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# What makes companies pursue an Open Science strategy?

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## ABSTRACT

Whereas recent scholarly research has provided many insights about universities engaging in commercial activities, there is still little empirical evidence regarding the opposite phenomenon of companies disseminating scientific knowledge. Our paper aims to fill this gap and explores the motivations of firms that disclose research outcomes in a scientific format. Besides considering a dimension internal to the firm, we focus particularly on knowledge sourcing from academic institutions and the appropriability regime. We conduct an econometric analysis with firm-level data from the fourth edition of the French innovation survey (CIS) and matched scientific publications for a sample of 2512 R&D performing firms from all manufacturing sectors. This analysis provides evidence that firms are more likely to adopt academic principles if they need to access scientific knowledge that is considered important for their innovation development, whereas the mere existence of collaborative links with academic institutions is not a strong determinant. Furthermore, the results suggest that the inclination of firms to publish is sensitive to the level of knowledge spillovers in a sector and the effectiveness of legal appropriation instruments.

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## 1. Introduction

The boundaries between the traditionally distinctive worlds of science and technology are becoming more and more porous. On the one hand, universities and public research institutions are not only contributing to scientific discourse but also becoming involved in the commercialisation of research results, leading to increasing numbers of university patents (Geuna and Nesta, 2006; Azoulay et al., 2007). The inventions originating from university research are used to generate additional funding via licensing and are regarded as an indicator of successful technology transfer. On the other hand, many profit-orientated companies are contributing to scientific literature via publications in peer-reviewed journals, and their contributions are often of a high standard (Hicks, 1995; Godin, 1996; Stephan, 1996; Lim, 2004). However, generic research and scientific publications by firms are counterintuitive since competitors might benefit from the disclosed knowledge. This raises the question as to which considerations are relevant for firms pursuing a strategy of scientific disclosure. In practical terms, such an “Open Science” (OS) strategy implies that firms allow or even encourage

their researchers to publish research outcomes in scientific journals or conference proceedings.

From a theoretical viewpoint, Hicks (1995) identifies several potential reasons. However, with a few notable exceptions (Stern, 2004; Ding, 2011; Polidoro and Theeke, 2012), there is still little empirical evidence concerning the motivations and drivers that actually lead firms to publish in a scientific format. Within the wider literature examining various aspects of science-based firms (e.g. Liebeskind et al., 1996; Cockburn and Henderson, 1998; Zucker et al., 2002; Gittelman and Kogut, 2003), studies also mainly focus on the pharmaceutical and biotechnology sectors while other R&D-performing areas receive much less coverage. This paper intends to fill these gaps with an econometric analysis of the determinants of an OS strategy. We use firm-level information from the fourth edition of the French Community Innovation survey (CIS4) and matched scientific publication data from Elsevier's Scopus database on a sample of 2512 manufacturing firms. In our analysis, which is based on a simple cost-benefit framework, we examine the impact of three major dimensions on the scientific openness of firms. These concern not only internal research activities as the origins of an openness strategy but also external drivers that shape the firm's decision, namely interactions with academic institutions and the appropriability regime at the sector level.

One of the first findings of this paper is that scientific publications are not only originating from the pharmaceutical and biotech industries but from almost every sector. The communication equipment, medical instrument and transport equipment sectors

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in particular also have high proportions of publishing firms. We find that firms with higher R&D intensities publish more frequently and in larger quantities, and this result also applies when controlling for R&D productivity, orientation towards generic R&D and firm size. Moreover, concerning links to academic institutions, firms publish more if interaction-based academic knowledge sources are regarded as important, whereas the mere existence of collaboration agreements has little impact. Finally, our results concerning the sector appropriability conditions suggest that lower spillover levels and greater use of legal protection instruments increase the frequency of scientific publications, while the use of strategic instruments has no apparent effect. We interpret these findings as indicative for the main drivers of scientific disclosure strategies and argue that the discovered relationships at least partially fit an open science paradigm. In particular, the sourcing of scientific knowledge promotes the adoption of scientific disclosure practices in firms.

The remainder of our paper is organised as follows. Section 2 provides a literature review regarding scientific publications originating from companies. The framework of analysis and theoretical discussion is presented in Section 3. In Section 4, data sources, variables and descriptive statistics are presented while the econometric design is discussed in Section 5. In Section 6, regression results are presented and discussed. Section 7 highlights robustness tests before conclusions, limitations and opportunities for future research are described in Section 8.

## 2. Scientific publications by firms

As a matter of fact, companies need to generate sufficient financial returns from their R&D investments in order to secure their long-term survival in a market economy. This implies a more applied orientation for corporate research than for university research (Nelson, 1959; Aghion et al., 2008). Apart from the different scope of research activities in comparison to industry, “Open Science” (OS) is based on different reward mechanisms encouraging the rapid disclosure of new knowledge (Hagstrom, 1965; Merton, 1973; Dasgupta and David, 1994). Only those authors who provide new and original insights receive recognition from the scientific community and acquire a good reputation. Based on their reputation, scientists can attain further career achievements like tenure or research grants (Latour and Woolgar, 1979; Dasgupta and David, 1994). Beyond the perspective of the individual scientist, disclosure also enables follow-on work to be done by other researchers in the field. Due to this importance of disclosure in the academic reward system, scientific publications represent a key component of OS. From a firm perspective however, voluntary disclosure is counterintuitive since competitors may access and utilise the knowledge as well (Arrow, 1962).

Given that firms may use legal intellectual property instruments for the same knowledge in parallel (Murray, 2002), the question is whether scientific publications by firms represent an equivalent openness to publications originating from academic institutions. Assuming a sufficient content overlap between the publication and the patent, which in practice is likely to vary, other firms cannot utilise the disclosed knowledge (see Murray and O'Mahony, 2007). The publication may still be informative, stimulate follow-up research beyond the particularly protected area or potentially even reveal additional knowledge due to comprehensive documentation requirements imposed by scientific journals, but direct benefits for other firms are typically limited. On the contrary, for the academic scientist audience group, a parallel patent application should not impose serious restrictions for cumulative follow-on work unless the academic researchers are also “consumers” of the

research outcomes that are protected by patents.<sup>1</sup> As Walsh et al. (2007) document in a survey that targeted academic researchers in biomedicine, patents are not regarded as an impediment for academic research in contrast to strategic behaviour like withholding information or not sharing research inputs, which should apply to the domain of academic and commercial research in a similar manner (see also Vallas and Kleinman, 2008). However, if firms also seek patent protection, the scientific equivalent can be regarded as less open than described in the “Mertonian” ideal of scientific practice (“communalism”). On the other hand, the existence of a scientific contribution in theory still represents greater openness than patent protection only. Moreover, this is also true for the interpretation of openness in the Open Innovation literature, which widely neglects the phenomenon of voluntary contributions to the public knowledge stock (see Dahlander and Gann, 2010).

In addition to potential spillover effects and costs of conducting generic research with uncertain outcomes, there are further reasons for which scientific openness is a costly strategy for firms. The disclosure process itself involves opportunity costs since researchers have to prepare their publications to meet the respective requirements of target journals, which may include, for instance, comprehensive documentation of experiments or responding to reviewers' queries (Kinney et al., 2004; Penin, 2007; Liu and Stuart, 2010). In this respect, requirements should become more stringent the higher the quality of the journal. Regarding the firm's R&D incentive structures, an orientation of the firm towards OS with publication incentives for the firm scientists may lead to agency conflicts. The scientists might devote too much effort to generic research and corresponding disclosure activities but no longer commit themselves sufficiently to converting the results into applied outcomes if the internal reward systems are not balanced (Cockburn et al., 1999; Gittelman and Kogut, 2003). Finally, scientists who publish are more visible for competing firms, which may impose the necessity of establishing costly retention policies to reduce outgoing job mobility (see Kim and Marschke, 2005; Liu and Stuart, 2010).

The possible benefits of scientific disclosure relate to both knowledge creation and diffusion. Hicks's paper (1995) highlights several potential benefits and therefore serves as an important starting point for analysing motivations. One reason is the possible desire of firms to be very closely connected to academic scientists and be part of the wider scientific community. By maintaining personal contacts with academic researchers, firms may be able to obtain the latest knowledge that has not yet even been published. Firms that publish can build up credibility thanks to their contributions and subsequently gain entrance to the respective scientific communities (Rosenberg, 1990; Hicks, 1995).

With respect to socialisation processes and firm cultures, Ding (2011) shows that the strong scientific backgrounds of biotech start-up founders have a positive effect on the adoption of an OS strategy. Moreover, companies can use scientific publications as an instrument for hiring and motivating researchers (Hicks, 1995; Stern, 2004). Even though the characteristics of academic scientists and their counterparts in firms vary in some ways, scientists in industry often share similar values and are concerned about their reputation (Sauermann and Stephan, 2012). Correspondingly, Stern (2004) and Sauermann and Roach (2011) reveal that many scientists on the job market are willing to accept lower salaries in order to receive the right to publish. This indicates that firms offering their

<sup>1</sup> A well-known example is the “Oncomouse”, where the firm DuPont patented an important input to biomedical research. Since academic scientists could not obtain these genetically manipulated mice without infringing the patent, academic research was hampered by the monopolistic prices applied by DuPont (Murray et al., 2009).

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