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Organizational innovation, internal R&D and externally sourced innovation practices: Effects on technological innovation outcomes

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ABSTRACT

This paper focuses on determining how organizational innovation, together with other innovation activities, such as internal and externally sourced innovation practices, influences the probability of obtaining product and process innovations. The research relies on panel data methodology; random effects bivariate and univariate probit models are estimated, as well as the corresponding average marginal effects (AMEs) in order to examine the causal effects. The results confirm the existence of positive effects of internal R&D and externally sourced innovation practices, as well as a positive influence of organizational innovation on the realization of technological innovations. Regarding the enhancing influence of organizational innovation on the effect of internally or externally sourced innovation practices, findings point to a moderating effect only on the probability of obtaining complex technological innovations (product and process innovations, jointly).

1. Introduction

For a long time, research on innovation management focused mainly on technological innovation as a fostering aspect for firm performance and economic growth (Fagerberg, 1994; Grossman & Helpman, 1994). As Schmidt and Rammer (2007) pointed out, this technological approach to the innovation phenomenon has been criticized, among other reasons, because it fails to provide a comprehensive picture of the innovative efforts firms engage in across all economic sectors. Also, scholars have pointed out the need to broaden the scope on the concept, signaling that the positive impact of innovation is not limited to the practices that imply high technology or high investment on internal R&D activities (e.g., Marsili & Salter, 2006). A systematic and holistic view on the innovation phenomenon should thus take into account the fact that firms engage in innovative activities that transcend the boundaries of their organizations and explicitly include the consideration of non-technological activities that may also constitute a source of innovation.

As for overcoming the strict internal view on innovation, it is worth noting the contribution embodied in vast literature dealing with the innovation practices carried out in collaboration with external agents (Dyer & Singh, 1998; Nooteboom, 1999). Particularly, the current study focuses on innovation practices encompassing all those activities aiming to integrate knowledge, resources and expertise from external agents, via cooperation agreements or less formalized procedures, such as the external sourcing of knowledge and ideas.

Also, the importance of broadening the scope of the innovation conceptualization towards non-technological aspects dates back a few decades. Indeed, the seminal work by Nelson and Winter (1982) emphasized the relevance of firm organization as a variable for analysis in its own right and stated that an evolutionary theory should consider organizational innovation just as it treats technical innovation. In line with these postulates, more recent research has recognized that innovation is not just about developing and applying new technologies but also about adopting and re-organizing business routines, internal organization, external relations and marketing (see Baranano, 2003; Boer & During, 2001). In this sense, the adoption of technological innovations alone has been claimed insufficient to sustain competitiveness, as their full benefit would be fully achieved only in the presence of complementary organizational innovations, which are in turn considered more systemic and difficult to imitate and thus more relevant as a source of competitive advantages (Evangelista & Vezzani, 2010; Martin-Rios & Parga, 2016a, 2016b). Accordingly, interest in the field is growing steadily, and this has been reflected in the ever-growing body of works devoted to the study of non-technological innovations (e.g., Hervás-Oliver & Sempere-Ripoll, 2015), and the attempt in academic research to go beyond the R&D centered vision of the innovation process with the use of comprehensive measures of innovation inputs, activities and outputs (Evangelista & Vezzani, 2010).

In line with this trend, the approach taken in this study relies heavily on the understanding the innovation phenomenon as a process in which the output obtained by a given firm is a function of its

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strategy, routines and resources (Foss, 2004) or, in the words of Karlsson and Tavassoli (2016), 'the result of new combinations of innovation inputs in the form of resources, ideas, information, knowledge and/or technologies'. As stated, the outputs of said process taken into account here are those referred to as 'technological innovations' (e.g., Mothe & Nguyen-Thi, 2010; Schmidt & Rammer, 2007), that is, product innovation, understood as the introduction of a new (or significantly improved) good or service; and process innovation, defined as the introduction of a new (or significantly improved) production or delivery method (OECD and Eurostat, 2005).

On the other hand, the innovation inputs of interest in the study comprise the following practices:

- the development internal R&D activities,
- the engagement in externally sourced innovation practices; in particular, the in-sourcing of knowledge from outside parties and the participation in collaborative agreements with innovation purposes, and
- the implementation of organizational innovations.

It is worth pointing out that this work proposes organizational innovation as an *input* in the innovation process (Haned, Mothe, & Nguyen-Thi, 2014), thus affecting the generation of technological innovations. This view is in line with a stream of literature that suggests that organizational innovation enhances flexibility and creativity, which in turn facilitates the development of technological innovations (see Mothe & Nguyen-Thi, 2010).

The influence of organizational innovation on the likeliness of introducing successful technological innovations is still under research. Some studies have found a positive effect of implementing organizational innovations on the generation of process innovations, while also identifying insufficient evidence to sustain the existence of an effect on the realization of product innovations (Cozzarin, 2017; Gunday, Ulusoy, Kilic, & Alpkan, 2011). Mothe and Nguyen-Thi (2010, 2012), nevertheless, have obtained results that point precisely to a positive impact of organizational innovation on the probability of developing product innovations.

Also, previous research addressing the potential benefits of combining technological and non-technological innovation generally has examined whether the implementation of organizational innovations enhances the influence of technological innovation outputs (i.e., product and process innovation) on performance (e.g., Sapprasert & Clausen, 2012; Schmidt & Rammer, 2007; Sempere-Ripoll & Hervás-Oliver, 2014). Other works have focused on determining the potential interactions between organizational innovations and collaborative innovation activities (Foss, Laursen, & Pedersen, 2011; Hecker & Ganter, 2016). However, contributions regarding the potential combinative effect of organizational innovation and internally or externally sourced innovation activities on the probability of obtaining successful technological innovation outputs are still lacking.

To address this research gap, the objective of this paper is to adopt a comprehensive view on the innovation phenomenon and explore (i) whether the introduction of organizational innovations affects the probability of obtaining successful product and/or process innovations, and (ii) whether organizational innovation leverages the effects that internally and externally sourced innovation practices have on the generation of said technological innovation outputs.

For this purpose, random-effects univariate and bivariate probit models are estimated, in order to analyze the causal effects of the set of innovation practices described above on the probability of obtaining successful technological innovations in the following scenarios: the generation of product innovations, the generation of process innovations and the generation of both types of technological innovations. The dataset employed collects information of more than 11,000 Spanish firms from 2008 to 2013.

This paper contributes to the innovation management literature by offering a refined insight on the combinations and interactions among different types of innovation practices, thus taking a comprehensive view of the innovation phenomenon, which has stepped aside from a strictly technological and isolated perspective to encompass non-technological aspects and a systemic view. In line with the resource-based view and a socio-technical perspective, this work tackles on the idea that technological and non-technological innovation activities reinforce one another and that firms would benefit from implementing and harmonizing a complex set of practices in order to optimize the results from their innovation processes. In this sense, there are still few contributions that focus on the complementarity of technological and organizational innovation, and these tend to consider organizational innovation as an *output* that, together with product and process innovations, have a combinative effect on performance. As stated before, this work posits, notwithstanding, organizational innovation as an *input* with a causal effect on the generation of product and process innovations. There are few studies that adopt this perspective and, to our knowledge, there is no contribution to date that examines the potential complementary effect of organizational and internal R&D activities on the generation of product and process innovations, as this work does.

Also, this work relies on the estimation and analysis of average marginal effects in order to determine the existence of direct and moderating effects. Prominent scholars have been warning against the use of estimated coefficients in non-linear models to draw conclusions on the causal effects of the independent variables, especially when said models include interaction terms (e.g., Hoetker, 2007; Norton, Wang, & Ai, 2004). However, the estimation of marginal effects has been rarely used in previous studies focusing on the influences of innovation practices (see for instance the works by Ganter and Hecker from 2013 and 2016). Thus, this study aims to contribute to the consolidation of the aforementioned methodology in the field of innovation management.

Lastly, this research sheds light on the intricate nature of the relationships arising between the implementation of organizational innovation and the engagement in (internally and externally sourced) innovation practices, which might be of interest for practitioners and policy makers alike. Indeed, results draw some interesting conclusions on the complementary or substitutive nature of the combination of these innovation activities, offering insight on how to make better profit of their joint implementation.

The remainder of the paper is structured as follows: first a literature review on the effects of the different kind of innovative activities described above is presented, in order to establish the hypotheses of the study; the research design and the data used are described in the methodology section; the results are then presented and discussed; finally, some conclusions are offered, together with the exposition of the limitations and main contributions of the study.

2. Antecedents and hypothesis development

Fig. 1 offers a conceptualization of the hypothesis developed in this section, which details the innovation process framework presented above. As explained before, this work intends to shed light on the intricate logics by which different innovative strategies result in the generation of technological innovation outputs. In particular, regarding the innovation practices, the focus is on internally and externally sourced innovation activities and organizational innovation. The purpose is to determine the unconditional effects of this set of inputs on the generation of technological innovation outputs, as well as examining the potential complementary effect of organizational innovation and the other types of innovation practices taken into account.

When tacking on the nature of organizational innovation as an input in the process to generate technological innovations, it is worth pointing out that the full intended performance of new organizational methods usually takes time since its introduction (e.g., Damanpour & Evan, 1984; Tavassoli & Karlsson, 2015). Also, while innovation