

Table 1: List of variables

<i>Firm characteristics</i>	
<i>SALES</i>	Company sales in 1988 (Millions of 1988 US\$).
<i>R&D/SALES</i>	Ratio between a company R&D spending and sales in 1988 (Millions of 1988 US\$).
<i>TECH-COMP</i>	Number of patents developed by the firm during the 5 years before the patent application
<i>TECH-SPEC</i>	Ratio between the number of patents developed by the firm in the technological field of the patent application and the total number of patents developed in the 5 years before the patent application.
<i>N-INVENTORS</i>	Number of inventors that collaborate to develop the innovation
<i>DLOC</i>	Dummy. It takes the value 1 if the inventors listed in a patent document are located in the same region. It takes the value 0 if one or more inventors are located in different regions.
<i>CITS</i>	Number of forward citations received by the patent in the 5 years after the application date. Self citations are not counted.
<i>Dummy for non chemical companies</i>	Dummy. It takes the value 1 if the company principal business is not in chemicals
<i>Dummy for missing values</i>	It takes the value 1 if data on SALES and R&D are missing
<i>Regional characteristics</i>	
<i>REG-HLABS</i>	Number of higher education laboratories located in the region
<i>REG-PATS</i>	Number of patents invented in the regions – average 87-96
<i>GDP</i>	Regional Gross Domestic Product, average 1987-1996 (in PPP and corrected for inflation).
<i>POP</i>	Population of the region
<i>AREA</i>	Area of the region in Km ²

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(continue)

<i>Other controls</i>	
<i>CITSSSEC</i>	Number of yearly citations to EPO patents in the sector of the patent (14 sectors)
<i>Inventor country dummies</i>	Dummy for the country of the inventors
<i>Applicant country dummies</i>	Dummy for the country of the applicant firm
<i>Year dummies</i>	Dummy for the application date (1987-1996)
<i>Sector dummies</i>	Dummy for the sector in which the patent is classified: biotechnology, materials, organic chemistry, pharmaceuticals, and polymers

Table 2: Descriptive statistics

	Mean	Standard Error	Minimum	Maximum
<i>Firm characteristics</i>				
<i>SALES</i>	17,607.2	254.8	4	87,542
<i>R&D/SALES</i>	0.063	0.002	0,002	3.125
<i>TECH-COMP</i>	1,581.8	24.54	1	6,279
<i>TECH-SPEC</i>	0.24	0.003	0	1
<i>N-INVENTORS</i>	3.27	0.31	1	16
<i>CITS</i>	0.60	0.02	0	13
<i>CITS-SELF</i>	1.06	0.03	0	19
<i>Firm characteristics (missing SALES and R&D data)</i>				
<i>TECH-COMP</i>	39.0	2.9	1	104
<i>TECH-SPEC</i>	0.53	0.01	0	1
<i>N-INVENTORS</i>	2.89	0.06	1	14
<i>CITS</i>	0.67	0.05	0	11
<i>CITS-SELF</i>	0.89	0.06	0	13
<i>Regional characteristics</i>				
<i>REG-HLABS</i>	77.4	0.93	0	461
<i>REG-PATS</i>	1,229.1	18.01	4.34	2,980.6
<i>GDP</i>	136,731.6	1,516.7	6,191.7	297,422.8
<i>POP</i>	7,743.9	79.4	388.4	17,339.5
<i>AREA</i>	24,502.2	239.2	161.4	154,311.9
<i>Other controls</i>				
<i>CITSSEC</i>	1,607.3	18.08	0	3,864

Source: Elaboration from the EPO data and European R&D database.

Note: These data do not include universities, government institutions and isolated inventors.

Table 3: Estimates of Negative Binomial regressions. Biotech patents vs. “Traditional chemical” patents. Dependent variable: CITS.

	<i>Biotechnology</i>	<i>Traditional chemicals</i>
<i>Firm characteristics</i>		
<i>SALES</i>	0.05 (0.13)	-0.02 (0.05)
<i>R&D/SALES</i>	0.05 (0.19)	0.13 (0.05)
<i>TECH-COMP</i>	0.17 (0.08)	-0.03 (0.04)
<i>TECH-SPEC</i>	0.54 (0.15)	-0.09 (0.04)
<i>N-INVENTORS</i>	0.16 (0.18)	0.17 (0.07)
<i>DLOC</i>	0.16 (0.21)	-0.015 (0.08)
<i>Regional characteristics</i>		
<i>REG-HLABS</i>	-0.15 (0.26)	-0.02 (0.09)
<i>REG-PATS</i>	0.71 (0.25)	-0.08 (0.08)
<i>GDP</i>	-2.65 (0.94)	-0.01 (0.32)
<i>POP</i>	2.69 (0.87)	0.12 (0.30)
<i>AREA</i>	-0.27 (0.14)	-0.04 (0.06)
<i>Other controls</i>		
<i>CITSSEC</i>	0.18 (0.08)	0.04 (0.02)
<i>Number of obs.</i>	424	3,270
<i>Log-likelihood</i>	-468.65	-3,185.32

Note: Variables are in logs. Standard errors are in parentheses. All regressions include: dummies for Non chemical companies, dummies for Missing value for R&D and SALES, Inventor country dummies, Applicant country dummies, Year of application dummies, sector dummies. For the likelihood ratio test in “traditional chemicals” the restrictions are the following: REG-HLABS = REG-PATS = GDP = POP = AREA = 0 – LR test = 3.35

Table 4: Estimates of Ordered Probit regressions.
Biotech patents vs. “Traditional chemicals”.
Dependent variable: *CITS* = 0, 1, 2 more than 2

	<i>Biotechnology</i>	<i>Traditional chemicals</i>
<i>Firm characteristics</i>		
<i>SALES</i>	-0.02 (0.09)	-0.15 (0.03)
<i>R&D/SALES</i>	0.01 (0.13)	0.05 (0.03)
<i>TECH-COMP</i>	0.11 (0.06)	-0.02 (0.03)
<i>TECH-SPEC</i>	0.34 (0.10)	-0.06 (0.03)
<i>N-INVENTORS</i>	0.17 (0.16)	0.07 (0.04)
<i>DLOC</i>	0.15 (0.15)	-0.03 (0.05)
<i>Regional characteristics</i>		
<i>REG-HLABS</i>	-0.16 (0.18)	-0.01 (0.06)
<i>REG-PATS</i>	0.38 (0.18)	-0.03 (0.06)
<i>GDP</i>	-1.24 (0.68)	-0.002 (0.20)
<i>POP</i>	1.35 (0.61)	0.07 (0.20)
<i>AREA</i>	-0.12 (0.10)	-0.03 (0.04)
<i>Other controls</i>		
<i>CITSSEC</i>	0.09 (0.06)	0.004 (0.02)
<i>Number of obs.</i>	424	3,270
<i>Log-likelihood</i>	-399.41	-2,898.28

Note: Variables are in logs. Standard errors are in parentheses. All regressions include: dummies for Non chemical companies, dummies for Missing value for R&D and SALES, Inventor country dummies, Applicant country dummies, Year of application dummies, sector dummies.
For the likelihood ratio test in “traditional chemicals” the restrictions are the following: REG-HLABS = REG-PATS = GDP = POP = AREA = 0 – LR test = 1.36

Therefore, there are two models of innovation:

In the “traditional” chemical sectors, big innovations depend on firm characteristics:

- Large diversified companies
- R&D intensity of the firm
- Large scale projects
- No localised knowledge spillovers

*...while regional characteristics are important in **Biotechnology**:*

- Local knowledge spillovers
- Technological specialisation at the firm level

Table 3a: Estimates of Negative Binomial regressions. Biotech patents vs. “Traditional chemical” patents. Dependent variable: CITS – self citations are included

	<i>Biotechnology</i>	<i>Traditional chemicals</i>
<i>Firm characteristics</i>		
<i>SALES</i>	0.07 (0.12)	-0.012 (0.04)
<i>R&D/SALES</i>	0.06 (0.16)	0.11 (0.04)
<i>TECH-COMP</i>	0.15 (0.08)	-0.02 (0.03)
<i>TECH-SPEC</i>	0.44 (0.13)	-0.01 (0.03)
<i>N-INVENTORS</i>	0.29 (0.17)	0.36 (0.05)
<i>DLOC</i>	0.24 (0.19)	-0.06 (0.05)
<i>Regional characteristics</i>		
<i>REG-HLABS</i>	-0.07 (0.23)	-0.07 (0.08)
<i>REG-PATS</i>	0.67 (0.22)	-0.08 (0.07)
<i>GDP</i>	-2.59 (0.85)	0.21 (0.26)
<i>POP</i>	2.48 (0.78)	-0.04 (0.25)
<i>AREA</i>	-0.23 (0.13)	-0.07 (0.05)
<i>Other controls</i>		
<i>CITSSEC</i>	0.18 (0.08)	0.03 (0.03)
<i>Number of obs.</i>	424	3,270
<i>Log-likelihood</i>	-548.77	-4,298.59

Note: Variables are in logs. Standard errors are in parentheses. All regressions include: dummies for Non chemical companies, dummies for Missing value for R&D and SALES, Inventor country dummies, Applicant country dummies, Year of application dummies, sector dummies.

For the likelihood ratio test in “traditional chemicals” the restrictions are the following: REG-HLABS = REG-PATS = GDP = POP = AREA = 0 – LR test = 5.22