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What Patent Data Reveal about Universities: The Case of Belgium

Sarina Saragossi
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ABSTRACT. In recent years, there has been a surge in patenting by Belgian universities. It appears that this increase can be attributed to growth of biotechnology, where there is a greater propensity to patent, to a desire on the part of universities to enhance commercialization through technology transfer offices (TTOs), and to effective collaboration between universities and government-sponsored research centers. Our qualitative analysis reveals that patent statistics could be a misleading indicator of an individual university's "technological productivity," since many inventions are developed at universities, yet applied by other institutions.

JEL Classification: D23, L31, O31, O32

1. A small revolution?

Universities are increasingly seen by national governments as an important determinant of economic growth. The role of universities in fostering technology transfer and economic growth is now considered to be a key element of national S&T policies.[1] In this regard, the European Commission's objectives are clearly stated: to foster industry-university partnership and to localize the most efficient knowledge-generating institutions. The latter objective aims at sustaining specialized centers. Two main tools can be used to assess the effectiveness of universities: scientific publications (and citations) and patents.

Patent data have been increasingly used over the past twenty years. Simple patent counts or more complex measures based on renewal data and citations have been developed either to measure the innovative performance of firms, industries and countries (see Griliches, 1990; Jaffe, 1986; Lanjouw *et al.,* 1998) or to trace the source of knowledge spillovers. The early studies focused mainly on the business sector. More recent investigations relied on patent data to underline the role of universities in the US national innovation system (see Jaffe, 1988; Mansfield, 1998; Mowery *et al.,* 2001; Mowery and Ziedonis, 2002). The objective of this paper is to analyze the evolution of the patenting performances of six major Belgian Universities and to test whether the data contained in their patent applications reveal relevant information about their technological productivity or patenting performances.

Counting patent is not straightforward; there is no single way of counting them (see Dernis *et al.*, 2001). Since we are focusing on Belgian universities we decided to opt for the EPO patent applications instead of the patent filed in Belgium or at the USPTO. For the sake of timeliness we used the number of patent applications instead of the number of patents granted (it takes on average five years at the EPO to grant a patent). Six major Belgian universities have been selected, three from the Flemish Community: the Vrije Universiteit Brussel (VUB), the Katholiek Universiteit van Leuven (KUL), the Universiteit Gent (RUG); and three from the French Community: the Université Libre de Bruxelles (ULB), the Université Catholique de Louvain (UCL), and the Université de Liège (Ulg).

Figure 1 presents the number of patent applications by the six Belgian universities for three periods: 1985–1989, 1990–1994, 1995–1999. There has been a quite stable evolution from the late eighties (17 patent applications) to the early nineties (23). What is striking is the substantial increase in

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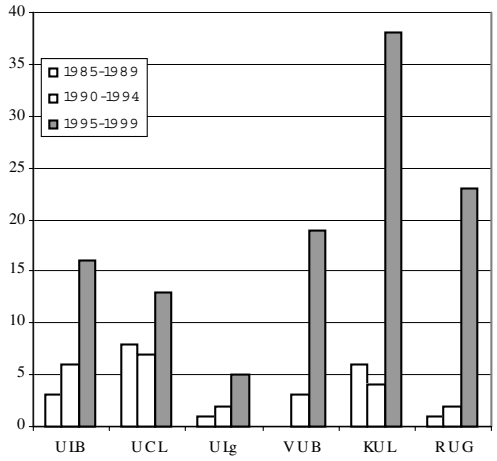

Figure 1. Patent applications at the EPO by six Belgian universities (1985–1999). Sources: Delphion Website and own calculations.

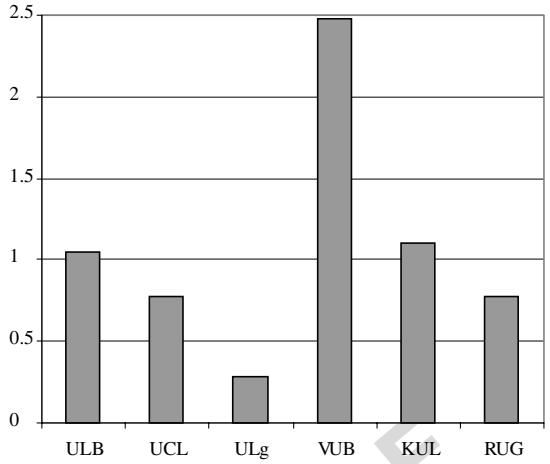

Figure 2. Relative patent applications per research personnel (weighted average = 1, 1995–1999).

the number of patent applications that took place in the late nineties. From 23 in the early nineties (or about 4 patents a year), it jumped to 113 in the late nineties (or about 23 patents a year).

Another key stylized fact is that there appears to be a striking difference in the propensity to patent between universities in the French and Flemish communities. The latter have filed 79 patents in the late nineties, against 34 for the former. During the two previous sub-periods the Universities from the French Community filed more patents (28) than their Flemish counterparts (16). In order to make a more relevant comparison of patenting performances, the counts have to be weighted by a size indicator. At the country level, OECD statistics (BSTI) show that, for the entire economy, there are about 40 researchers per patent application. For the higher education sector this ratio is about 650, a 16 times lower 'observed' patent productivity. If the comparison is made with respect to patents per R&D investment, one finds that the entire economy is 10 times more productive than the higher education sector. These broad 'observed' productivity measures witness two particularities of universities. First they have a much lower propensity to patent inventions than the business sector. Second, Universities traditionally perform a significant share of basic research, which is much less subject to patent protection than applied research.

Figure 2 includes patent counts weighted by R&D personnel. A similar pattern emerges in Figure 2 as compared to Figure 1. Flemish universities seem to be more performing in terms of patent applications per R&D personnel, especially the VUB. One must be very cautious with such kind of comparison, because it is based on a relatively few number of patents. Furthermore, these figures are not adjusted for the quality of patents, which has a highly skewed distribution (see Henderson *et al.*, 1998). Nevertheless this statistical evidence raises two closely related issues. The first one is to understand why there has been such an important surge in patenting by Belgian universities. The second issue is to try to explain the striking differences between the relative patenting performances of the six universities. Two main factors can be used to explain the differences in patenting performances: a higher productivity and/or a higher propensity to patent inventions.

2. Measuring productivity

It is not the purpose of this paper to try to evaluate 'real' productivity differences among Belgian universities. This issue is too complex and too sensitive to be tackled in this paper. The evaluation tools would differ according to the research strategy of a university. If it is to perform more applied research the evaluation must focus more on patents, spin-offs, and R&D contracts with the business sector. If the objective is to perform more basic research, the evaluation criteria would focus

more on scientific publications and research contract for public institutions. University technology transfer offices generally view licensing revenues or the number of technologies licensed as their "output" performance (see Siegel *et al.*, 1999). Finally, even if patents had to be used to benchmark universities, an important bottleneck would have to be solved: how to find them?

The creation and development of University Technology Transfer Offices (TTOs) are relatively recent in Europe and especially in Belgium. At the Université Libre de Bruxelles it was created in 1993 and so far there are no strict rules regarding intellectual property associated with the inventions made within the university. It is common that inventions performed under research financed by the business sector become the exclusive property of the funding firm. It is therefore legitimate to attempt to approximate the number of patents invented within a university but controlled by a third institution.

Our starting point is a 'raw' list coming from the ULB's TTO ("Cellule Recherche") which gathers all the researchers of the university who declared being the inventor of one or more patent(s).[2] For the sake of comparability we have considered only the patents that have been applied to the European Patent Office. All the names included in this 'raw' list have been checked in the Delphion web site in order to be as accurate as possible. From this cleaning exercise we obtained a list of 61 patent applications at EPO whose inventors were ULB researchers but whose applicants were diverse institutions (who had most probably financed the research project).[3] These 61 patents have a priority date that ranges from 1978 to 1998 and are distributed as follows: for the late eighties (1985–1988) 14 patents; for the early nineties (1989–1993) 13 patents, and for the late nineties (1994–1998) 31 patents.

If we merge this list with the one of the patents that have been invented at the ULB and applied by the ULB, we obtain a much higher number of patents. It underlines the potential bias that exists when the productivity of a university is measured with the number of patents it owns as patentee. The 'observed' patent productivity can be much lower than the 'real' productivity measure. In the case of the ULB the share of patents that were invented at the ULB but no controlled by her was 78% in the late eighties (1985–1988), 68% in the early nineties (1989–1993) and 72% in the late nineties (1994–1998). And these shares are lower bounds (see footnote 2). In other words, the risk of having a wrong picture when looking exclusively at the patents that are filed by universities is extremely high. It is worth noticing that the share of patents held by other institutions has been stable over time.

It is difficult to know if this bias is of the same range in the other Belgian universities of our sample. Informal discussions with the VUB and KUL authorities and/or researchers suggest that this bias is lower, about 35% and 50%, respectively (lower bounds). These figures clearly demonstrate that so far it is not possible to get a clear picture of the patenting activity of the higher education sector of Belgium. The use of patents as an indicator of university technology transfer performance may be highly misleading.

3. Different propensity to patent?

The propensity to patent is indubitably associated with the scientific field of research. Table I shows that most Belgian universities are specialized in the same technological fields. The 4-digit IPC (International Patent Classification) classes A61K (Preparations for medical, dental, or toilet purposes) and C12N (Micro-organisms or enzymes . . .) are the most frequent technological classes for all universities. These two classes are related to the bio-technology sector. A straightforward implication is that the sharp increase in the patenting activity of Belgian universities is mainly due to a technological revolution, the start of the bio-tech era. The high propensity associated with this technological field and the fact that the frontier between basic and applied research is far from being clear in that sector are the two main factors that explain this evolution. A second implication is that patent data cover only a tiny fraction of the research output of universities, as already mentioned in Section 2. So far, it seems that only a couple of scientific fields can be partly traced with patent data.

Besides these sectoral specificities, the way a university manages the output of its broad research activity would clearly affect the propensity to patent. This can be investigated through

Table I
Scientific fields and co-applications (1989–1998)

	ULB applicant[1]	ULB non applicant	UCL	ULg	VUB	KUL	RUG
Technological concentration ratio[2]							
C3—4 digit	61%	54%	60%	100%	62%	55%	61%
Class 1[3]	A61K (5)	C12N (12)	C12N (5)	A61K (2)	C12N (8)	C12N (12)	A61K (4)
Class 2	C12N (4)	C23C (6)	A61K (5)	A611 (2)	H01L (4)	A61K (8)	G01N (4)
Class 3	G01N (2)	A61K (4)	B01J (2)	C12N (1)	A61K (4)	C07K (2)	C23C (4)
Percentage of co-application with tiers[4]							
Co-applicant	22%		20%	20%	46%	20%	39%
# of patents	18	41	20	5	22	40	18

Sources: Delphion website and ULB, own calculations.
[1]The three Flemish universities are: the Vrije Universiteit Brussel (VUB), the Katholiek Universiteit van Leuven (KUL), and the Universiteit Gent (RUG); and the three universities from the French Community are: the Université Libre de Bruxelles (ULB), the Université Catholique de Louvain (UCL), and the Université de Liège (Ulg).
[2]Concentration ratio (C3) is the percentage of patents in the three most frequent technological classes. We use the first technological class, according to the 4-digit IPC system (International Patent classification).
[3]The International Patent classification: "A61K" Preparations for medical, dental, or toilet purposes; "C12N" Micro-organisms or enzymes . . . ; "G01N" Investigating or analyzing materials by determining their physical or chemical properties; "C23C" Coating metallic material . . . ; "H01L' Semiconductor devices.
[4]Percentage of co-applications with other institutions: it occurs when the university applies for a patent at EPO jointly with at least one other applicant.

an indirect analysis of the TTO's behavior. In the United States there are strong rules about the ownership of the inventions made within universities. Whatever the sources of funds (private or public), an invention made intramuros is generally claimed by the university. Although this is far from being the case in Europe, there is a tendency towards such a system, witnessed by the creation of TTOs and the intensification of their activities in all universities.

Filing a patent requires competencies that are closely related to the scientific field of the invention. For instance, the content of the claims, the expertise, and the filing strategy will be drastically different in information technology than in biotech. The presence of a collaborating institution specialized in a given field of research would most probably foster the propensity to patent invention. The bottom of Table I validates this hypothesis for some universities. Over the period 1989–1998 the universities from the French Community, which are associated with a lower observed patenting performance, have filed co-applications (application of a patent with at least one other applicant) jointly with another institution for about 20% of their total patent applications. For the VUB and the RUG in the Flemish region the ratio is at least twice as high. The collaboration with a specialized institution seems to be an important factor underlying the patenting performance of a university. Forty-six percent of the patents filed by the VUB, for instance, have been filed through a co-application with other institutions (according to recent discussion with the VUB authorities this ratio is much higher for more recent years). The two major co-applicants are the IMEC (Interuniversitair Instituut voor Micro-Electronica, in the class "H01L") and the VIB (Vlaamse Instelling voor Technologish Onderzoek). These institutions have been set up within the Flemish Region to foster collaboration and induce synergies in microelectronics and bio-tech, respectively. From the point of view of technology output they seem to be very effective in increasing the propensity to patent academic inventions.

4. Concluding remarks and policy implications

Since the late nineties there has been a sharp increase in patenting activity by Belgian universities, especially in the Flemish Region. The number

of patent applications by Belgian universities jumped from about 4 patents a year in the early nineties to about 24 patents a year in the late nineties. This increase can be attributed to two major changes. The first one is due to the new technological opportunities resulting from research activities related to the biotechnology sector. The second one is due to an increased propensity to patent technologies developed by Belgian universities. This higher propensity to patent is also due to more effective technology transfer offices.

Nevertheless, there are still significant differences among the Belgian universities in their 'observed' patenting performances. One of the determinants of these differences seems to be related to the effective collaboration with outside specialized institutions. The universities with a high relative patenting performance are often filing their patent applications jointly with specialized government-sponsored research centers. From a policy viewpoint it seems that the establishment of technologically specialized consortia between universities and government institutions would greatly improve the observed patenting performances of universities.

The observed patenting performances of universities may be one of the key indicators used by the European Commission and national governments to locate the most efficient knowledge-generating institutions within Europe. Our qualitative analysis reveals that patent-based statistics may be a misleading indicator of an individual university's "technological productivity," since many inventions are developed at universities, yet patented by other institutions. The bias—i.e., the share of university inventions patented by other institutions—is ranging from 30 to 75% of the total inventions made within the Belgian universities.

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Notes

1. The two other roles are the diffusion of knowledge through education and the generation of knowledge through basic research.
2. This list is not exhaustive since it is not compulsory to declare a patent. Nevertheless since a patent contributes to academic valuation one can assume that the number of patent that have not been declared is small. In any case, we can consider in what follows that we are in the presence of a lower bound.
3. We had no other recent published application due to the 18 months lag between the priority date and the publication date at EPO and since the raw list that we were given brought together data up to 2000.

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