diffusion of organisational innovations: the long, winding road from a plant level ‘field experiment’ to regional economic development. In: Ekmann M, Gustavsen B, Asheim BT, Palshaugen O (eds) *Learning regional innovation*. Macmillan, Palgrave, pp 187–205
23. Rasbash J, Steele F, Browne W, Prosser B (2005) A user’s guide to MLwiN. Centre for Multilevel Modelling, University of Bristol
24. Reilly R (2008) Is expertise a necessary precondition for creativity? A case of four novice learning group facilitators. *Think Skills Creativ* 3:59–76
25. Simonton DK (1985) Quality, quantity, and age: the careers of 10 distinguished psychologists. *Int J Aging Hum Dev* 21:241–254
26. Sternberg R (ed) (1988) *The nature of creativity: contemporary psychological perspectives*. Cambridge University Press, Cambridge
27. Storper M, Scott A (1995) The wealth of regions. *Futures* 27(5):505–526
28. Weisberg R (1988) ‘Problem-solving and creativity’. In: Sternberg R (ed) *The Nature of Creativity: contemporary psychological perspectives*. Cambridge University Press, Cambridge
29. Weisberg R (1993) *Creativity: beyond the myth of genius*. Freeman, New York

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