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Do EU-Funded ICT RTD Policies Really Matter?
An Empirical View from the Regions

12 / 2008

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DEPFID Working Papers - 12/ December 2008

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Abstract

This paper provides evidence of a positive correlation between participation in the European ICT-RTD Programmes, the innovation capacity of the EU regions and the growth of regional value added adjusted by worked hours. We also offer additional support to the findings of previous studies concerning the rationale of the geographical concentration of innovation activities in some core areas of Europe. This evidence calls for a further integration of EU ICT-RTD policies at regional rather than national level, particularly encouraging the participation of regional organizations in multiple and related instruments.

KEYWORDS: regional innovation systems, regional growth, European policies, ICT RTD programmes.

JEL CLASSIFICATION: C23, E62, 038, R58

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1. Introduction

The European Research and Technology Deployment (RTD) programmes are designed to strengthen the innovation and competitiveness of European industry by furthering the collaboration, across geographic borders, between firms, leading universities, and governmental institutions. In particular, ICT-related policies and funding instruments focus on harnessing the benefits from the use of Information Communication Technologies (ICT) to ensure long run sustainability of growth, better quality of life, and the creation of ”more and better jobs”.

Evaluating progress in these directions requires an assessment of the impact of ICT-related RTD activities not only at European or national, but also at regional level. This is because innovation is a localized adaptive process that consists of an interplay of networks in which the geographical links between nodes are crucial. This concept is highlighted by the term “innovation system”, which has been put at the centre of a series of recent evaluative studies[1] in order to examine what impact EU-funded policies have had on European regional economies. By means of subsequent implementations of Social Network Analysis[2] concepts and tools, these analyses have assessed the “behavioural additionality” of the EU RTD intervention, which is given by the creation of new information and communication linkages between partner organisations located in different European countries. The main finding of this research is the central role played by the so-called ”Knowledge Hubs” and ”Gatekeeper Organisations”, which have implemented networks of relations by acting as a bridge between the EU and the private or public companies and associations.

The necessity of a further impact assessment emerges from two considerations. First, the regional level orientation of several policy documents, which point toward deploying the Information Society in Europe, from the Lisbon Agenda to the recent *i2010*' initiative. In February 2008, the Competitiveness Council called for the Member States to better co-ordinate with the Community their efforts to improve framework conditions for innovation, such as improving science-industry linkages and support services for innovation, including the development of regional clusters and networks.

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[1] See European Commission (2007)
[2] See Wasserman and Faust (1994),

Secondly, under DG REGIO coordination, ICT-RTD oriented strategies have been included within the scope of the Structural Funds that are mostly operating at regional level, for example in the ERDF[3], RPIA[4], INTERREG[5] and partly LEADER+[6]. But until now, the conventional wisdom regarding the effect of ICT-RTD programmes, has limited itself to evaluating the effects deriving from participation in EU-funded projects to individual organizations, rather than to territories or regional economic systems.

This approach looked quite reasonable from the viewpoints of both EU institutions and the national or regional policy makers. On one hand, the European Commission, as ultimately responsible for the calls launched and the funds awarded through the mechanism of Framework Programmes, has put at the very centre of its objectives the creation and strengthening of a common European Research Area (ERA). Consequently, it has given priority to the evaluation of the system effects deriving from the building up and maintenance of multinational and multidisciplinary networks of excellence, composed by universities, enterprises, research laboratories and innovation centres, located anywhere in the territory of the Union.

On the other hand, the promotion and the accreditation of national or regional RTD "champions" in the context of the ERA, has been a task traditionally assigned to (formal or informal) lobbying organisations – such as the National Contact Points or Regional Representative Offices – aimed at increasing the absolute number of participations in the winning consortia for EU-funded RTD and innovation, without any attempt of discriminating between locations or the juridical nature of individual organizations.

Consequently, the "political need" for an ex-post evaluation of the benefits deriving from such participations has been limited to the level of the single organisation, taking into consideration a few additional corporate improvement areas – beside those of merely financial nature – like learning and benchmarking, quantity and quality of human resources, lower opportunity cost of radical innovation, faster time to market of low-return RTD, and the like.

[3] See http://ec.europa.eu/regional_policy/country/prordn/search.cfm?gv_pay=ALL&gv_reg=ALL&gv_obj=1&gv_the=4&LAN=EN&gv_per=1
[4] See http://www.eriknetwork.net/frontend/search.php
[5] See http://ec.europa.eu/regional_policy/country/prordn/search.cfm?gv_pay=ALL&gv_reg=ALL&gv_obj=5&gv_the=4&LAN=EN&gv_per=1
[6] See http://leaderplus.ec.europa.eu/cpdb/public/project/CopDbSearch.aspx

Thus, it is not easy to draw clear implications from these exercises on how to take on a system approach to policy making at regional level.

Very recently, this scenario has started to change, thanks to a string of evaluative studies funded by DG INFSO ("Information Society") of the European Commission over the years 2005-2007. From this research, a new picture has gradually emerged, in which the macroeconomic effect of these policies has been also detected at regional level. This impact is especially visible on the *growth differentials* of competitiveness and innovation between different European regions, ranging from those involved in a significant number of participations to ICT-RTD Framework Programmes, to those not showing a comparable track record of individual participations, independently on their initial level of development.

This paper addresses this specific point by presenting some new evidence on the impact of ICT RTD policies on the regional innovation systems.[7] Our main findings can be summarized as follows:

1) there is a statistically significant positive correlation between regional competitiveness and innovation growth, and the number of regional participations in ICT-RTD Framework Programmes;

2) the correlation is stronger in the less advanced regions, implying that an enhanced regional convergence can be an unintended side-effect of ICT-RTD Framework Programmes, and also confirming the intuition that EU-funded RTD programmes have a greater impact just where the initial conditions are less favourable;

3) finally, the correlation is statistically more evident at Member State than at regional level, supposedly because of the lack of attention devoted so far to the support of locally based networks in EU Framework Programmes.

The rest of the paper is organized as follows. The theoretical background is presented in section 2. In section 3 we describe methods and findings. Policy implications are the object of section 4, while section 5 concludes the paper by summarizing its main results.

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[7] This paper is an outgrow of one of these studies, which was funded by DG INFSO in 2007, entitled "Effectiveness of IST RTD Impacts on the EU Innovation Systems". The final report of the study can be downloaded at: http://ec.europa.eu/dgs/information_society/evaluation/data/pdf/studies/s2006_03/final_report. pdf

2. Regional Systems of Innovation and Public Policies: The Theoretical Background

The assessment of the impact of ICT on innovation performance has been the object of deep investigations in recent years. Most studies point out that ICT are an important factor for innovation because they facilitate the flow of information within networks of firms (Brynjolfsson and Hitt, 2000; Arvanitis, 2005; Matteucchi et al., 2005). Although this effect reduces information costs, it does not necessarily increase networks and firms performance (McEvily et al., 2004). New or more information spreading within networks of firms has to be processed and adapted to the specific local needs in order to make ICT work productively (Batt, 1999). Macroeconomic evidence on this point is controversial. Applied research (Jorgenson et al., 2000; Colecchia and Schreyer, 2002) shows that in the 1990s ICT contributed between about 0.2 and 0.9 percentage points per year to economic growth, but these studies exhibit relevant differences among countries. While United States has benefited the most from ICT capital investment, the largest European countries (Germany, Italy, France) exhibit lower contributions of ICT to economic growth.

These differences can be explained by considering that innovation is the application of external knowledge to existent production and commercial activity, and hence it strictly relies upon learning processes. These processes require local and qualified interactions between agents (Cohen and Levinthal, 1990). The main implication of this view is that geographical location does matter in the actual process of innovation, in balancing two opposing forces: the increasingly availability of standard 'codified' knowledge and the spatial boundedness of idiosyncratic and tacit knowledge, as well as of other contextual factors. Our focus on regional systems increases the complexity of this analysis. European regions have quite different capacities to transform both codified and tacit knowledge into innovation and economic growth. As a consequence, the definition of a best practice in improving local innovation capacity is not a clear-cut problem. Even if the literature on local innovation systems acknowledges the existence of certain basic organizational characteristics in the more dynamic and innovative regions (Storper, 1993), the routes to improving regional performances are very diversified. Such heterogeneity is fully replicated at theoretical level. In a recent, wide-ranging review on territorial innovation models (TIM), Moulaert and Sekia (2003) conclude that "there is a broad field of tensions between the various TIM about how territorial innovation should be theorized. The apparent semantic uniformity and the shared theoretical sources hide a pluralism of interpretations of innovation dynamics and their theoretical inspirations. This pluralism could be interpreted in a positive way, as a creative stage in the building of a new theory. But for the time being, ambiguity predominates and there is a clear need to achieve some analytical clarity" (p. 299).

The sharing of a common theoretical framework is also important to assess the impact of public policies. At European level, much emphasis has been placed by the Third Cohesion Report (European Commission, 2004) on the disparities in regional development, which pose a substantial challenge to the Union's internal cohesion. Not surprisingly, the evaluations of the effects of the European Structural Funds are controversial (Rodriguez-Pose and Fratesi, 2003; Marelli, 2007; Martin and Tyler, 2006; Puigcerver-Penalver, 2007). A possible explanation is that European regions exhibit such a wide range of structural differences that there is no simple way to assess and to compare their response to public intervention over time. The same is true when it comes to EU research and innovation programmes. In this case, funds are deployed in different ways and according to different policy priorities and over an extended span of time. Moreover, there are serious conceptual problems in disentangling the impacts of these programmes from the effects of an array of different factors that have changed through time and influenced the innovative performance of regions in many ways.

The direction we chose to tackle this problem is *cluster analysis*. As a one-size-fits-all measure of the growth of innovation capacity was not available, we chose to classify the European regions according to a set of indicators. Then we assessed the impact of European policies by comparing the evolution over time within and across the subgroups created. Our approach, which is detailed in the following section, also opens up another theoretical issue. In literature, there is little consensus on how the innovation capacity of very different local systems could be improved by the policies promoted by central institutions. The reason is that pre-existent conditions are key determinants of the actual impact of these policies. Regions with a better initial technological endowment are expected to receive a different (not necessarily stronger) impulse in terms of their innovation capacity from less developed ones. It has been argued (Rodriguez Pose, 1999) that the effect of R&D investment is dependent on the structural (social, political and economic) differences among regions, accounting for their capacities to transform R&D investment into innovation and economic growth.

This context effect might be reinforced by another factor highlighted in a previous research on the impact of ICT RTD policies (Cespri, 2006). This study shows that the core areas of Europe benefit more from these funds than the peripheral regions. This outcome is attributed to the fact that some sectors carrying out innovation react more promptly to the stimulus provided by EU financial support. Specifically, while research conducted at universities and public institutes would have a limited impact on innovation capacity, the research performed by the private sector would explain a great part of the change over time (Bilbao-Osorio and Rodriguez-Pose, 2004). More significantly, big and multinational firms located around the main European capitals would play a leading role in these activities. These actors would play the role of "hubs" in the networks created by the provision of EU funds, by providing the critical lever in the effort to obtain and to manage financial resources. This hierarchical pattern of network organizations would imply that the hubs possess a strong bargaining power within their networks and decide whom and, above all, how the funds are distributed. They can also act as "gatekeeper" organizations, which "are the most effective in terms of both enriching the network with new knowledge and facilitating the dissemination of knowledge among network members. In turn, ICT-RTD Hubs are more effective than other ICT-RTD participants in terms of both producing and disseminating new knowledge" (Cespri, 2006, p. 35).

What this interpretation undervalues is that this hierarchical organizational arrangement may also have a negative effect on the actual impact of EU policies. The decentralization of information is indeed an important factor for improving innovation capacity within local systems (Innocenti and Labory, 2004). Information decentralization in networks of firms is given by the increase of the share of information processed by the same node/firm that collects it. A network can be defined as fully hierarchical if it contains a single node processing all the relevant information, including that collected by the other nodes of the network. In contrast, a network is fully decentralized if each node collects and processes all the information necessary to implement its activity. In the intermediate cases, information is partially transmitted by the collecting node to another node for processing it. If innovation activity is based on localized learning processes that complement codified and general information with tacit and specific knowledge, the *governance* of the networks created by EU funding becomes a key factor in the implementation of these policies. By keeping control over the whole network and by filtering the information and the knowledge getting in and out of the network, hubs and gatekeeper organizations may weaken the incentives to develop specialized knowledge by other participants, whose contractual power is not protected and enhanced by information decentralization.

When applied to the study of the effects of ICT RTD policies on regional innovation systems, the argument goes that core and peripheral areas perform differently in their innovation absorptive capacity, because the incentives to implement autonomous innovations by peripheral areas are replaced or weakened by the fact that hubs are mainly located in the core areas. These regions produce and disseminate new knowledge according to their needs and capacities, which are different from those of the peripheral areas. In particular, most innovation clusters hinge upon decentralised communication processes, activated not through hierarchical "top-down" arrangements, but by means of the 'bottom-up" or "horizontal" generation of a shared body of knowledge in the relationships between the nodes composing the network. In this light, the diffuse impact of ICT RTD policies on regional systems of innovation can be weakened rather than strengthened by the hubs. To assess the extent to which this effect has been significant in the implementation of the EU-Funded ICT RTD Policies, we chose to perform a macroeconomic multivariate analysis that is the object of the following section.

3. Measuring the Effect of Participation in ICT RTD and Deployment Programmes[8]

To evaluate the effect of participation in ICT RTD Framework Programmes on the innovative and economic performance of the EU NUTS-2 regions, we performed a macroeconomic multivariate analysis. We used two statistical multidimensional techniques, Factor and Cluster Analysis, which allowed us to identify some homogeneous subgroups, or clusters, of European regions, with respect to the change over time of some relevant factors of innovation capacity.

Factor Analysis was put forward in order to isolate the sources accounting for the growth of the regional propensity to innovate. We adopted the Principal Component approach, which takes into account the total variance of the data. In the first stage, we attributed a rating to the regional indicators of innovation capacity. The chosen indicators were those listed in the EU

[8] We are grateful to Filippo Oropallo for his invaluable support.

Regional Innovation Scoreboard 2006[9], namely Knowledge Workers, Life-Long Learning, Med/Hi-Tech Manufacturing, Hi-Tech Services, Public R&D, Business R&D, and Patents, limited to the period 2001-2005. In order to capture the regional participation in ICT RTD and deployment programmes, we also included the number of EU projects active per year and per region.

To assess the role of hubs, we also included in our dataset the Coordinators of FP5, FP6, eTEN, classified by regions, for the same years 2001-2005. We adopted the regional NUTS 1 for Belgium and UK, and NUTS 2 for all other countries (Spain, France, Italy, the Netherlands, Greece, Austria, Portugal, Finland, Czech, Republic, Hungary, Poland, Slovakia, and Sweden). In the same database, the remaining countries (Denmark, Ireland, Luxemburg, Estonia, Latvia, Lithuania, Slovenia, Malta and Cyprus) are treated as uniregional countries. For our analysis, this amounted to select 212 out of the 255 European (EU-25) regions.

The rating given to each indicator of innovation capacity was related to its interdependence with the other indicators. A statistical algorithm deconstructed the rating, or raw score, into its various components and reconstructed the partial scores into the underlying factor scores. The degree of correlation between the raw score and the factor score was called factor loading. In this way, we isolated a reduced set of innovation factors, which allowed us to identify the clusters of EU regions characterized by similar internal patterns, given by the minimization of *within-propensity innovation*, and by different external patterns, given by the maximization of *between-propensity innovation*.

The values of factor loadings are shown in Table 1 below, which includes the list of innovation indicators and, in bold, the correlation ratios between the three principal components.

[9] See Matteucchi et al. (2005) for a detailed definition of these indicators.

Table 1. Factor loadings (Principal Component Analysis)			
Innovation Indicators	Innovation 1	Innovation 2	Innovation 3
No. of EU ICT RTD projects coordinator (rtdpr)	0,54	-0,13	**0,51**
Knowledge workers (hrstc)	0,77	-0,40	-0,11
Life-long learning (lll)	0,59	-0,39	-0,22
Med/hi-tech manufacturing (htman)	0,41	**0,80**	0,05
Hi-tech services (htser)	**0,82**	-0,23	-0,06
Public r&d (pubrd)	0,65	-0,28	-0,12
Business r&d (berd)	0,80	0,34	-0,03
Patents (patent)	0,75	0,43	0,00
Year 2001-2005	0,03	-0,17	0,86

The three indicators Hi-tech services, Med/hi-tech manufacturing, and the number of EU ICT RTD projects coordinators, were selected as those accounting better for the underlying variance of the innovation capacity.

In the following step, we grouped all the EU regions in ten different clusters. To discriminate between clusters, we calculated the distances between them based on the regional values of the three chosen indicators. In this way, the regional differences in the change of the propensity to innovate for the period 2001-2005 were minimized within each cluster and maximized between clusters.

The list and the map of the regions classified by cluster is included in the Appendix. The following Table 2 lists for each selected cluster some differentiating features.

Table 2. Some distinctive features of the EU Regional Innovation Clusters

Cluster	N. of regions	%	Types	Features
1	10	4.7	Technology Investors	mainly German regions the highest increase in med/hi-tech manufacturing employment low capacity to lead EU ICT-RTD projects
2	11	5.2	Knowledge Investors	mainly Swedish and Finnish regions plus Denmark pronounced growth of life-long learning and knowledge workers medium capacity to lead EU ICT-RTD projects
3	19	9.0	Capital Regions	mainly Urban and Capital regions very good innovative performance, especially knowledge workers high capacity to lead EU ICT-RTD projects
4	1	0.5	Leader Region	Ile de France the best performing region in terms of innovation capacity the highest concentration of EU ICT-RTD projects coordinators
5	3	1.4	Leading Innovators	German and Dutch regions very good innovative performance, especially hi-tech services high capacity to lead EU ICT-RTD projects
6	78	36.8	Static Regions	Italy, Greece, Poland, Portugal, Spain low performance in terms of innovation capacity low capacity to lead EU ICT-RTD projects
7	19	9.0	Traditional Regions	mainly Central Europe and districts and manufacturing areas good performance in terms of medium-high tech manufacturing very low capacity to lead EU ICT-RTD projects
8	37	17.5	Laggards	regions from Czech Republic, Spain, Italy, Hungary very low number of patents very low capacity to lead EU ICT-RTD projects
9	24	11.3	Self-sustained	less developed regions of UK, Sweden and Netherlands important role of Public R&D moderate capacity to lead EU ICT-RTD projects
10	10	4.7	New Comers	mainly Eastern and Southern European regions the lowest increase of innovation capacity no EU projects coordinators detected in this group

The statistical analysis of these clusters highlights some relevant implications for the assessment of the impact of EU ICT-RTD programmes.

Our first finding is that this impact, as measured by the number of regional coordinators of EU projects, is highly dependent on the national level. Table 3 below shows the distribution of EU25 Member States across the 10 clusters.

Table 3. Contingency Values by Clusters and Countries

	Clusters										
Nuts 1	1	2	3	4	5	6	7	8	9	10	Total
AT	-	-	11.1%	-	-	22.2%	33.3%	33.3%	-	-	100.0%
BE	-	-	33.3%	-	-	-	33.3%	-	33.3%	-	100.0%
CY	-	-	-	-	-	100.0%	-	-	-	-	100.0%
CZ	-	-	12.5%	-	-	12.5%	-	62.5%	-	12.5%	100.0%
DE	27.0%	2.7%	-	-	5.4%	5.4%	13.5%	35.1%	10.8%	-	100.0%
DK	-	100.0%	-	-	-	-	-	-	-	-	100.0%
EE	-	-	-	-	-	100.0%	-	-	-	-	100.0%
ES	-	-	5.3%	-	-	68.4%	-	21.1%	-	5.3%	100.0%
FI	-	60.0%	-	-	-	-	-	-	40.0%	-	100.0%
FR	-	-	9.1%	4.5%	-	31.8%	27.3%	18.2%	4.5%	4.5%	100.0%
GR	-	-	-	-	-	92.3%	-	-	7.7%	-	100.0%
HU	-	-	14.3%	-	-	42.9%	-	42.9%	-	-	100.0%
IE	-	-	50.0%	-	-	50.0%	-	-	-	-	100.0%
IT	-	-	4.8%	-	-	61.9%	9.5%	19.0%	-	4.8%	100.0%
LT	-	-	-	-	-	100.0%	-	-	-	-	100.0%
LU	-	-	100.0%	-	-	-	-	-	-	-	100.0%
LV	-	-	-	-	-	100.0%	-	-	-	-	100.0%
MT	-	-	-	-	-	100.0%	-	-	-	-	100.0%
NL	-	8.3%	16.7%	-	8.3%	-	8.3%	-	33.3%	25.0%	100.0%
PL	-	-	6.3%	-	-	81.3%	-	-	-	12.5%	100.0%
PT	-	-	16.7%	-	-	83.3%	-	-	-	-	100.0%
SE	-	-	-	50.0%	-	-	-	-	50.0%	-	100.0%
SI	-	-	-	-	-	-	-	100.0%	-	-	100.0%
SK	-	-	25.0%	-	-	25.0%	-	25.0%	-	25.0%	100.0%
UK	-	8.3%	33.3%	-	-	-	58.3%	-	-	-	100.0%
Total	4.7%	3.3%	9.0%	2.4%	1.4%	36.8%	11.8%	17.9%	8.0%	4.7%	100.0%

Visual inspection shows that clusters and countries are strictly correlated, or that the majority of Member States tend to position themselves in one or two clusters at most. The *Chi-square Pearson test* confirms that the hypothesis of independence between the two variables is rejected with a probability of error near to zero. The value of the *Chi-square* distribution with 216 degrees of freedom is 416 and differs significantly from the zero (independence) level. In order to give a quantitative measure of this interdependence, we have also calculated the *Cramer-V coefficient*, which is equal to 0.47 and confirms the tight correlation existing between countries and clusters.

This finding can be interpreted in at least two ways: either Member States, rather than Regions, have been so far the main targets of the EU ICT-RTD policies and this effect has increased the regional homogeneity within, rather than across, countries; or that, independently from the EU policies, the most appropriate unit of analysis for describing innovative behaviour is the national one, which better summarizes the factors of innovation propensity

To address this question, a useful insight is provided by the previous studies on the impact of EU ICT-RTD programmes (Rand Europe 2004 and, especially, CESPRI 2006). These researches emphasize the role of HGAOS - Hubs, Gateways and Other Structures, which are more active at national, than at regional level. If the implementation of EU ICT RTD programmes hinges on the national hubs, these organisations are also crucial in connecting local participants to EU projects. These artificially created networks are consequently identified by the Member State of the hub leading them, which also shapes the qualitative features of the relative cluster. This result can arguably be seen as the effect of the EU Framework Programmes not being focused on the regional areas but strictly dependent on the Hubs, Gateways and Other Structures, that are mostly active at national as well as European level. Thus, the appropriate unit of analysis for describing the impact of the EU-funded ICT RTD and deployment programmes on the propensity to innovate is the national one.

The second finding of our statistical analysis is that the clusters attracting more EU projects (clusters 3, 4 and 5) are those characterized by the highest growth in the propensity to innovate. These clusters also show the best performance in terms of knowledge workers and employment in hi-tech services. Statistically, these two variables are the driving factors of the positive performance of the most innovative regions. This evidence corroborates the results of previous studies[10] showing a strong geographical concentration of innovation capacity in the core areas of Europe, that in our analysis are the capital regions included in clusters 3 and 4.

This result led us to integrate our statistical analysis with the consideration of socio-cultural determinants of economic growth. It is indeed evident that the development of these core areas is largely dependent on the specific social, political, and economic characteristics that enhance their capacity to transform the EU financial support into innovation and economic growth. Rodriguez-Pose (1999) proposes to measure this capacity at regional level by means of an indicator of “social filter”. This index provides an assessment of the innovation potentiality of a region by considering the values of six socio-economic indicators:

1) Highly educated population, i.e. the percentage of total population with tertiary education (levels 5-6 ISCED 1997);

[10] See Rand (2004) and CESPRI (2006)

2) High education of the labour force, i.e. the percentage of employed persons with tertiary education (levels 5-6 ISCED 1997);

3) Life-long learning, or rate of involvement in life-long learning, i.e. the percentage of adults (25-64 years) involved in education and training;

4) Agricultural labour force, i.e. agricultural employment as percentage of total employment;

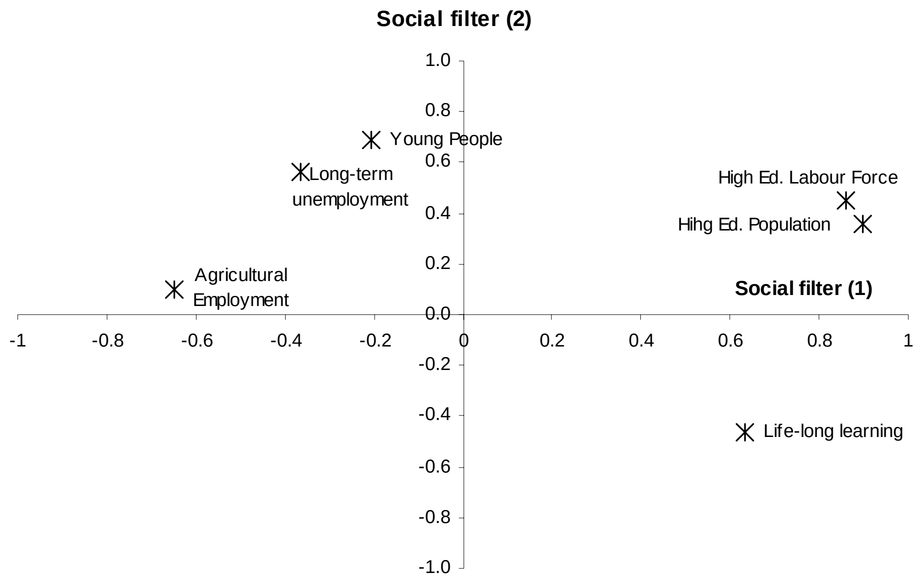
5) Young people long-term unemployment, i.e. people aged 15-24 as percentage of total long-term unemployment;

6) Long-term unemployment, i.e. long term unemployed people of all ages as percentage of total unemployment.

This group of variables represents a proxy for the socio-economic conditions of the region to capture the influence on the local community of two main sets of factors: the first related to educational achievements and the second to the productivity of human capital. For the first set, the diffusion within workers and population of tertiary education and the participation to learning programmes measure the past accumulation of human capital. For the second set, agricultural occupation, long-term unemployment and the diffusion of unemployment among young population are chosen as the main sources of productivity growth at regional level.

We applied again the Common Factor Analysis to disentangle the underlying correlations among the six factors. In this way, we selected Highly Educated Population and Young People Long-Term Unemployment as representative social filters, as shown in Figure 1 below.

Figure 1 – Principal Component Analysis of social filters (Correlation Diagram)



Finally, we conducted a series of econometric regressions coping with the relations at regional level among the two selected factors, the number of ICT-RTD projects and the value added (scaled by the worked hours) in the period 2000-2004. We adopted the following functional form based on the logarithmic transformations of the absolute values in order to reduce heteroskedasticity, due to the different variances of the error term:

$$Log\left({VA_{04}}/{VA_{00}} \right)_i = \beta_1 Log\left(RTD\ projects_i\right) + \sum_j \gamma_j Social\ Filter_{ji} + \sum_n \delta_n Country\ Dummy_n + \varepsilon_i$$

Our regression analysis gives a measure of the impact of RTD projects on regional performance as measured by value added, which takes into account the role of the social filters and excludes, at the same time, the effect of the performance of the Member State to which each region belongs to. The model was tested by means of the goodness-of-fit statistics R^2, which shows how the model explains the 95% of the total variability. The residual term, white noise, is randomly distributed and independent from the explanatory variables. The variable "number of EU projects" does positively influence (coefficient=+0.02, Student's t=10.58) the growth of the regional value added. The chosen variables, High Educated Population (Social filter 1) and Young People Long-Term Unemployment (Social filter 2), exhibit a statistically significant effect on regional growth of value added. Finally, the inclusion of one dummy for each Member State depurates the relationships from the effect of the national economic performances, as shown in Table 4 below.

Table 4. Regression results for the Variation of regional Value Added		*2000-2004*
	Coeff.	T*
RTD EU projects	0.02	10.58
Social filter 1	-0.02	-2.18
Social filter 2	0.01	2.58
AT	0.03	1.40
BE	0.05	1.92
CY	0.12	2.84
CZ	-	-
DK	0.07	1.58
EE	0.35	7.96
ES	0.22	18.79
FI	0.12	4.85
FR	0.05	4.93
GR	-	-
HU	0.41	21.35
IE	-	-
IT	0.09	5.43
LT	0.31	6.92
LU	0.16	3.67
LV	-	-
MT	0.01	0.25
NL	-	-
PL	-	-
PT	0.11	4.42
SE	0.05	2.33
SI	0.13	2.91
SK	0.39	12.59
UK	0.07	3.77

By summarizing our findings, we find a statistically significant and positive correlation between the number of regional participations in the EU-funded ICT-RTD and deployment programmes and the growth of value added adjusted by worked hours at regional level. Regression analysis also confirms the relevance of the Member State level, which explains the greatest part of the variability of regional performance in terms of adjusted GDP growth. The introduction of national ‘dummies’ as control variables permits to highlight the positive role of ICT innovation on growth: these dummy variables increase definitively the statistical significance of the correlation between EU projects participations and economic performance.

Our analysis also confirms the strong geographical concentration of innovation capacity in core areas of Europe.

Then, we provide evidence that productivity growth depends on the "social filters". Negatively on the first filter, related to the percentage of highly educated population, which implies that the impact of ICT is lower in regions with a higher level of education. Positively on the second filter, related to comparatively less developed regions, characterized by a higher percentage of young people in conditions of long term unemployment. Finally, multidimensional analysis shows that the clusters attracting more EU participations exhibit the highest growth of innovation propensity. These clusters show the best performance in terms of the levels of knowledge workers and of hi-tech services. Statistically, these two variables represent the critical success factors explaining the best performance of the most "virtuous" regions in terms of innovation.

4. Policy implications

Our empirical analysis calls for a reorientation of EU ICT-RTD policy from the national to the regional level, particularly encouraging the participation of regional organizations in multiple and related instruments. The goals of the EU Framework Programmes, to create and support industry-science linkages and to reduce the structural barriers to the development of innovative projects across borders and sectors in Europe, have been indeed more effectively pursued at national than at regional level.

Both cluster and regression analyses support the relevance of the Member State level, which obscures the regional dimension, when it comes to evaluating the impact of participation in EU ICT RTD and deployment programmes to value added and innovation capacity. However, if one takes into account the national propagation effects, a statistically significant, positive correlation emerges between the participation in European ICT-RTD Programmes, the innovation capacity of the EU regions and the growth of regional value added adjusted by worked hours. Furthermore, this impact appears to be stronger for the regions that are currently lagging behind in terms of economic and social development.

In the Community Strategic Guidelines for 2007-2013, the European Commission states that "*synergy between cohesion policy, the FP7 and the CIP is vital so that research and cohesion policies reinforce each other at regional level by providing national and regional development strategies showing how this will be achieved*". As a matter of fact, this drive towards a better synergy clearly emerges from several references within the EU official documents, starting from the common policy "umbrella" of the Lisbon, Gothenburg and revised Lisbon objectives, and going on with a broad design scheme that locates the Structural Funds, the FP7 and the CIP at different stages of RTD, deployment and innovation, avoiding financial gaps between the three. Our evidence adds a significant incentive to this synergy, namely the creation of "regional champions" able to play a leading role in the European research arena.

By conception, the Structural Funds should be used to build up and reinforce an autonomous RTD and innovation capacity in the territory, as a precondition for participating in the other pan-European Programmes. Basically, CIP and FP7 share the common objective of strengthening Europe's competitiveness, sustainable growth and employment, though the former Programme focuses primarily on deployment as one of the final stages of the product/service development process, while the latter Programme focuses on RTD, with a limited, though crucial, projection towards demonstration and market exploitation activities. Within the CIP, the Regions that are also eligible for the Convergence Objective of the Structural Funds, are expected to participate in exchange and networking activities, so as to identify and promote best practices and regional excellence in specific fields. In particular, FP7 sustains trans-national research cooperation, technological development, researchers' mobility between firms and academia, and joint RTD activities, especially between enterprises and higher education institutions, including specific RTD schemes in favour of SMEs. The support of trans-national cooperation between research-driven clusters (the so-called 'Regions of Knowledge') complements similar interventions of the CIP in focusing on regional innovation actors, networks and policies.

A well known feature of ICT-RTD consortia is the high level of fragmentation within the regions. Very few participant organisations get involved with a variety of partners of the same region, which would improve knowledge diffusion locally. Likewise, the connectivity of Hubs, Gateways and Other Structures (HGAOS) operates better between regions than within regions. Some organisations that are Hubs in interregional consortia do not appear to be connected at the intraregional level, thus calling into question their effectiveness in disseminating innovation within the region. Therefore, the intended regional impact of these programmes is thwarted by lack of connectivity within the regions. Just as the density and cohesion of project consortia is better between regions than within regions, the HGAOS connectivity appears to operate better between regions as well.

Individual participants in EU-funded activities can easily identify the gains in both tangible and intangible assets, which enhance their competitive edge. However, under current conditions, follow-up, value creation and exploitation are largely left to the sole discretion of these participants. Therefore, many results of past projects often do not carry beyond the organisational level. Current project selection mechanisms do not assign any particular value to the establishment of regional dissemination or exploitation strategies that would allow e.g. for implementation of results by local subcontractors of larger companies, or ultimately commercialisation by university spin-offs and the like. Regions should proactively adapt to this scenario by focusing more on the creation of 'breeding environments' as a way to improve the take-up of ICT results in the local industry and society.

To promote and expand the participation of local organisations in EU-funded programmes, the Regions might act in several concurrent ways, e.g. by:

1. Aligning Regional Information Society deployment strategies with the establishment of more favourable conditions for innovation in the local socio-economic context.
2. Creating financial and non-financial incentives to encourage participation in EU ICT Framework Programmes, especially for first time participants.
3. Using the Structural Funds and their related initiatives to enlarge the intra-regional collaboration and the local take-up of ICT solutions and tools developed as a result of EU ICT RTD.
4. Providing specific support to the follow-up of past research results and replication of the networks created – so as to consolidate the participation of regional organizations (especially SMEs) in EU-funded programmes, particularly encouraging participation in multiple and related instruments.

In order to set up more explicit links between regional convergence and the research policy aims, in a renovated framework of cooperation between EU, Member State and Regional authorities -

as depicted by the Competitiveness Council of February 2008 - joint policy guidelines between the European Commission, the Member States and the Regions should be adopted, in order to leverage the value created from organisations' participation in ICT RTD and deployment collaboration networks.

5. Conclusive remarks

This paper provides evidence of a positive correlation between participation in the European ICT-RTD Programmes, the innovation capacity of the EU regions and the growth of regional value added adjusted by worked hours. We also offer additional support to the findings of previous studies concerning the rationale of the geographical concentration of innovation activities in some core areas of Europe. This evidence calls for a further integration of EU ICT-RTD policies at regional rather than national level, particularly encouraging the participation of regional organizations in multiple and related instruments.

Our findings open a new perspective on regional convergence and the way it can be improved at Member State and Regional levels. If the progress of a country is measured not only in terms of structural capital, but also through a more pervasive penetration and diffusion of ICT in local industry, the process of convergence as promoted by the EU cohesion policy can be enhanced by the promotion of further research and deployment of ICT RTD results.

In this study, we have used the available RIS (Regional Innovation Scoreboard) and Eurostat datasets to provide indicators of economic and innovative behaviour. A systematic data gathering would allow these indicators to be integrated with other measures that better describe a regional innovation system. The objective of this effort should be to help policy-makers assess the degree of innovation at regional level and enable comparison among regions on issues such as technology transfer, human capital, intellectual capital, and the cohesion and level of integration of ICT technology clusters.

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APPENDIX European Regions by Cluster

Figure 2 The Map of European Regions by Clusters

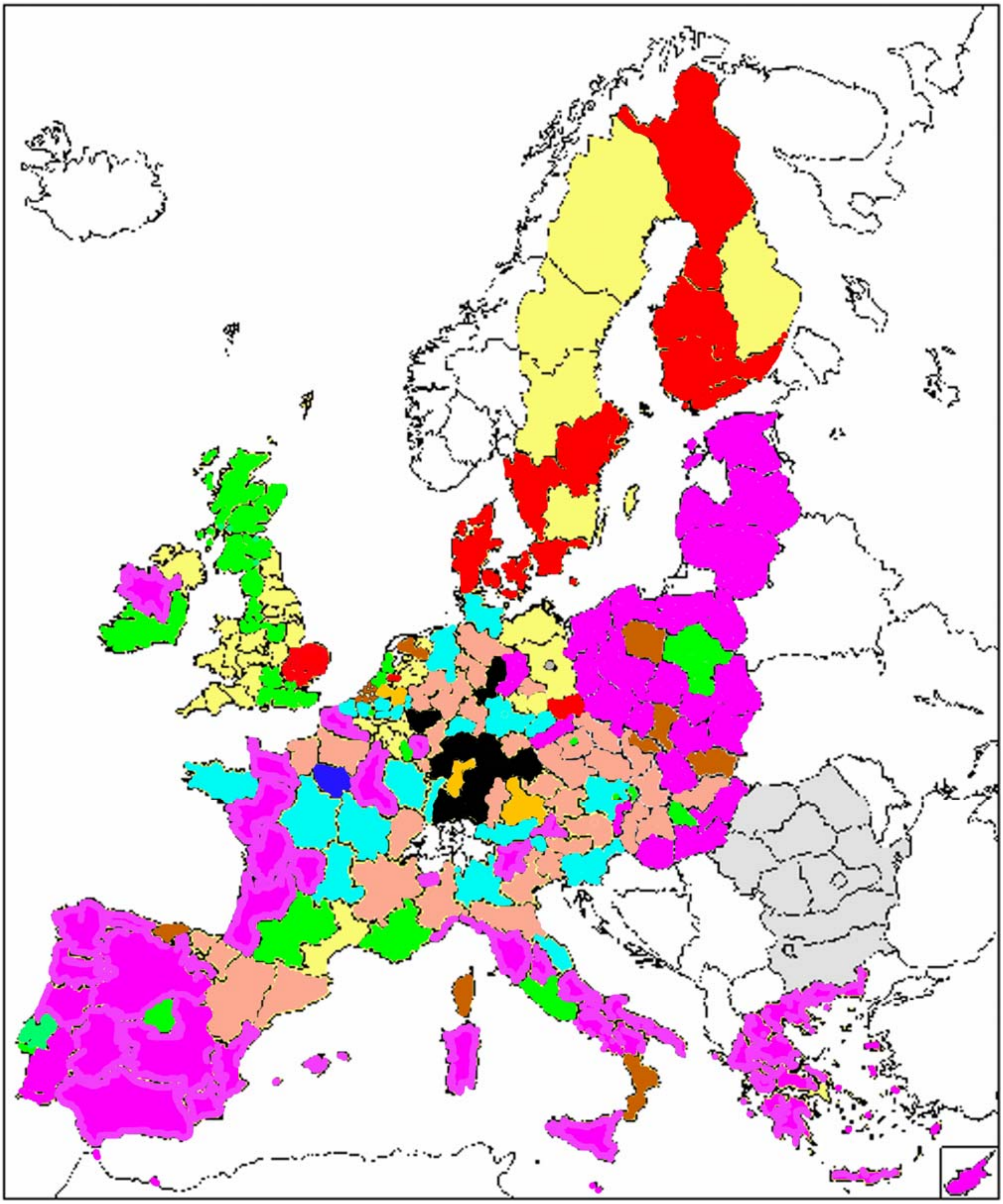

Table 5 European Regions by Clusters

Nuts Class.	Region	Cluster
de91	Braunschweig (DE)	1
de71	Darmstadt (DE)	1
de13	Freiburg (DE)	1
dea2	Köln (DE)	1
de25	Mittelfranken (DE)	1
de23	Oberpfalz (DE)	1
deb3	Rheinhessen-Pfalz (DE)	1
de11	Stuttgart (DE)	1
de14	Tübingen (DE)	1
de26	Unterfranken (DE)	1
dk	Denmark (DK)	2
ded2	Dresden (DE)	2
ukh	Eastern (UK)	2
fi18	Etelä-Suomi (FI)	2
fi19	Länsi-Suomi (FI)	2
se02	Östra Mellansverige (SE)	2
fi1a	Pohjois-Suomi (FI)	2
se01	Stockholm (SE)	2
se04	Sydsverige (SE)	2
nl31	Utrecht (NL)	2
se0a	Västsverige (SE)	2
sk01	Bratislavský kraj (SK)	3
es3	Comunidad de Madrid (ES)	3
hu1	Közép-Magyarország (HU)	3
ite4	Lazio (IT)	3
pt17	Lisboa (PT)	3
uki	London (UK)	3
lu	Luxembourg (Grand-Duché) (LU)	3
pl12	Mazowieckie (PL)	3
fr62	Midi-Pyrénées (FR)	3
nl32	Noord-Holland (NL)	3
ukd	North West (UK)	3
cz01	Praha (CZ)	3
fr82	Provence-Alpes-Côte d'Azur (FR)	3
be1	Région de Bruxelles-Capitale (BE)	3
ukm	Scotland (UK)	3
ukj	South East (UK)	3
ie02	Southern and Eastern (IE)	3
at13	Wien (AT)	3
nl33	Zuid-Holland (NL)	3
fr1	Île de France (FR)	4
de12	Karlsruhe (DE)	5
nl41	Noord-Brabant (NL)	5
de21	Oberbayern (DE)	5
itf1	Abruzzo (IT)	6
pt18	Alentejo (PT)	6
pt15	Algarve (PT)	6
gr11	Anatoliki Makedonia, Thraki (GR)\	6

es61	Andalucia (ES)	6
fr61	Aquitaine (FR)	6
itf5	Basilicata (IT)	6
fr25	Basse-Normandie (FR)	6
ie01	Border, Midlands and Western (IE)	6
at11	Burgenland (AT)	6
itf3	Campania (IT)	6
es7	Canarias (ES) (ES)	6
es41	Castilla y León (ES)	6
es42	Castilla-la Mancha (ES)	6
pt16	Centro (PT) (PT)	6
fr21	Champagne-Ardenne (FR)	6
es63	Ciudad Autónoma de Ceuta (ES) (ES)	6
es64	Ciudad Autónoma de Melilla (ES) (ES)	6
es52	Comunidad Valenciana (ES)	6
cy	Cyprus (CY)	6
hu33	Dél-Alföld (HU)	6
hu23	Dél-Dunántúl (HU)	6
pl51	Dolnoslaskie (PL)	6
gr23	Dytiki Ellada (GR)	6
gr13	Dytiki Makedonia (GR)	6
ee	Estonia (EE)	6
hu32	Észak-Alföld (HU)	6
es43	Extremadura (ES)	6
es11	Galicia (ES)	6
es53	Illes Balears (ES)	6
gr22	Ionia Nisia (GR)	6
gr21	Ipeiros (GR)	6
gr12	Kentriki Makedonia (GR)	6
gr43	Kriti (GR)	6
es23	La Rioja (ES)	6
lv	Latvia (LV)	6
itc3	Liguria (IT)	6
fr63	Limousin (FR)	6
lt	Lithuania (LT)	6
pl11	Lódzkie (PL)	6
pl31	Lubelskie (PL)	6
pl43	Lubuskie (PL)	6
dee3	Magdeburg (DE)	6
pl21	Malopolskie (PL)	6
mt	Malta (MT)	6
itf2	Molise (IT)	6
fr3	Nord - Pas-de-Calais (FR)	6
pt11	Norte (PT)	6
gr42	Notio Aigaio (GR)	6
pl52	Opolskie (PL)	6
fr51	Pays de la Loire (FR)	6
gr25	Peloponnisos (GR)	6
pl32	Podkarpackie (PL)	6
pl34	Podlaskie (PL)	6

fr53	Poitou-Charentes (FR)	6
pl63	Pomorskie (PL)	6
es12	Principado de Asturias (ES)	6
itd1	Provincia Autonoma Bolzano-Bozen (IT)	6
itd2	Provincia Autonoma Trento (IT)	6
itf4	Puglia (IT)	6
pt3	Região Autónoma da Madeira (PT) (PT)	6
es62	Región de Murcia (ES)	6
at32	Salzburg (AT)	6
itg2	Sardegna (IT)	6
cz04	Severozápad (CZ)	6
itg1	Sicilia (IT)	6
gr24	Sterea Ellada (GR)	6
sk03	Stredné Slovensko (SK)	6
pl33	Swietokrzyskie (PL)	6
gr14	Thessalia (GR)	6
ite1	Toscana (IT)	6
deb2	Trier (DE)	6
ite2	Umbria (IT)	6
itc2	Valle d'Aosta/Vallée d'Aoste (IT)	6
gr41	Voreio Aigaio (GR)	6
pl62	Warminsko-Mazurskie (PL)	6
pl41	Wielkopolskie (PL)	6
pl42	Zachodniopomorskie (PL)	6
fr42	Alsace (FR)	7
fr72	Auvergne (FR)	7
fr26	Bourgogne (FR)	7
fr52	Bretagne (FR)	7
fr24	Centre (FR)	7
ded1	Chemnitz (DE)	7
de72	Gießen (DE)	7
nl42	Limburg (NL)	7
itc4	Lombardia (IT)	7
fr41	Lorraine (FR)	7
ite3	Marche (IT)	7
at12	Niederösterreich (AT)	7
def	Schleswig-Holstein (DE)	7
si	Slovenia (SI)	7
deg	Thüringen (DE)	7
at33	Tirol (AT)	7
be2	Vlaams Gewest (BE)	7
at34	Vorarlberg (AT)	7
de94	Weser-Ems (DE)	7
es24	Aragón (ES)	8
dea5	Arnsberg (DE)	8
es51	Cataluña (ES)	8
es22	Comunidad Foral de Navarra (ES)	8
dee1	Dessau (DE)	8
dea4	Detmold (DE)	8
dea1	Düsseldorf (DE)	8

itd5	Emilia-Romagna (IT)	8
hu31	Észak-Magyarország (HU)	8
fr43	Franche-Comté (FR)	8
itd4	Friuli-Venezia Giulia (IT)	8
de92	Hannover (DE)	8
fr23	Haute-Normandie (FR)	8
cz06	Jihovýchod (CZ)	8
cz03	Jihozápad (CZ)	8
at21	Kärnten (AT)	8
de73	Kassel (DE)	8
deb1	Koblenz (DE)	8
hu21	Közép-Dunántúl (HU)	8
de93	Lüneburg (DE)	8
dea3	Münster (DE)	8
de22	Niederbayern (DE)	8
hu22	Nyugat-Dunántúl (HU)	8
de24	Oberfranken (DE)	8
at31	Oberösterreich (AT)	8
es21	Pais Vasco (ES)	8
fr22	Picardie (FR)	8
itc1	Piemonte (IT)	8
fr71	Rhône-Alpes (FR)	8
dec	Saarland (DE)	8
de27	Schwaben (DE)	8
cz05	Severovýchod (CZ)	8
at22	Steiermark (AT)	8
cz02	Strední Cechy (CZ)	8
cz07	Strední Morava (CZ)	8
itd3	Veneto (IT)	8
sk02	Západné Slovensko (SK)	8
fi2	Åland (FI)	9
gr3	Attiki (GR)	9
de4	Brandenburg (DE)	9
ukf	East Midlands (UK)	9
nl23	Flevoland (NL)	9
nl22	Gelderland (NL)	9
nl11	Groningen (NL)	9
dee2	Halle (DE)	9
fi13	Itä-Suomi (FI)	9
fr81	Languedoc-Roussillon (FR)	9
ded3	Leipzig (DE)	9
de8	Mecklenburg-Vorpommern (DE)	9
se07	Mellersta Norrland (SE)	9
se06	Norra Mellansverige (SE)	9
ukc	North East (UK)	9
ukn	Northern Ireland (UK)	9
nl21	Overijssel (NL)	9
se08	Övre Norrland (SE)	9
be3	Région Wallonne (BE)	9
se09	Småland med öarna (SE)	9

ukk	South West (UK)	9
ukl	Wales (UK)	9
ukg	West Midlands (UK)	9
uke	Yorkshire and The Humber (UK)	9
itf6	Calabria (IT)	10
es13	Cantabria (ES)	10
fr83	Corse (FR)	10
nl13	Drenthe (NL)	10
nl12	Friesland (NL)	10
pl61	Kujawsko-Pomorskie (PL)	10
cz08	Moravskoslezko (CZ)	10
pl22	Slaskie (PL)	10
sk04	Východné Slovensko (SK)	10
nl34	Zeeland (NL)	10

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ISSN 1972 - 361X