REGIONAL PATTERNS OF INNOVATION: THE ANALYSIS OF CIS RESULTS AND LESSONS FROM OTHER INNOVATION SURVEYS

Study carried out in the framework of the
Innovation & SME Programme
Directorate General – Enterprise

Contract CIS 98/192
Final Report, June 2000

Giuseppe D'Agostino
STEP Economics, Turin

Contacts at STEP:
Giuseppe D'Agostino
e-mail: dagostino@e-step.it

Executive Summary

The Community Innovation Survey is the result of a significative increase in the importance given to innovation issues at the EU level, and of a great effort in providing a rich set of information about input/output indicators of innovation activity at a firm level.

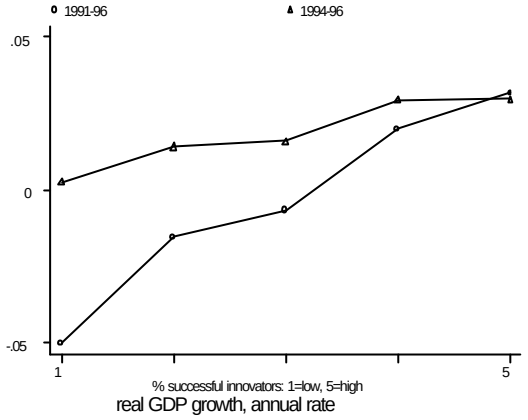
The CIS-2 database is based on a survey that was carried out in all member countries in the European Union between 1997 and 1999. In each country a stratified random sample of firms operating both in the manufacturing and in the service sector was drawn; surveyed firms were then requested to complete a common questionnaire developed by Eurostat: this procedure made it possible to obtain a harmonised database. The total number of surveyed firms is quite large (about 70,000) – although the overall response rate was lower than expected (only 57% of these firms returned the questionnaire, the figure being very low for some 'big' countries like Germany and the United Kingdom).

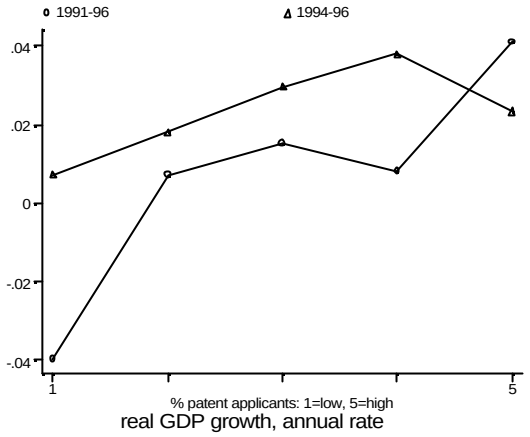
Following the recommendations of the Oslo manual, firms were asked a number of questions regarding their innovation attitudes and processes: about the results of their innovation activities (for example, whether they patented any innovation in the period considered), about their efforts (e.g. the amount of resources they devoted to innovation processes), about their objectives and strategies (including sources of information and whether they had co-operation agreements) and about the environment in which they operated (e.g. the main obstacles to innovation process).

The analysis performed in this study is based on data aggregated at NUTS 2 (regional) level, without any segmentation according to sector or size. Data aggregated by size class were available only at NUTS 1 (macro-regional) level. No information was available according to NACE (sector): this is a major limit since different industries differ much in terms of propensity to innovate, and also in terms of the characteristics of the innovation processes involved and of the innovation outputs.

Our first result is that – on average – **regions where innovation activities are more diffused tend to grow more**, at least in the manufacturing sector (data concerning the service sector are hardly reliable). We expect, following the literature, the causal link to go from innovation to growth and not vice-versa. Unfortunately, due to the lack of a time-series dimension in the dataset, it is not possible to address the problem of the lag required for innovation activities to impact the growth rate. In the graphs below, we have used both the growth rate attained in the same period (1994-96) and the 1991-96 growth rate (that should average out the business cycle)[1]. As a measure of innovation diffusion, we have used the share of self-reporting innovative firms and the share of patenting firms on the total number of firms in each region, from the CIS-2 dataset.

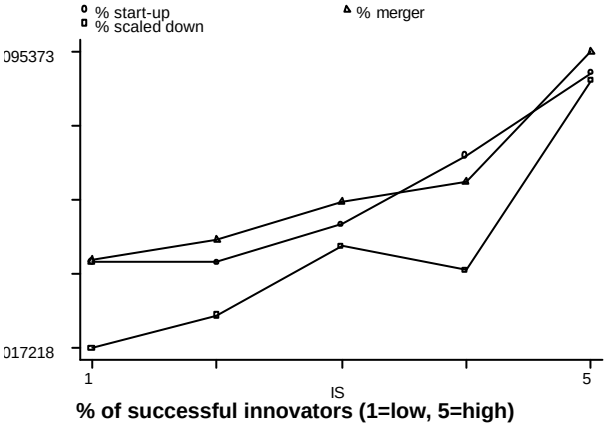
[1] Source: Regio database





This result contrasts with one strong indication emerging from CIS II data, i.e. that both in terms of number of employees and turnover, firms in high innovation density regions (regions with a higher share of self-reporting innovative firms on the total number of firms) do not differ significantly – on average – from firms in low-density regions.

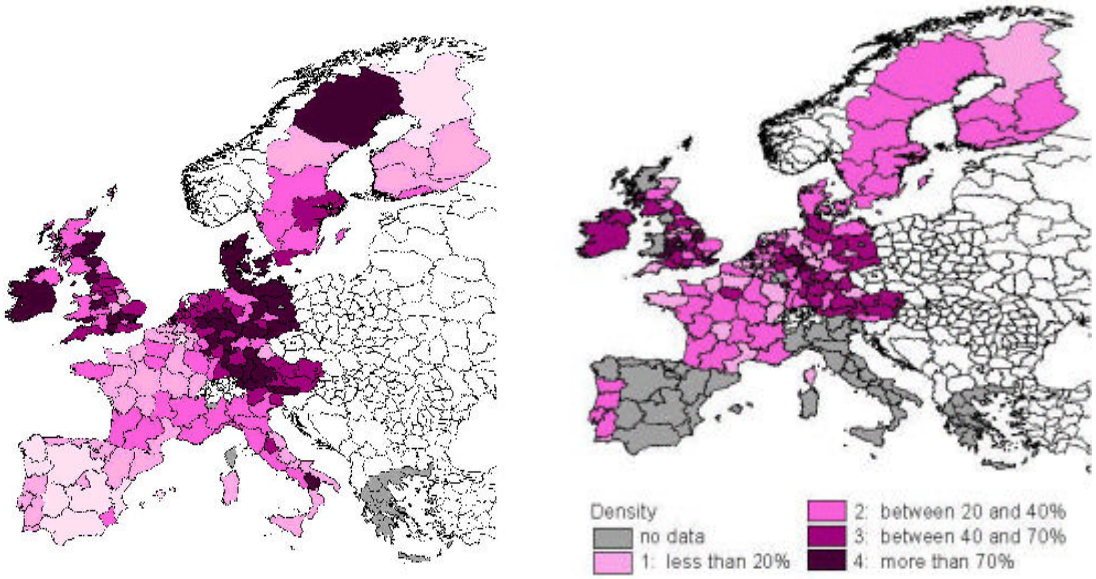
Since CIS II data concerning turnover, employees and export change refer both to innovators and non innovators, they should reflect the aggregate GDP trend. One reason why they do not could be the fact that it is the *number* of firms – rather than the *size* of existing firms – that is growing. This is confirmed by the graph below, that shows that **regions with a wider diffusion of innovation activities are more dynamic, in terms of higher birth and death rate of firms and in terms of mergers and acquisitions**, than regions with low innovation density:



These results strongly suggest that innovation activities have important externalities, mainly in terms of increased spin-off and start-up of new firms.

The two maps below report the share of innovative firms over the total number of firms (the “innovation density”), for the manufacturing and the service sector. The first thing to note is that the proportion of firms that declare to be innovative is far

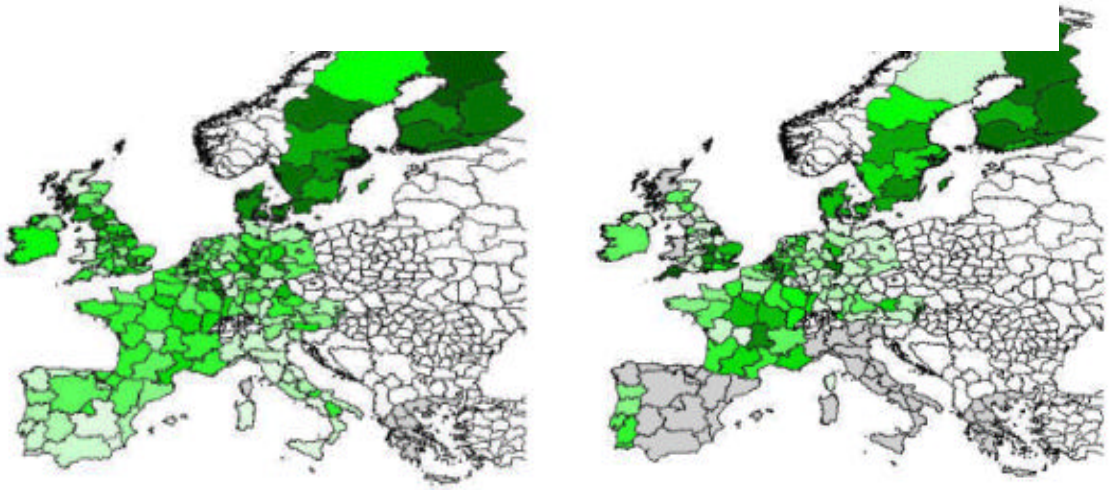
lower for the latter (35% of the overall sample) than for the former (more than 50%).



Manufacturing sector Service sector

Share of innovative firms

It is interesting to note that the existence of (formal) cooperation agreements (with other firms of the same group, with Universities, with public institutions…), long understood to be one of the key drivers of innovative performance, seems to be peculiar only to some innovation systems, namely those of the Baltic countries. On the other hand, these regions do not excel as regard to the diffusion of innovative activities among firms.

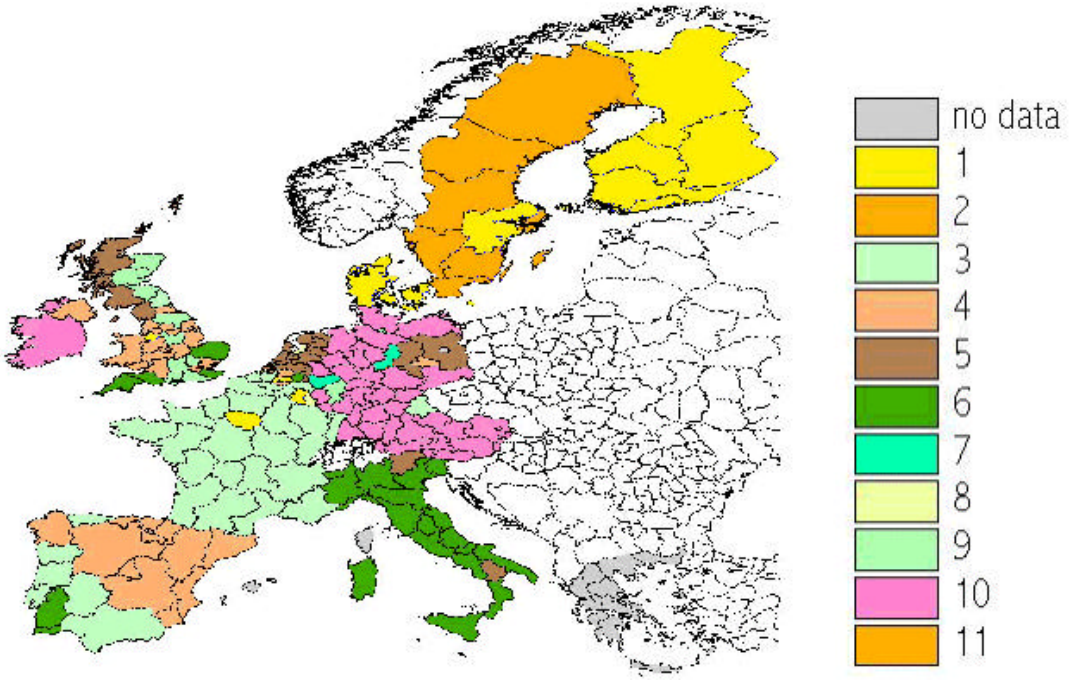


Manufacturing sector Service sector

Share of innovative firms engaging in cooperation agreements, 1994-1996

In order to attempt an identification of different (regional) systems of innovation, we have clustered the EU regions according to their main input, output and

"environmental" characteristics. Since clusters for the service sector are of doubtful interpretation, we comment here only on clusters for the manufacturing sector.



Innovation clusters – Manufacturing sector

The most interesting clusters, for what concerns innovation effectiveness, are clusters 10 (**"private R&D, good transfer and exchange mechanisms"**), Cluster 9 (**"private and public R&D, good information flows"**), cluster 2 (**"the Swedish model: innovation is for academics"**), and Cluster 5 (**"private R&D, public support, poor transfer and exchange mechanisms"**).

Cluster 10 (**"private R&D, good transfer and exchange mechanisms"**) includes Austria, most of Germany (except Brandenburg and Sachsen-Anhalt in Eeastern Germany, Oberpfalz in Bayern, Koblenz, Koln and Hamburg, plus Braunschweig) and Ireland. This cluster is characterised by a high diffusion of innovation activities: the share of product and process innovators is very high (50% higher than the EU regional average[2]), as the number of both patent applicants (+50%) and patent applications (+100%). Innovation is particularly driven by cost reduction purposes. Firms located in the 38 regions of this cluster are on average bigger than the EU regional mean for the manufacturing sector, but they export much less. Their R&D effort is quite in line with the EU regional average, while public R&D effort is lower (both by the government and by other

[2] The "EU regional mean" refers to the mean of all EU regions: this is the arithmetic average of all regions, i.e. without taking the appropriate weights (population, gdp…) into account. This measure has the advantage of "allowing small regions to count", and may be considered as appropriate when looking for different models, where each model has the same scientific interest, regardless of its dimension.

research institutes). On the other hand, firms use all possible sources of information for their innovation activities, both public and private, and co-operation with Universities and other higher education or research institutes is much more common (2.5 times more frequent, but with a high variance in the cluster).

In general, firms experience less problems in their innovation efforts (but there is a lot of variance in the sample as well).

Thus, this cluster looks like a model of innovation diffusion, although the data are not good enough to allow for an underlying coherent innovation system – if any – to be fully described. Anyway, it points to the importance of co-operation between private firms and research institutions, in which firms are not simply passive beneficiaries, but pro-active players who undertake most of the R&D themselves.

Cluster 9 (**"private and public R&D, good information flows"**) includes two German regions (Hamburg and Koblenz) plus eight British regions, on north-south axes. They are characterised by a good level of human capital (25% of the male 25-59 population has a higher education degree), low youth unemployment, small export, small R&D personnel (but R&D expenditure in line with the EU regional average), and better than average innovation diffusion (the share of innovators on the total number of firms is almost 50% higher, and the share of patent applicants is almost double, than the EU regional average). Firms particularly focus on the compliance of standards and regulations and cost reduction as their main objectives for innovation activities. The flow of information among innovation players is good (firms use more than average other firms and research institutions as a source of information for their innovation activities), but cooperation is quite low. Firms strongly complain the lack of adequate sources of financing. This turns out to be mainly a British problem (cluster 4 also share it). If it may seem at odds with the reputation of the UK (and in particular of London) as a financial centre, it could also point more to the consideration financial aspects have in the British business culture than to financial support being really unavailable to most firms for innovation activities.

Overall, this cluster looks like the only successful model of innovation diffusion, other than the one described in the previous cluster. Overall, this innovation system looks more *government-pushed*, while the one of cluster 10 looks more *cooperation-driven*.

Cluster 2 includes most of Sweden (6 small, export-oriented regions, with a highly educated workforce), and effectively represents what we could call **"the Swedish model: innovation is for academics"**. The amount of R&D performed by non-profit research institutes is impressive (more than 10 times the EU regional average) and is the single variable that most characterises this cluster (R&D expenditure by the government – in opposition - is about half as high, in proportion of GDP, as the EU regional average, and direct public support to the firms is not high). This knowledge is not transferred to the firms: public sources of information are not relevant and public institutions do not enter into co-operation

agreements with the private sector. If private expenditure by the firms is roughly twice the EU regional average, R&D personnel is much lower. Firms engage in co-operation agreements with other enterprises up and down their value chain. But innovation output is not particularly high. Firms lament more than the EU regional average an excessive risk and cost of innovation activities and the lack of qualified personnel, but they seem to be on average fine as regard the sources of finance.

"The Swedish model" is thus a model of high public expenditure (via research institutes), that are not transferred efficiently to the innovative performance of the firms. It seems that the main culprit has to be found in the transfer mechanism, that appears particularly poor.

Cluster 5 (**"private R&D, public support, poor transfer and exchange mechanisms"**) includes 19 regions: the Netherlands (except Flevoland), the Italian regions of Basilicata and Trentino-Alto Adige, three eastern German regions (Brandenburg, Magdeburg and Halle) and three north-eastern British regions (Cumbria and the regions around Glasgow in Scotland). These are fairly small regions, with low youth unemployment and a low number of firms with a very low export propensity. As opposite to the Swedish model, firms in this cluster spend a low amount on R&D (more than 40% less than the EU regional average) even if they have more R&D personnel than the average. The diffusion of direct public support is about two and a half times higher than the average. Innovation diffusion is slightly higher than in other clusters, even if patenting propensity is not high (but firms are good in bringing new products to the market). Few firms explicitly declare an objective for their innovation activity. The transmission mechanism is similar to the Swedish one: firms co-operate particularly with business partners, and very little with public partners. Apparently in contradiction, firms do not use business relationship much in order to gain information for their innovation activities. So, in this cluster we have little but highly subsidised private expenditure on R&D activities, and the development of innovations is mainly left to the firms themselves. As compared to the Swedish model, where the main innovative efforts were undertaken by universities and research institutes but the results were not transferred to the firms, this model seems to work better for what concerns the diffusion of innovative firms.

Overall, most of Germany, Austria and Ireland look clearly like an example to follow. Their main points of strength lie in the **importance of *transfer and exchange mechanisms* (mainly information flows and co-operation) *between the public and the private sector***, a factor that has gained much attention also in the literature on innovation, as we have seen in the task 1 report.

A second model that performed well in the diffusion of innovation activities is to be found in some British and German regions (North Yorkshire, Derbyshire, Nottinghamshire, Bedfordshire, Hertfordshire, Berkshire, Buckinghamshire, Surrey, East and West Sussex, Hampshire in the UK, and Hamburg and Koblenz in Germany). Here, the role of the government in *assisting* private firms, that bear most of the weight of undertaking innovation effort replaces the importance of co-

operation agreements. A good flow of information between research institutions and private firms, and within private firms (mainly up and down the value chain) is again essential.

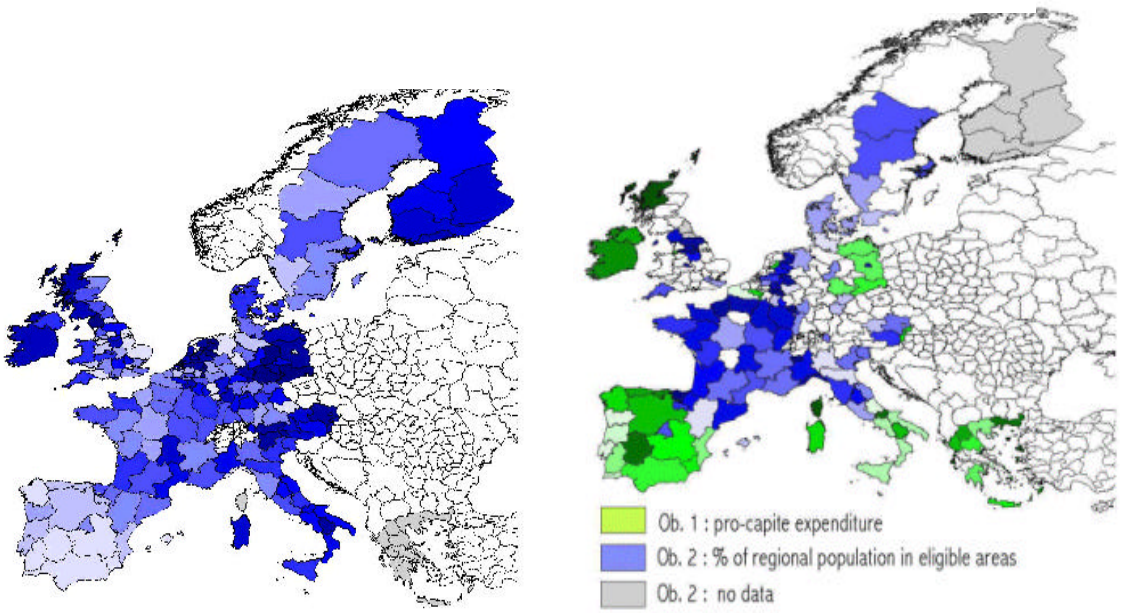
Other models seem to be less effective and efficient in fostering innovation diffusion. Either in case of a strong role of research institutes (the Swedish model) or in case the government supports financially the firms to undertake R&D themselves, the absence of good transfer and exchange mechanisms paves the way to low innovation.

Some regions (cluster 6) have found an innovation model based mainly on informal efforts: this has been quite effective so far, but is definitely at risk for the future. **Cluster 6** (**"informal innovation"**) includes most Italian regions (but Basilicata and Trentino), the southern Portuguese regions, four southern English regions (East Anglia, Kent, Cornwall and Devon, plus Dorset and Somerset) and the Limburg region in Belgium. These regions are characterised by a relatively less educated workforce (only 10% of the male 25-59 population has a higher education degree, on average), many small firms (50% smaller in terms of employees than the EU regional average) with low export propensity (only 14% of EU regional export average) and low R&D expenditure (only 35% of the EU regional average). Research institutions make the deficit of R&D expenditure even worse, with only 56% of EU regional average. The result is low diffusion of formal innovation output (i.e. patents). On the other hand, firms consider themselves to be quite innovative, and they seem to be slightly better than average in bringing new products to the market (quite surprisingly, innovation is very little sales increasing-led). The scarcity of formal innovation activities, together with a not-so-bad figure for innovation diffusion, could suggest the presence of the industrial districts the literature on innovation has extensively focused on. However, the poor exchange of information (among firms and with research institutions), and the scarcity of co-operation agreements on innovation activities (50% lower than the EU average) do not support this hypothesis. Although this may be due to the level of aggregation in the data (the districts should be an entirely local phenomenon), this data show that they are not particularly relevant. Finally, firms also report few obstacles to innovation activities, suggesting a low concern rather than real absence of problems.

In addition, there are some regions that are not specialised at all in innovation activities (clusters 3 and 4, basically). This does not mean that there are no islands of excellence in these regions, but these islands cannot be spotted due to the high level of aggregation of the data.

This study also address the relationship between innovation diffusion and public support (to due the quality of the data, only the manufacturing sector is considered). As long as direct public support given to innovative companies by national governments is concerned, an interesting negative correlation can be found: **regions with the lowest public support are those with the highest innovation rates**. On the other hand, regions with high national public support rates have lower dissemination levels. This evidence meets however three interesting **exceptions:** Ireland, Eastern Germany and Netherlands (all countries

with **high human capital** and education levels) where high innovation rates are combined to high rates of public participation and support. This points to the importance of human capital, as measured for instance by education, as a prerequisite for successful innovation activities to take place.



Direct public support

Share of innovative firms that received EU structural funds, 1994-1999

Then, we consider the relationship between innovation diffusion and EU structural funds contribution. We focus on the EU structural funds most related to innovation activities, i.e. Objective 1 (lack of infrastructure and lagging development) and Objective 2 (industrial regions in decline) funds.

For both measures, there is a **moderate tendency for low innovation-density regions to receive more EU supports**. Even if the result is actually quite weak, it validates both the EU assignation procedures and the link between innovation and development. This result is confirmed when looking at the total number of *patent applications* (from a non CIS II source, the Regio database). Unfortunately, due to the lack of a time-series dimension in the CIS II data, assessing the effectiveness of EU contributions on convergence in innovation performance is impossible. Thus, overall, the evidence does not support any conclusion on the effectiveness of EU structural funds support in fostering innovation activities.

So far innovation performance has not been included among the criteria governing Objective 1 and 2 regional structural funds assignment. Including them would make sense, since the relationship between innovation and growth is well accepted (as – according to the results of this study – should become the

relationship between innovation diffusion and dynamism, i.e. the birth rate of firms).

By proposing the inclusion of some “innovation criteria” for the post-2006 structural funds allocation, the EU Commission could encourage, in accordance with Member States, the elaboration of a specific regional strategy for innovation both for the less favoured regions and for the most developed and innovative regions. Of course, this would address the historical dilemma in economic policy between the option of favouring the ‘**islands of excellence**”, thus maximising overall GDP growth and the objective of convergence between regions in order to **reduce disparities and achieve cohesion**; the latter being, of course, EU choice until now.

Unfortunately, CIS-2 data do not allow to look for an empirical assessment of which policy option works better: actually, an argument can be made for both options. On one side, the facts that innovation helps growth and that innovation clusters could point towards a “picking-the-winner” choice in EU policy. On the other side, the importance of human capital for increasing returns to take place, thus fostering innovation performance could push for a twist in infrastructural policy in less developed regions, from physical infrastructures (e.g. roads) to infrastructures directly aimed at improving the technological and scientific level (e.g. polytechnics).

Without diminishing the role of the political debate on such a delicate issue, we believe that to a certain extent it is possible to test the effectiveness of these two policy options: the question remains open for further CIS editions.