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Does involvement in patenting jeopardize one's academic footprint? An analysis of patent-paper pairs in biotechnology

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ABSTRACT

The question whether involvement in patenting hampers the dissemination of a scientist's published research is a relevant and important one. To this end, a detailed, large-scale citation analysis of patent-paper pairs in biotechnology is conducted. Those pairs signal the occurrence of research resulting simultaneously in scientific publications and patent applications. Patent-paper pairs are detected using text-mining algorithms applied on a large dataset. Starting from a dataset consisting of 948,432 scientific publications and 88,248 EPO and USPTO patent documents, 584 patent-paper pairs are identified. The forward citation patterns of these patent-paper pairs are then matched and compared to biotechnology publications without an equivalent patent. Publications linked to a patent receive more citations than publications without a patent link (after taking into account the necessary controls). In addition, by comparing H-indexes, our findings reveal that the authors involved in such pairs develop a larger scientific footprint than comparable colleagues refraining from patent activity. We conclude that involvement in patenting does not hamper the dissemination of published research in the field of biotechnology.

1. The entrepreneurial university phenomenon

Numerous scholars emphasize the importance to include science and universities to fully grasp the innovative capacity of (national) innovation systems (e.g. Freeman, 1987, 1994; Lundvall, 1992; Nelson, 1993; Nelson and Rosenberg, 1993; Mansfield and Lee, 1996; Mansfield, 1995; Mowery and Nelson, 1999; Dosi, 2000). The resulting, more holistic, view on innovation dynamics has gained wide acceptance amongst scholars and policy makers as a guiding framework to understand and model innovation systems on a more aggregated level (OECD, 1999, 2013; European Innovation Scoreboard, 2002).

In these models, knowledge generating institutions including universities, industrial research centres and public or non-profit research institutions are identified – besides firms and entrepreneurs – as important actors in developing and stimulating the innovative capacity of a particular region or country. Likewise, the Triple Helix model, which emerged in the second half of the 1990s (Leydesdorff and Etzkowitz, 1996, 1998; Etzkowitz and Leydesdorff, 1997), argues in favor of the complementary roles for firms, knowledge creation institutes – including universities – and governmental agencies, and underscores the importance of the interactions between these different actors.

There are multiple reasons why the science base – and hence universities – is relevant within innovation systems and can contribute to a nation or region's innovation capacity. Research institutions produce information and ideas upon which the development of new products, processes and services can build. Universities are well placed to address market failures that occur in the field of innovation (Arrow, 1962; Freeman, 1994; Baumol, 2002). Such market failures arise especially in relation to basic research, characterized not only by high levels of uncertainty, but equally by extended time frames to bear fruit (often decades). These characteristics pose specific challenges for private investors, who – guided by rational decision-making – tend to refrain from investing in basic research activities. In order to avoid a loss of social welfare – due to the non-investment behavior of private actors – public resources are invested in basic research performed at universities and public research institutes.

Universities and public research organizations offer exploration possibilities that are essential for the mid to long-term innovation potential of innovation systems. Lester points to the importance of 'interpretative', problem-defining activities, besides analytical,

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problem-solving ones. As enterprises primarily focus on the latter, it is essential that sufficient attention is paid to create an environment for exploration. In this sense, universities, as public spaces where new ideas can be explored and studied, become indispensable (Lester and Piore, 2004).

At the same time, contributing effectively to the innovative capacity of an innovation system requires a willingness of universities to become more 'entrepreneurial'. The notion of 'entrepreneurial universities' (Branscomb et al., 1999; Etzkowitz et al., 1998; LERU, 2012) refers to the development of a spectrum of activities ranging from more intense commercialization of research results, patent and license activities, spin-off activities, collaboration projects with industry, and greater involvement in economic and social development by academia. One thus observes a 'second academic revolution'[1] whereby education and research become complemented with service and valorization activities aimed at transferring new scientific knowledge to the realm of economic activity.

An increased activity of academic researchers in exploiting their discoveries has thus been observed (Henderson et al., 1998; Thursby and Thursby, 2002; Meyer et al., 2003; Lissoni et al., 2008). University patents become an important – and visible – method of technology transfer (Basberg, 1987; Schwartz, 1988; Boitani and Ciciotti, 1990; Trajtenberg, 1990; Archibugi, 1992). Universities tend to become more effective in this area the more they are active in scientific research. Recent research in the US as well as in Europe, confirms this relation: an explicit research focus enables enterprising activities in academia (patents, spin-offs, contract research) (Di Gregorio and Shane, 2003; O'Shea et al., 2005; Van Looy et al., 2003, 2011; Sapsalis and van Pottelsberghe, 2007).

Interaction and exchange between academia and industry can have positive effects, both for the business partner (e.g. Zucker and Darby, 2001; Hall et al., 2001; Faems et al., 2005) and for the academic sector (e.g. the presence of cognitive spill-overs via the realization of complementarities between applied and basic research and innovation activities – Azoulay et al., 2009; Callaert et al., 2009; the generation of new research ideas – Rosenberg, 1998; attracting additional resources for (basic) research – Agrawal and Henderson, 2002; Franzoni and Scellato, 2011; Perkman et al., 2013). Additional benefits – when introducing intellectual property activity in scientific activities – are found in the facilitation of the creation of a market for ideas and the ability of society to realize the commercial and social benefits of a given discovery (Kitch, 1977; Merges and Nelson, 1990; Gans and Stern, 2000; Arora et al., 2004; Hellman, 2007; Murray and Scott, 2007).

Nevertheless some concerns arise due to the increasing commercialization of scientific activities undertaken by universities. First, too much emphasis on (market) exploitation may negatively impact the quantity and quality of scientific research. While a complete crowding out of scientific activities by commercialization endeavours is considered as rather unlikely (Merton, 1968; Scotchmer, 2004; Thursby et al., 2007), some scholars do signal a (moderate) negative impact on the quality of research (Henderson et al., 1996; Trajtenberg et al., 1997; Murray and Scott, 2007; Czarnitzki et al., 2009). At the same time, a majority of reported empirical findings report a positive relationship between patenting and publication outcomes of academic researchers (e.g. Fabrizio and Di Minin, 2008; Van Looy et al., 2006; Breschi et al., 2007; Czarnitzki et al., 2007; Stephan et al., 2007; Larsen, 2011; Forti et al., 2013). Patents as commercialized discoveries seem to be derivatives of scientific work rather than substitutes (Murray, 2006).

[1] During the first academic revolution (19th century) research became a part of universities activity profile.

In this study, we analyze the potential negative effects of introducing intellectual property activities in science in the context of the field of biotechnology by comparing forward citation patterns of scientific publications by examining a large dataset containing all biotechnology patents (EPO and USPTO) and scientific publications (published in ISI Web of Science covered journals) from 1991 to 2008. We investigate whether biotechnology publications for which a counterpart exists in the patent system (so called 'patent-paper pairs', i.e. scientific publications from which the contents – methodology, findings, discovery – also result in a patent application or vice versa) are cited differently (more/less) within scientific journals, compared to similar biotechnology publications which are not related to a patent document, taking into account a wide array of control variables. We also compare the H-index of authors involved in patenting to analyze to scientific footprint of those more entrepreneurial scientists. We compare the lifespan H-index of those authors with authors not involved in patenting activity, but with the same publication profile in terms of publication lifespan, number of publications, highest cited publication and initial H-index at the moment of getting involved in patenting activities.

A major challenge for this type of study pertains to the identification of science-related patents in general and the identification of scientific results protected by intellectual property rights (IPR) in particular. Previous studies at the level of countries, sectors or technologies relied on the identification of non-patent references or the matching of inventor and author names. While approaches based on the number of non-patent references are easy to conduct on a large scale, it is clear that the presence of a non-patent reference only signals relevance of the scientific publication to qualify the nature of the invention (see e.g. Callaert et al., 2006). Adopting an approach based on inventor and author matching allows identifying involvement in different activity realms (science and technology), but identifying such individuals does not necessarily imply that patents and publications are identical (for a detailed overview on this approach, see Lissoni et al., 2008; Lissoni, 2012)

A promising new approach involves the use of text mining techniques to identify similar documents in terms of the topics they address, the methods they use, the results they obtain and the inventions or discoveries they address. This might enable a (semi) automated compilation of large datasets based on content similarity. Given the focus of this study, we are particularly interested in applying text-mining heuristics to identify patents related to scientific publications and vice versa. As such, we also contribute to the development of new techniques and indicators that signal similarities between patent documents and scientific publications.

In the next pages, we first outline the selection of the data used for this analysis, followed by a description of the methodology adopted to assess the similarity between patents and scientific publications leading to the identification of patent-paper pairs. This section is followed by a report on the findings, for the scientific citations of publications belonging to 'pairs' and the scientific footprint of authors involved in these publications. We conclude with outlining the limitations of our work and suggest avenues for further research in this area.

2. Data and methodology

2.1. Field selection

We focus on patents and scientific publications in the field of biotechnology, as this is an important evolving field known to be science-intensive (Meyer-Krahmer and Schmoch, 1998; Van Looy et al., 2007). This makes it an ideal candidate to investigate the effects of involvement in patenting on one's scientific footprint as it is characterized by a sufficient number of publications, patents as

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