Patents and Academic Research: A State of the Art

N. van Zeebroeck, B. van Pottelsberghe de la Potterie and D. Guellec

The sharp increase in academic patenting over the past 20 years raises important issues regarding the generation and diffusion of academic knowledge. Three key questions may be raised in this respect: What is behind the surge in academic patenting? Does patenting affect the quality and quantity of universities' scientific output? Does the patent system limit the freedom to perform academic research? The present paper summarizes the existing literature on these issues. The evidence suggests that academic patenting has only limited effects on the direction, pace and quality of research. A virtuous cycle seems to characterise the patent-publication relationship. Secondly, scientific anti-commons show very little effects on academic researchers so far, limited to a few countries with weak or no research exemption regulations. In a nutshell, the evidence leads us to conclude that the benefits of academic patenting on research exceed their potential negative effects.

JEL Classifications: O31; O34; O50
Keywords: Patent systems, Research Exemption, Academic Patenting
Abstract
The sharp increase in academic patenting over the past 20 years raises important issues regarding the generation and diffusion of academic knowledge. Three key questions may be raised in this respect: What is behind the surge in academic patenting? Does patenting affect the quality and quantity of universities' scientific output? Does the patent system limit the freedom to perform academic research? The present paper summarizes the existing literature on these issues. The evidence suggests that academic patenting has only limited effects on the direction, pace and quality of research. A virtuous cycle seems to characterise the patent-publication relationship. Secondly, scientific anti-commons show very little effects on academic researchers so far, limited to a few countries with weak or no research exemption regulations. In a nutshell, the evidence leads us to conclude that the benefits of academic patenting on research exceed their potential negative effects.

Keywords: Patent systems, Research Exemption, Academic Patenting

JEL classification codes: O31; O34; O50

Article Outline

1. Introduction
2. What is behind the boom in academic patenting
3. Patent vs. publication?
4. Anticommons and academic freedom
5. Concluding remarks

References
Tables and figures

---

ULB – Solvay Business School – Centre Emile Bernheim – CP145/01 – Av. Roosevelt 21 | 1050 Brussels (Belgium) – nicolas.van.zeebroeck@ulb.ac.be.


© OECD – DSTI – Paris (France) – Dominique.GUELLEC@oecd.org.
1. Introduction

Over the past two decades, the patenting behaviour of Western universities has dramatically changed. They account now for a significant share of patent filings in national and regional offices. This evolution has raised numerous questions, many of which are still open and subject to intense debates among scholars. The objective of this paper is to summarize the burgeoning economic literature on the main issues induced by academic patenting.

The actual drivers underlying this evolution make the first object of investigation of this paper. Does this increasing academic patenting activity result from Government regulations? Is the growth in academic patenting concentrated in mainly a few emerging technologies or is it widespread? Or do they find their roots in more general factors, such as an increasing propensity to patent more basic scientific output and discoveries?

The second concern arising from academic patenting refers to its potential impact on the quality, quantity or focus of academic research. Do the benefits that universities and researchers can draw out of their patents distract them from their fundamental research objectives toward fields more susceptible of industrial applicability or patenting? More particularly, to what extent do the patenting requirements affect or delay scientific publications?

Finally, many concerns have been raised around the potential negative impact of patented technologies on the freedom of academic laboratories to pursue their research objectives. Indeed, the increase in academic patenting, the higher propensity of patent owners to enforce their rights (Bessen and Meurer, 2005), the uncertainties surrounding research tools patents and research exemptions, and the vanishing frontier between basic and applied research (especially in life sciences and biotechnologies) make universities and public labs more prone to find themselves infringing patents.

These are the three main questions addressed in this paper, in sections 2, 3 and 4 respectively. This leads to the following set of conclusions, presented in section 5: first, the boom in academic patenting originates from technological revolutions and has been reinforced by Bayh-Dole Act-like regulations. Second, there is little evidence – if any – of a drop in quality or quantity of academic research due to academic patenting, the opposite relationship seems to hold. And third, the damaging effect of patents on the actual freedom to do research is so far limited to certain countries and technologies but might increase in the near future, justifying the need for policy actions and harmonization.

2. What is behind the boom in academic patenting?

For twenty years, a radical increase in the number and share of academic patents has been observed (Zucker et al., 1998; Mowery et al., 2001; Geuna and Nesta, 2006), first in the US and then in Europe. From less than 1 percent in 1975, the share of US patents applied for by universities grew to almost 2.5 percent in 1990 (Trajtenberg et al., 1994). In Europe, the share of public research institutions’ filings (including universities) in total patent applications at the EPO has jumped from about 0.5 per cent in 1981 to nearly 4 per cent in the early 2000s. In any case, it must be kept in mind that these figures are lower-bound measures, as many university invented patents are assigned to non academic institutions (generally corporations), as shown by Schmoch (2000), Balconi et al. (2003), Meyer (2003), Saragossi and van Pottelsberghe (2003), and Azagra Caro and Llerena (2003).

Figure 1 provides the share of patents filed at the EPO by the academic sector of selected European countries (see van Pottelsberghe, 2007). It only shows a lower bound estimate of the patenting
Because there is no information available for the patents invented by professors or academic researchers, but applied by third institutions, the surge in academic patenting is much more important in countries like Belgium (up to 12% of all patents filed by Belgian assignees at the EPO), Spain and the UK. The relatively low figures for Germany, Italy and Sweden do not mean that academics are less productive in these countries, but rather reflect different legal statuses. Germany has only repealed the professors’ privilege status in 2001, whereas it is still enforced in Italy and Sweden. In these countries, academic inventions are ‘managed’ by the professors, not the university. For France the share is biased downward, as an important share of academic inventions are performed and applied by the CNRS, a public research centre, which is the 7th largest patentee in France, but which is not taken into account in figure 1.

In the US, because this increase was contemporaneous with the Bayh-Dole Act of 1980, it has long been seen as a direct consequence of this regulation. Since then, many European countries have adopted analogous legislations, such as the UK in 1998 with the National Health Service Circular, Germany in 1998, and Belgium in 1999 with the Decree on Education. Further regulatory changes in Europe concerned the ‘professor’s privilege’ allowing university professors to patent their inventions on their own. Very well established in German and Nordic countries, this privilege has been abandoned by some of them (Denmark in 2000, Germany and Austria in 2002) but maintained for instance in Sweden and even installed in Italy in 2001. Beside this ‘appropriation’ of academic inventions by universities, the latter have adopted some incentive mechanisms. In many European countries, “researchers may now even be granted a portion of the royalties derived from their patented discoveries, even though the patent legally belongs to the institution in which the discovery was developed” (Geuna and Nesta, 2006).
Undoubtedly, by “allowing universities to patent the results of federally-funded research and license the resulting technology to businesses and other entities”, the Bayh-Dole Act (and similar regulations in other countries) gave universities greater incentives to commercialize technology. But little evidence has been shown to support this assertion (Mowery et al., 2001). Major American universities (e.g. the University of California and the Stanford University) had already become increasingly active in patenting before the Act, and many European countries in which a similar phenomenon has been observed had no Bayh-Dole Act-like regulations in force at that time.

In addition to these regulations, many national and regional authorities have sponsored the creation of technology transfer offices in their local universities, aiming at maximizing knowledge spillovers from universities to industries. Licensing of university patents are one of the most widespread forms of such technology transfers, due to their legal clarity and to the benefits that universities can obtain from such deals. Patents allow knowledge to be transferred from universities to business entities in a way that enables the latter to appropriate the returns generated (see e.g., Mowery et al. (2001) and Agrawal and Henderson (2002)). These business entities frequently take the form of academic spin-offs, with high ‘geographically localized’ employment growth prospects. In addition, licensed patents may provide universities with additional financial resources, much welcome given the overall decline in government structural subsidies in most European countries (Geuna, 2001).

The expected social benefits of knowledge transfers have further decided governments to create incentives for universities and researchers to enter into collaborative research, which increased further the propensity to patent academic inventions. Certain scholars expressed concerns that it may also have induced universities to slightly modify their focus toward more applied or commercially exploitable research. This question will be discussed later in section 3.

In addition, universities’ increasing propensity to file patent applications may find some of its roots into the increasing competition for IP rights. Patents with their exclusive power may indeed be turned into a bargaining instrument in front of third party institutions to get access to their patented technology (e.g. Nokia in the loudspeakers business (Reitzig, 2004)). Why such bargaining instruments may have turned critical for universities and not only for firms will be discussed in section 4.

Ample evidence, however, shows that the surge in academic patenting has been concomitant with a shift in research or in patenting activities in universities towards life sciences and more specifically biotechnologies (Mowery et al., 2001), notably thanks to national or regional research programmes and funding. The same authors further mention that the growth rate of academic patenting in the seventies has been as high as 123 percent for biomedical patents against a 22 percent increase in non-biomedical patents. Sapsalis and van Pottelsberghe (2003) showed 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.”

This suggests that the propensity to patent academic inventions is higher in the field of biomedical technologies than in any other field of research. This is confirmed by figure 2 showing the evolution of the share of university filings in different sectors. The figure clearly shows that academic patenting represents a much larger share in the biotech with up to 15% of all applications in the sector against less than 1% in other sectors such as the automotive industry. In addition, the picture exhibits large differences in the growth rate of academic patenting, from a 5% average annual growth rate in engineering against 25% in the telecom industry (and an average 11% in biotech).

---

1 Joint Economic Committee US Congress, 1999, p.31.
There may be various reasons why patenting should be more likely or easy in the field of biotechnologies: drugs and chemical products, thanks to their high degree of codification and standardisation, have for long been the industrial sectors with the most intense patenting activity; the frontier between basic and applied research is much less clear in this sector than in others; but most of all, specific rulings in the US and the evolution of patent systems regarding the patentability of engineered molecules or genes have made patenting in general much easier in those fields. This was particularly true with the Diamond vs. Chakrabarty case in 1980, when the Supreme Court confirmed a previous ruling allowing the grant to Ananda Mohan Chakrabarty of a patent on the bacterium he developed to break down crude oil. Against the opinion of the US Patent and Trademark Office that living things were not patentable by law, the court held that “a live, human-made micro-organism is patentable subject matter under [Title 35 U.S.C.] 101. Respondent's micro-organism constitutes a ‘manufacture’ or ‘composition of matter’ within that statute.”

All in all, the surge in academic patenting seems to be mainly due to increasing research efforts of universities into life sciences in general and biomedical research in particular, and to a larger propensity to patent inventions – and more basic results –, especially in these fields. This higher propensity was enabled by ad-hoc Bayh-Dole Act-like regulations and fostered by direct government support to the creation of technology transfer offices.

3. Patent vs. publication?
The first question raised by the increasing patenting activity of universities and public research laboratories is whether this activity does affect the quantity, quality or focus of their scientific research efforts and production. This major concern finds its roots in several observations. First, fulfilling the patenting criteria requires the non-disclosure of the invention as long as a patent application has not been filed, especially in countries – such as most EU member states – offering no grace period. This may have an impact on the publication of scientific results, and at least on its timeliness. Second, the increasing private funding of academic research frequently induces restrictions on the disclosure and timing of publication of the outcomes (Thursby and Thursby, 2002). And finally, the increasing competition between universities in prestige (or high level publications) races may be suspected of inducing a decrease in the sharing and disclosure of scientific knowledge, as suggested by Rosenberg (1996), Cohen (1995), King (1996), and Campbell et al. (2000); and this has little to do with patenting.

Potential effects of a university’s increasing propensity to patent may be suspected on three areas: on the quality of its patents, on the quality and quantity of its scientific publications, and on the directions or freedom of its research activities. These three major concerns regarding the patent-publications relationship are tackled in the present section.

Similar quality or value of academic patents
There is – to the best of our knowledge – no strong quantitative evidence to determine whether fostering academic patents leads to lower quality patents. Table 1 shows that overall, academic patent applications filed at the European Patent Office (EPO) between 1990 and 1999 have received on average slightly more citations (a 50% mark-up) from subsequent patents (often seen as an indicator of patent value) despite a lower grant rate (about 55% against 66% for non-academic patents) and a slightly (1%) lower opposition rate (two other frequently used value indicators).

<table>
<thead>
<tr>
<th>Applicant</th>
<th>Grant rate</th>
<th>Opposition rate</th>
<th># 5-year forward citations received</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Academic</td>
<td>66%</td>
<td>5.6%</td>
<td>1.24</td>
</tr>
<tr>
<td>Academic</td>
<td>55%</td>
<td>4.7%</td>
<td>1.83</td>
</tr>
</tbody>
</table>

*Source: Own calculations based on EPO databases and PATSTAT (EPO, 2006)*

Nonetheless, Henderson et al. (1998), by examining the impact of Bayh–Dole on the quality of university patents, as measured by the number of times they are cited in subsequent patents, found that it declined dramatically after the Act. But Sampat et al. (2003) nuanced these findings by showing that the results of the former study reflect changes in the intertemporal distribution of citations to university patents, rather than a significant change in the total number of citations these patents eventually receive. Furthermore, Mowery and Ziedonis (2002), by analysing the patents applied for by three major US universities (University of California, Stanford University, and Columbia University) before and after the Bayh-Dole Act, concluded that the increase in patenting of the two Californian universities (the only ones with a significant pre-1980 patent portfolio) may have reduced the commercial ‘yield’ of their portfolio, but did not reduce its importance or generality. Rather, they observed that the learning experience with patenting plays a role: “*Inexperienced academic patentees appear to have obtained patents that proved to be less significant (in terms of the rate and breadth of their subsequent citations)*.” The issue in this case is more a matter of management competencies of technology transfer offices, which will naturally improve over time.
In Sapsalis et al. (2006), the authors compared 400 Belgian corporate and academic biotech patents. They observed that academic and corporate patent value distributions have similar levels of skewness and that the institutional origin (self, academic or industrial) of the knowledge embedded in a patent influences its value. Sapsalis and van Pottelsbergh (2007) further noticed that collaboration between public research organisations lead to more valuable patents, and that academic patents’ value is largely determined by the scientific profile (in terms of scientific publications) of the academic inventors. These last findings bring to the next question regarding the level of scientific publications issued by universities with an increasingly active patenting profile.

**A positive impact on the quality and quantity of scientific publications?**

Here again, the available empirical evidence does not seem to support the hypothesis of a detrimental effect of academic patenting on the scientific production of academic researchers. Some qualitative observations from surveys in Europe (Webster and Packer, 1997; EU Commission, 2002) do suggest that a number of scholars “have become much more strategic in their choice of what information to disclose in their publications to avoid the possibility of a future patent application being compromised” (Geuna and Nesta, 2006) and that some researchers report considerable delays in the publication of research results of the less experienced academic patentees or young technology transfer offices (see Mathieu et al. (2007) for instance).

Apart from these few results, many studies tend to demonstrate, to the contrary, a rather positive effect of patenting on publications. Breschi et al. (2005), for instance, clearly show that Italian university professors involved in at least one patent application at the EPO publish more and higher quality papers than their colleagues with no patents, and increase their productivity after patenting. Zucker and Darby (1996) also find that prominent US researchers in biotechnology appeared to have outstanding research records, even after their involvement in patenting. This result is further confirmed by Azoulay et al. (2005) who find that scientists’ patents are positively related to subsequent publication rates. In addition, an in-depth case study of the K.U. Leuven performed by Van Looy et al. (2006) emphasizes that the publication behaviour of academic inventors differs from their colleagues (non-inventors) working within similar fields of research. Inventors publish significantly more. More surprisingly, Canadian, US, Belgian and Norwegian studies (Godin, 1998; Blumenthal et al., 1996; Ranga, 2003; Gulbrandsen and Smeby, 2005) revealed that faculty who received industrial funding publish more scientific articles than their colleagues with no industry funds. Conversely, a high scientific performance in terms of publications and citations turns out to increase the probability of filing a patent. Breschi et al. (2005) provide further evidence with a quantitative analysis of Italian professors: “more productive scientists are more likely to become academic inventors, to no detriment of their orientation towards basic research.” Geuna and Nesta (2006), also notice that patents and publications tend to go hand in hand. Sapsalis and van Pottelsberghe (2007) and Sapsalis et al. (2006) obtain complementary results based on Belgian academic patents, underlining the importance of scientific publications for the patenting process of academic inventions. They show that the researchers with a high scientific profile in terms of publications crystallize their scientific expertise – or tacit knowledge – into patents with an above than average value.

All this tends to demonstrate that there is a virtuous relationship between patents and publications rather than any detrimental effect of the former on the latter, at least in terms of quantity. When looking at the quality of the issuing publications, the evidence is even more limited, with the notable exception of Sampat (2004), who showed with a sample of about 500 genomic patent-paper dyads in the US that publications disclosing later-patented genomic sequences receive fewer
citations by subsequent papers than non-patented ones. This impact however disappeared with non-sequence genomic discoveries, which suggests that this effect – if real – is probably limited to very specific technologies. To the contrary, Azoulay et al. (2005) observe no effect of patenting on the quality of publications and Breschi et al. (2005) even observe a positive impact.

In any case, it would be very difficult to assess the extent to which such an effect – positive or negative – should be attributed to a different importance of patented discoveries, to a different level of basicness of these discoveries, or to the difficulty for potential subsequent researchers to access the patented knowledge or research tool. Hence, the impact of academic patenting on the value of scientific publications still needs to be assessed and monitored.

**And no impact on the type of research activities**

Nevertheless, the possibility remains that patenting behaviours may drive the content of research towards less fundamental or more commercially-oriented objectives. This idea is also a recurring concern in the literature. By assessing the patentability of research papers, Azoulay et al. (2005) find for instance that actively patenting universities may be shifting their research focus towards questions of more commercial interests. More generally, Gulbrandsen and Smøby’s (2005) study in Norway has highlighted the effect of universities’ technology transfer activities on the directions of their research. They showed indeed that industry funding of researchers tends to lead them away from basic research but also from experimental developments as compared to researchers without external funds. This result is nevertheless in contradiction with Ranga’s (2003) study on KUL University in Belgium who finds no effect of the like. Furthermore, Mowery et al. (2001) suggest that the noticeable shift of academic research towards biomedical research may rather be a cause than a consequence of university patenting as discussed in section 2. In addition, the authors observe that “this shift does not on its face represent a move out of fundamental research” and that although “the areas in which university research has grown rapidly have been rich in results with commercial promise, much of the research that generated them has been quite fundamental in nature.”

In our view, the empirical evidence provided by the literature so far tends to attenuate the concerns about the impact of academic patenting on academic research direction and output. But if patents and publications seem indeed to complement rather than neutralize each other, questions remain open as to the exact effect of academic patents on the timeliness and extent of the disclosure of scientific results. Moreover, rather than patents, increasing industry-university partnerships – fostered by universities’ need of external funding and by governments’ and firms’ willingness to boost knowledge spillovers from universities to industries – may have a detrimental effect on the direction of academic research toward more commercially oriented objectives. This leaves some open questions on the free generation and sharing of scientific knowledge and may become increasingly critical when tangible research inputs are patented as discussed in the next section.

**4. Anticommons and academic freedom**

Since patents are rights to exclude and since downstream research often relies on basic research as an input, the boom in academic patenting has raised serious concerns about the future freedom of researchers, especially in public and academic laboratories where resources may be lacking to access patented technologies. The time when academic research could evolve in a totally patent-free world, exempt of any exclusive rights preventing access to necessary inputs, is sometimes perceived as being over.
**A lower diffusion of academic knowledge?**

This concern is notably fed by the fear of the scientific anticommons hypothesis. Whereas intellectual property rights allow inventors to derive profits from their research investments, a tragedy of the anticommons, as put forward by Heller and Eisenberg (1998) and empirically illustrated by Murray and Stern (2005), would consist in a lower use of the invention in downstream research than would be socially desirable due to the exclusive rights provided by the patent. According to Nelson (2004), the increasing privatization of the scientific commons induces a risk to see an important share of future scientific knowledge becoming private property and hence falling outside the public domain.

In 1988, the grant to Harvard University of the famous oncomouse patent by the USPTO – the first patent ever granted on a living mammal – and its exclusive license to DuPont raised a lot of worries and debates in the scientific community. DuPont’s fierceness to enforce its exclusive rights, even on further scientific works, highlighted the risk for scientific research to become more and more dependent on such ideas as the oncomouse, with a high scientific value and a high degree of usefulness and industrial applicability at the same time. This of course is especially true in the field of biotechnology (Stokes, 1997).

Should such a patent on what constitutes in the end a very nice research tool be licensed to any third-party willing to undertake downstream research against payment of a royalty, then those intellectual property rights will have induced at least some transaction costs resulting in a deadweight loss for society. Promising but highly uncertain research projects whose undertaker might not be ready to face upfront licensing costs might therefore be abandoned beforehand. And cumulative research projects requiring access to several patented research tools would have to face even higher transaction costs.

In this respect, competition policy may be adapted to impose compulsory licensing when no voluntary solution can be found, applying the Japanese ‘essential facility’ doctrine. This would allow providing ad-hoc responses to isolated cases. In addition, licensing guidelines, as adopted by the OECD biotechnology group, should encourage – but not force – patent holders to offer their patents for licensing at fair (‘RAND’) conditions (see Guillec et al., 2007).

**The academic freedom through research exemption**

A closely related issue concerns the freedom to operate, especially within academic laboratories. To overcome this potential ‘tragedy of the anticommons’, many OECD countries have adopted some countermeasures, statutory or not. The key issue is to determine whether or not research activities relying on (i.e. using, testing, or aiming at improving) a patented invention fall outside the scope of the patent protection and hence may or may not be considered as infringing activities. Dent et al. (2006) provide several arguments for and against research exemptions. On the opponent side, the argument is that patents do not prohibit research on the invention, they merely add to the cost of doing research. The appropriate level of investment incentives would require researchers to pay the full cost of any input they use. If this incentive disappears, the rate of invention may decrease. The arguments of the advocates of research exemptions are based on the potential adverse effects of patents, such as the heavy transaction costs induced by multiple licensing agreements and the fundamental uncertainty induced by basic research inventions. The main advantages induced by research exemptions are that they stimulate extensions or improvements to the original inventions, they open the door towards different technological trajectories, and they generally contribute to a wider expansion and diffusion of knowledge.
As observed by Dent et al. (2006), there are four ways in which such countermeasures can be put in place: “restricting the rights that attach to a patent to specific classes of action rather than the more general ‘use’ or ‘exploit’ where those classes do not include research uses, amending the definition of infringement in order for research to fall outside the category of infringing behaviour, introducing a compulsory research licence, and including a statutory research use exemption.”

Europe is somewhat more favourable to research exemptions than the USA. Most EU countries have indeed adopted a statutory research exemption, usually based on Article 27 of the Community Patent Convention (CPC). Article 27(b) states that: “the rights conferred by a Community patent shall not extend to: [...] (b) acts done for experimental purposes relating to the subject-matter of the patented invention”, but its interpretation widely differs across member states. According to Dent et al. (2006), a very liberal approach has been taken by the German Constitutional Court, which concluded that patent owners had to “accept such limitations on their rights in view of the development of the state of the art and the public interest.”

To the contrary, there is no general statutory exemption in the US, but rather a case law one with a variable geometry. Indeed, two major decisions of the Court of Appeal of the Federal Circuit have considerably restricted its scope: Roche Products Inc. vs. Bolar in 1984, and Madey vs. Duke University in 2002. In the former decision, the Court held that scientific inquiry having “definite, cognisable, and not insubstantial commercial purposes” did not qualify as experimental use, and that the experimental use defence applied only to actions performed “for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry”, excluding any business or substantially commercial purposes as well as experiments required for FDA drug approvals.3 This decision led to the legislative compromise that resulted in Hatch-Waxman amendments, which “permitted a generic drug company to begin the testing required for FDA approval while the pioneer drug company's patent was still in force and shortened the period needed to obtain generic drug approval by eliminating the need for safety and efficacy data.”4,5 More recently, in Madey vs. Duke University, the court held that the defence does not apply if the use is “in furtherance of the alleged infringer's legitimate business”, and that “the profit or non-profit status of the user is not determinative.”6 Since research is universities’ main legitimate business, this decision has been seen as making the safe harbour exemption simply unavailable to academic research, unchaining new debates and concerns on its freedom.

All in all, the increasing use of the patent system, the vanishing frontier between basic and applied research in some fields and the restrictions to research exemptions especially in the United States have reinforced the fears that universities may be tempted to diffuse knowledge exclusively via licence agreements, hence limiting the free flow of scientific knowledge and impeding further academic research.

However, there is still very little evidence of such a negative effect of the patent system and its use on R&D efforts. Merges and Nelson (1990) have highlighted some cases and Murray and Stern (2005) as well as Sampat (2004) have developed an interesting approach to evaluate the impact of patents on subsequent research. Given the fact that many scientific research efforts result in both a scientific paper and a patent (especially in biosciences), these scholars analysed patterns in the citations received by the scientific publications before and after the issuance of the corresponding

---

5 Note that the issue remains unclear in the US after a Supreme Court decision in Merck vs. Integra, which held that the Hatch-Waxman exemption applies to pre-clinical research and even to patented compounds, but left a lot of uncertainty as to the extent of the exempted upstream research.
6 Madey vs. Duke University, 307 F.3d at 1362 (Fed Cir 2002).
patent (usually occurring after a much longer process than the publication of the article). By doing so, they use citations received by scientific articles as an indication of the research activities subsequently performed in the same field. Both studies – relying on a few hundreds patent-publication pairs each – observe a small decline in the number of citations received by a publication before and after the issuance of the patent and a relatively lower rate of citations for patented inventions as compared to a control group of publications with no corresponding patent. Murray and Stern (2005) showed in particular that the citation rate of 169 articles that were published and then patented fell by 9 to 17 percent after the patent was granted. This suggests – although quite anecdotally – that granted patents may have discouraged some research on a specific topic.

In parallel to these findings, different surveys have given a bit of substance to the concerns at hand (see e.g., Walsh et al. (2003, 2006), the American Association for the Advancement of Science (AAAS) reported by Hansen et al. (2005), and Onishi and Nagaoka (2006) for Japan). Whereas in the AAAS survey (reported by Hansen et al. 2005) 40 percent of respondents say that intellectual property issues induced delays, changes or abandonment of their project, especially in biosciences, Walsh et al. (2003) observed “little anti-commons breakdown, and even restricted access generally overcome, due to ‘working solutions’, especially, though not only, disregard of IP and rational forbearance of such infringement supported by interdependent system of incentives and constraints.” These findings were confirmed by Walsh et al. (2006) and by Onishi and Nagaoka (2006). Joseph Straus made a similar observation in Germany on the effect of research tools patents.7 Everywhere around the globe, researchers have a very strong tendency to disregard the patent literature, which somewhat mitigate the findings of Murray and Stern (2005) previously described.

Table 2 – Average number of backward patent (BPC) and non-patent (NPC) citations of applications filed at the EPO from 1990 to 1999

<table>
<thead>
<tr>
<th></th>
<th>BPC</th>
<th>NPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (any applicant and technical area)</td>
<td>4.67</td>
<td>1.07</td>
</tr>
<tr>
<td>Biotech filing</td>
<td>3.88</td>
<td>2.64</td>
</tr>
<tr>
<td>Academic applicant</td>
<td>3.90</td>
<td>3.29</td>
</tr>
<tr>
<td>Biotech filing applied for by academic applicant</td>
<td>3.09</td>
<td>4.74</td>
</tr>
</tbody>
</table>

Source: Own calculations based on EPO databases and PATSTAT (EPO, 2006)

Additional evidence on this issue is suggested in table 2. The table shows that academic and biotech patent applications refer much more to the scientific literature (with about three to five times more non patent citations) than the average patent filed at the EPO. Conversely, reliance on patented prior art (backward patent citations) is less frequent. Patents that are both issuing from the academic world and pertaining to the biotech sector, show even larger differences in these respects, suggesting that sectoral and academic specificities sum up and reinforce each other.

The difficulty to observe infringement behind laboratory doors and frequent ignorance by researchers of existing patent rights (only 5% of 381 respondents check regularly for patents on knowledge or material inputs), associated with a general propensity of firms to refrain from asserting their rights against universities seem to make the main elements of the ‘working solutions’ evoked by Walsh et al. (2003) and explain to a large extent the scarcity in empirical evidence.

Nonetheless, recent surveys converge in reporting more frequent issues with biomedical research, and more specifically when the required information for research takes the form of tangible inputs. Overall, only 1 percent of US biomedical researchers surveyed reported delaying more than one month or modifying a project because of patents. This figure grew to 8 percent when it turned to

---

7 Reported in OECD, 2002.
tangible inputs (information on recent experiments, new databases, gene’s mutation details, algorithms, etc.). Difficulties in accessing research tools are also examined and confirmed by Campbell et al. (2000). The surveys mentioned here above illustrate that the difficulties in accessing patented research tools are more due to competition between (university) research laboratories than to pure legal or financial constraints.

All this suggests that the issue of patents impeding further research is so far limited to a few countries (including the USA) in which research exemptions are unclear, limited or absent, and especially to research in biotechnology and pharmaceuticals with a particular emphasis on research tools in genomics and biotechnology. Nevertheless, the frequency of problems, although still very small, has increased since 2002. Problems arise more frequently within the business sector than within academic research (Hansen et al., 2005), and many researchers prefer to ignore the fact that they are infringing patents while patent owners seem to opt for benign neglect. As a matter of fact, there is an economic or financial explanation to this neglect: the limit to damages potentially occasioned at research stage might not be sufficient to cover costly litigation expenses.

However, the fact that the current ‘de facto exemption’ relies to some extent on ignorance of the law is not a very reassuring element for its future. What is more, several trends suggest that the issue might intensify in the coming years. First, the increasing patenting activity of universities makes them patent owners who enforce their rights and leverage their IP portfolios to guarantee their freedom to operate and cooperate in research. Second, in turn, firms may increasingly see universities as rivals in the patent arena and become less reluctant to suing infringing ones, especially if they are cooperating with other firms. Third, the boom in multidisciplinary research (e.g. bio-informatics) and in new science-based technologies next to biotechnologies (e.g. nanotechnologies) may yet increase the propensity of universities and industries to patent more fundamental results (Nelson, 2004) hence the number of patents potentially infringed by academic researchers. And finally, universities may face difficulties in assessing their freedom to operate in their research since they do not necessarily enjoy intellectual property departments to render such routine opinion to researchers (Barash, 1997).

These factors made Dent et al. (2006) consider the risk that “researchers may be sitting on a litigation time bomb” and would justify the need for preventive policy remedies. In designing remedy actions, governing bodies should consider the following options. First, research exemptions should protect research ‘on’ patented subject matters but not research ‘with’ a patented subject matter in order to preserve the emerging research tools industry. In any case, research exemptions need to be clarified in most countries and internationally harmonised.

Second, patent standards should be strengthened so as to make sure that no patents are granted on pure scientific discoveries without industrial application or utility, and that patents are granted only to new and non obvious inventions. This would allow re-drawing a line between science and technology and would probably avoid some of the most potentially threatening patents to be granted or enforced.
5. Concluding remarks

The boom in academic patenting has been essentially driven by technological revolutions, and allowed and stimulated by Bayh-Dole Act-like regulations and regional governments’ pressures in several European countries. This sharp increase in academic patenting has raised concerns that it might be modifying the effects of the patent system on research and be reshaping the common perception of the traditionally free flows of knowledge. The two central concerns in this respect are i) the potential negative effect of an ‘academic patenting culture’ on the quality and quantity of academic research and publications, and ii) the impact of patented inventions on academic freedom to do research.

First, a burgeoning literature clearly suggests that patents and scientific publications complement each other. This virtuous relationship may well induce some delays and selectivity in the disclosure and sharing of results, but it seems to depend more on managerial competences than on systemic barriers. Second, whereas a very limited yet increasing number of cases supports the assertion that patented inventions limit the freedom to perform research, these scientific anticommons seem so far limited to the business sector and such burdens to academic research appear concentrated in countries with weak research exemptions and in highly science-based technologies such as biomedical research. Third, granted patents in the end may enhance incentives for further research and development efforts, especially in the business sector, and encourage an effective commercialization effort, much more risky and expensive than fundamental research. Therefore, the benefits of academic patents on research seem to exceed their potential negative effects.

Nevertheless, some factors suggest that the concerns at hand may gain in importance over time for academic research and would therefore deserve to be carefully monitored. This is especially the case for the increasing number of academic patents and the development of new multidisciplinary and science-based technologies. This burgeoning patenting practices within academic spheres may increase the risk of infringement by academic researchers, along with the risk for them to face costly litigations soon or later. This might become especially true if universities start enforcing their IP rights and litigating against businesses more frequently, making the latter less reluctant to attacking the former in return.

However, the weakness of the damages incurred and potentially recoverable from a patent being infringed by a university should remain such that there is little reason to believe that litigation against academic laboratories doing research would suddenly explode in the coming years. Hence, the issue of patents preventing research from being done would probably remain limited to cases where tangible inputs are required, which is rather a matter of cooperation between researchers than a pure legal issue.

The expansion of the knowledge economy has increased the production and commercialization of knowledge in such a way that it may create some tensions with the patent system in a limited number of countries and technological areas. To reduce these local tensions, the tenants of the open science model would probably encourage universities to maintain their commitment to the free flow of knowledge to serve the global public interest and pursue their scientific and technological achievements (Nelson, 2004), and policy makers should adapt the patent system to these specific challenges where necessary in a stable, predictable and internationally harmonized manner.
References


