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Publishing, patenting, and standardization: Motives and barriers of scientists

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ABSTRACT

In this paper, we analyze the motives and barriers of researchers to engage in standardization in comparison with publishing and patenting. We conduct a survey on 129 researchers at the Federal Institute for Materials Research and Testing, one of Germany's largest federal research institutes. The resultant dataset enables us to study not only the researchers' motives and barriers but also the effect of those motives and barriers on the extent to which the respective activities are undertaken. We find that publishing constitutes a baseline activity. By contrast, patenting is driven by commercialization motives, and standardization is mainly fostered by intrinsic motivation. With respect to the barriers, we find that they are mostly inherent to the activity itself or the system in which it is performed. Finally, we discuss several options to develop a more integrative incentive system to exploit the possible synergies between standardization and publishing and patenting.

1. Introduction

Researchers in universities have three main tasks, namely, education, research, and knowledge transfer, which is a recent addition. Research is the main activity of researchers working in state-owned research institutes. However, as universities and institutes are funded directly by the government, knowledge transfer is a declared goal to further the state of the art of technology. The most common and investigated transfer channel is the publication of research results in scientific journals. However, because of the objective of increasing the social impact and the requirement of raising more financial resources in addition to the basic funding, the range of transfer activities of researchers in the last decades has expanded to include academic engagement and, more recently, commercialization. Academic engagement can be defined “as knowledge-related collaboration by academic researchers with non-academic organisations” (Perkmann et al., 2013, p. 424). Commercialization initially included mainly patenting and licensing of research results, but it has recently included the promotion of entrepreneurship through spin-offs from universities and research organizations. Participation in standardization processes is an academic engagement as defined above, and it specifically leads to the common

development of standards.¹ Further, it represents an opportunity to source external knowledge from other participants. It is an option to commercialize one's own research results directly by referencing one's own patents in standards and indirectly by using standardization as an opportunity to establish collaborations with companies as a starting point for raising funds for common research projects or contract research.

Despite the fact that technology diffusion is important for the commercial success of innovations, the only recently identified knowledge transfer channel standardization has not yet been adequately addressed. Blind and Gauch (2009) analyze standardization in the area of nano-technology, which covers the issues of generating common terminologies or measurement and testing methodologies in the early phases of technology life cycles. In information and communication technologies, standards are mainly developed to achieve interoperability, for example, the numerous components in a laptop (Biddle et al., 2010) or a mobile phone to promote their diffusion in the market. Obviously, standardization covers various phases within the research and innovation process.

For the first time, Zi and Blind (2015) investigate the influence of scientific publication and patenting activity on researchers'

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¹ According to EU-Regulation No 1025/2012 a standard is a technical specification, adopted by a recognized standardization body for repeated or continuous application, with which compliance is not compulsory. CEN, the European Committee for Standardization, publishes the following definition: “A standard is a technical document designed to be used as a rule, guideline or definition. It is a consensus-built, repeatable way of doing something. Standards are created by bringing together all interested parties such as manufacturers, consumers and regulators of a particular material, product, process or service. All parties benefit from standardization through increased product safety and quality as well as lower transaction costs and prices.” According to ISO/IEC Guide 2.2004 standardization is an “activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context”.

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participation in standardization. They find tension in standardization activities in relation to basic research but find no synergies to applied research and no link to patenting activities. Accordingly, the question on researchers' motivations for standardization in general has emerged. Therefore, our research focuses on analyzing the personal motivations of researchers to participate in standardization in comparison with writing scientific papers and applying for patents. The latter two options, which are characterized by the dichotomies of outputs of basic versus applied research and being accessible to everyone versus being usable for their owners or paying licensors, have been investigated in detail.

By contrast, contributing to standards, on the one hand, is similar to writing a scientific paper because researchers provide access to technical solutions even if they are not awarded with explicit credit because of the non-disclosure of authorship in most cases. Further, standardization is usually a collaborative effort with stakeholders from a potentially different background, such as non-government organizations, industries, and the public sector. On the other hand, standardization is similar to patenting in the sense that both activities are closely linked to applied research in contrast to scientific publications as outputs of basic research. Again, patent applications include not only the name of the owner but also the names of the inventors, which is not the case for standards. Consequently, participation in standardization is contributing to a publication available to everyone for free or by paying a small fee, such as for a journal article, but it is more interesting for applied researchers and even technology and product developers. Therefore, the current study aims to reveal the motivation of researchers to contribute to this particular hybrid form of publication.

We build on the empirical work of [Blind and Gauch \(2009\)](#) and [Zi and Blind \(2015\)](#) and refer to the motivational framework of [Lam \(2011\)](#) to analyze the researchers at the Federal Institute for Materials Research and Testing (Bundesanstalt für Materialforschung und -prüfung, hereafter BAM). We also validate our results with the findings of [Blind and Gauch \(2009\)](#), who focused on nanotechnology in general, and those of [Blind et al. \(2017\)](#), who focused on engineers working in the automotive industry. Therefore, our research is an analysis of the personal motivations of researchers to participate in standardization. Subsequently, we perform an exploratory factor analysis to determine if the motives for standardization as well as for publishing and patenting are driven by the underlying motivational factors of “puzzle,” “ribbon,” and “gold.” Furthermore, we determine through another factor analysis the types of barriers related to the three activities. In the last step, we introduce a negative binomial regression model to determine the effect of the motivational factors as well as the barriers on the extent to which the respective activity is undertaken, thus enabling us to answer our research questions.

As another contribution of this research, we complement our analysis of the motives to publish, patent, and standardize with the investigation on the related barriers to engaging in the three activities. Accordingly, we propose potential actions to be taken by research institutions to promote the participation of their employees in the three activities, particularly in standardization.

The objectives of our paper are summarized by the following research questions:

RQ1: What are the motives/barriers of researchers to engage in standardization activities, and how do they compare with the motives/barriers to publish and patent?

RQ2: Which motives/barriers influence the extent to which researchers engage in standardization, and do they compare with the motives/barriers to publish and patent?

Our results indicate that the number of publications is not significantly associated with the motives. Therefore, they support our expectation that publishing constitutes a baseline activity because it represents a major component in the researchers' job description. Patenting activities, also called a target in the job specification, are significantly driven by the commercial “gold” motive, and the intrinsic

“puzzle” motive is the most relevant in standardization participation (not listed as an objective in the job description). The most relevant factor deterring researchers from participating in the three activities is subsumed under the term *Alternatives*. For example, researchers may prefer to publish their research instead of introducing it into standardization. We argue that *Alternatives* may be a relevant barrier because of time and resource constraints, the appropriateness of the transfer channel, or simply the value orientation of researchers.

The remainder of the paper is organized as follows. Section 2 presents an introduction to self-determination theory and a review of the literature on the motives and barriers of standardization participation in comparison with those of publishing and patenting. Section 3 discusses the case study research institution, survey design, resultant dataset, and methodology used in our study. Section 4 reports the descriptive results of the survey. Section 5 discusses the results of the exploratory factor analysis of the motives and barriers. Section 6 presents the results of the negative binomial regression analyses. In the last section, the results are summarized in comparison with other studies to generalize the results, and their implications are presented.

2. Literature review

The literature on researchers' activities in general and knowledge transfer in particular has focused on scientific publications for a long time (e.g., [Stephan, 1996](#)). Nevertheless, the portfolio of activities undertaken by researchers has extended to several activities ([Landry et al., 2010](#); [Perkmann and Walsh, 2007](#)), such as patenting ([Azoulay et al., 2007](#); [Baldini et al., 2007](#); [Breschi et al., 2008](#)) and recently to entrepreneurship ([Abreu and Grinevich, 2013](#); [Clarysse et al., 2011](#); [Giacomin et al., 2011](#); [Goethner et al., 2012](#); [Grimaldi et al., 2011](#); [Perkmann et al., 2013](#); [Rothaermel et al., 2007](#)). However, even these recently published surveys do not include standardization as one instrument or channel of researchers' knowledge transfer. Only [Abreu et al. \(2012\)](#) include this option in their survey among academics in the United Kingdom. The present paper addresses this research gap and incorporates standardization as an aspect of knowledge transfer and commercialization efforts.

Although many studies have been conducted on the effect of commercialization on publication activities, only a small fraction of research has looked into the motives of scientists to engage in commercialization ([Baldini et al., 2007](#); [Lam, 2011](#)). We extend the existing literature by examining the motives and barriers of researchers to standardization in comparison with those to publishing and patenting.

In this section, we introduce the possible spectrum of motives, from intrinsic to extrinsic, of researchers' activities in general based on self-determination theory. To categorize the different motives, the differentiation between intrinsic and extrinsic motives based on self-determination theory is applied ([Deci and Ryan, 2000](#); [Gagné and Deci, 2005](#); [Ryan and Deci, 2000](#)). According to this theory, extrinsically motivated individuals aim for benefits provided by some authority in the researchers' environment, such as superiors, peers, and even the market, based on the assessment of effort or performance ([Sauermann and Cohen, 2010](#)). Therefore, the benefits from extrinsically motivated activities are an indirect consequence of the performed action. By contrast, intrinsically motivated individuals perform activities for inherent direct benefits, such as those associated with the activity itself ([Sauermann and Cohen, 2010](#)). These benefits crucially depend on the specific interaction of the characteristics of the individual and those of the activity. The degree of intrinsic motivation is increased by the autonomy of choosing which actions to perform and how ([Gagné and Deci, 2005](#); [Sauermann and Cohen, 2010](#)). However, motives are not always either intrinsic or extrinsic. Consequently, researchers can be extrinsically or intrinsically motivated to different levels in performing an activity depending on the internalization of the related values ([Ryan and Deci, 2000](#)). Individuals' motives can move along a continuum between intrinsic and extrinsic. Behavior that was originally

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