

Concentrated versus distributed efforts: what contributes most to Regional Technology Development?. An investigation of texture characteristics of European Biotech Regions.

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Introduction

Innovative activities, especially in knowledge-intensive industries, display a tendency to cluster geographically (Audretsch and Feldman, 1996; Lecocq et al., 2009). Technology clusters (St. John and Pouder, 2006) are local environments where knowledge is created and diffused through (frequent) interactions between a variety of innovation actors (Leydesdorff and Etzkowitz, 1996; Lundvall, 1992; Freeman, 1987; Nelson, 1993). On the role and importance of different types of innovation actors (knowledge institutes, private firms and individual entrepreneurs), however, different perspectives are being advanced. While some authors acknowledge and stress the importance of knowledge generating institutes such as universities (e.g. Saxenian, 1994), other studies emphasize the importance of large(r) private firm(s) for a region to become a leading technology region (e.g. Agrawal and Cockburn, 2003). While the development and growth of clusters has been studied from a wide range of perspectives, quantitative studies examining the relationship between composition - in terms of innovation actors – and technological performance of the region are scarce. This paper engages in such an analysis for the field of biotechnology in Europe (EU-15 and Switzerland). Based on patent data, we investigate whether biotech regions in Europe differ in terms the role and size of different sectors and to what extent this impacts the overall technological performance of the region. The following hypotheses are guiding our efforts:

Hypothesis 1a: Regions will perform better in terms of technology development to the extent that technological development efforts are of a more distributed nature (across different types of actors).

Hypothesis 1b: Regions will perform better in terms of technology development to the extent that efforts are concentrated within a limited number of strong actors (firms).

Next, we complement this analysis by looking at the specific impact of international collaboration on the performance of regions. While cluster research focuses on collaborative dynamics within the region, it is clear that relevant knowledge is also created outside technology clusters. Even in the most dynamic clusters, firms and other innovation actors therefore might benefit from an outward stance (Porter, 1998). Previous empirical work in the field of biotechnology (Lecocq and Van Looy, 2009) revealed such beneficial effects of international collaboration during different phases of the technology life cycle. Building on these ideas, we advance the following hypotheses:

Hypothesis2a: Regions that engage more in collaboration on an international scale, benefit in terms of technology development.

Hypothesis2b: Beneficial effects of international collaboration will be more outspoken, to the extent that the local texture is more concentrated.

Data and results

In this study, we draw on panel data of 50 European regions (EU-15 and Switzerland) over a time period of 7 years (1991-1997). The selected European regions developed a substantial amount of

biotech activity over the time period under study. The chosen time frame corresponds with a period of rapid growth in the field of biotechnology. Patent data allows us to construct measures of local diversity, international collaboration and the technological performance of regions in the field of biotechnology (see Table 1).

Table 1 Indicators

Local diversity	Herfindahl based on the regional concentration of 1) universities and public research centres, 2) private firms and 3) individuals. Concentration of a sector is measured through the share of total patents of a particular sector. In the econometric analyses, the reciprocal of the index is used to represent the number equivalent.
International (regional) collaboration	The share of co-patents with assignees belonging to different countries (to the same region). Co-patents are defined as patents with minimum two different assignees.
Technological performance	Total number of biotech patents with at least 1 assignee in the region
Portfolio 5 years	Total number of biotech patents over the last 5 years

First, we investigate whether regions differ with respect to the composition of their local texture. Therefore, a 2-step cluster analysis is performed on the 50 largest biotech regions in Europe, based on quantitative indicators measuring local diversity and total biotechnology activity developed within these regions over the period 1991-1997. The cluster results point to the existence of two types of regions in terms of local diversity. In the first group of regions, technological activity is rather distributed over different types of innovation actors (universities and public research centers, private firms and individuals), while technology development in the second group of regions is mostly – and significantly more - concentrated within firms. In addition, ANOVA analysis shows that the propensity to collaborate is significantly higher in the “distributed” regions than the “concentrated” regions. In terms of the amount of technology development, however, there is no significant difference between both types of regions.

In a next step, the relationship between technological performance and international R&D collaborations is being examined (Table 2). Model 1 provides evidence of an inverted-U relationship between the share of international collaborations and the technological performance of top biotech regions in Europe. Model 2 & 3 further reveal that this inverted-U relationship is especially strong and significant for the concentrated regions, but not significant for the distributed regions. The latter, in contrast, seem to benefit from a higher share of regional collaboration, as evidenced in model 4 & 5. Distributed regions also enjoy better technological performance as local diversity further augments.

Together, these results provide evidence that differences exist across European biotech regions in terms of local texture characteristics. Regions with a concentrated texture benefit more from international collaborations than regions where technology development effort are more distributed across different type of innovation actors. Further research is needed to refine the current findings and to investigate whether a superior model for regional technology development can be advanced based on the local texture characteristics of regions in combination with the intensity and type of international R&D collaboration linkages.

Table 2 Random effect negative binomial regression model on the 50 largest biotech regions in Europe (period 1991-1997). Dependent variable is the number of biotech patents in t+2

	All regions	Distributed Regions	Concentrated Regions	Distributed Regions	Concentrated Regions
	Model 1	Model 2	Model 3	Model 4	Model 5
Portfolio5y	0.0049***	0.0050***	0.0046***	0.0049***	0.0055***
	(0.0007)	(0.0009)	(0.0011)	(0.0009)	(0.0010)

Local diversity	0.1132	0.1800*	0.061	0.1977**	0.0352
	(0.0820)	(0.0937)	(0.2140)	(0.0942)	(0.2189)
International collaboration	0.6894***	0.5404	1.1508***		
	(0.2666)	(0.3532)	(0.4315)		
(International collaboration) ²	-0.5069**	-0.486	-0.8225**		
	(0.2514)	(0.3587)	(0.3804)		
Regional collaboration				0.8036**	0.5951
				(0.3946)	(0.4981)
(Regional collaboration) ²				-0.8883**	-0.9181
				(0.4293)	(0.6039)
Time	0.0762***	0.0777***	0.0763***	0.0796***	0.0696***
	(0.0141)	(0.0199)	(0.0200)	(0.0196)	(0.0211)
Constant	1.4365***	1.4177***	1.3554***	1.4210***	1.4380***
	(0.2275)	(0.3417)	(0.3764)	(0.3434)	(0.3683)
Number of observations	248	146	102	146	102
Number of regions	49	29	20	29	20
Loglikelihood	-860.356	-485.142	-368.077	-484.233	-371.313

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ⁱ Only European regions with at least 20 patent applications in the period 1991-97 were selected.

ⁱⁱ Within these 2 groups, two subgroups can be distinguished based on the total number of biotech patents in the region. A limited number of regions exhibit a very high number of biotech patents (Distributed regions: Paris, Inner London and Mannheim-Heidelberg; Focused regions: Darmstadt - Frankfurt-Am-Main, Basel and Bagsvaerd - Copenhagen). In the econometric analyses of the paper, we only distinguish between the distributed and the focused regions.

ⁱⁱⁱ The propensity to collaborate is calculated as the share of total patents with at least 2 different assignees.