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An analysis of the open innovation effect on firm performance

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ABSTRACT

The open innovation (OI) paradigm describes how firms innovate by interacting with other organizations. Several authors found that specific OI strategies have a positive effect on economic and industrial innovation performance. Nevertheless, over-search and over-collaboration phenomena might reduce the OI marginal returns when a firm resorts to additional external innovation partners. This article hypothesizes that the variety of external innovation channels (search breadth) used by a firm, the extent to which a firm draws deeply from them (search depth) and the extent to which a firm collaborates through different external channels (coupled OI) are curvilinearly related with innovation performance. The empirical models are estimated using 84,919 firms from Eurostat's Community Innovation Survey, which was conducted in 2008 across European countries. The results suggest that search breadth is curvilinearly related with all the measures of innovation performance, whereas search depth is not subject to diminishing marginal returns in most cases. Furthermore, this article shows that coupled OI is curvilinearly related with the development and commercialization of radically new products. The findings of this study make several contributions both in a practical perspective, showing how managers can put into practice different OI strategies to influence innovation performance, and in a theoretical perspective, suggesting a number of recommendations for future research.

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1. Introduction

Open innovation (OI) deals with the innovating capability of a firm deriving from the interaction with other firms (Chesbrough, 2003). The origin of the term lays in its ideally opposite meaning with respect to closed innovation, which incurs when all the organizational innovations are produced by means of internal Research & Development (R&D) efforts (Chesbrough, 2003). Firms can adopt OI resorting to one or more strategies: inbound OI, which describes internal use of external knowledge; outbound OI, which describes external use of internal knowledge; and coupled OI, which describes active collaboration with partners to innovate (Cheng & Huizingh, 2014; Gassmann & Enkel, 2004) and ideally results from the combination of inbound and outbound OI activities (Gassmann & Enkel, 2004).

The access to external knowledge through OI is increasingly recognized as a critical source of the firms innovativeness (Duysters & Lokshin, 2011). The literature focussing on OI is mainly devoted to

explore how such strategies can affect a firm's innovation performance, both in economic (e.g. turnover share from innovative products) and industrial terms (e.g. development of innovations). Therefore, according to recent reviews, the study of the relationships between OI strategies and firms' innovation performance has roused much interest in the literature (Schroll & Mild, 2012; West & Bogers, 2014). Most authors hypothesized and demonstrated that OI strategies have a positive effect on innovation performance. The rationale behind such hypotheses is quite intuitive: the more a firm interacts with other organizations, the higher will be its access to external ideas, competences, knowledge, technologies and other intangible assets, the higher will be its chances to innovate successfully. In particular, many authors explored the effect on innovation performance of general OI strategies such as inbound, coupled or outbound OI (Cheng & Huizingh, 2014; Chiang & Hung, 2010; Frishammar, Lichtenthaler, & Rundquist, 2012; Hernández-Espallardo, Sánchez-Pérez, & Segovia-López, 2011; Leiponen, 2012; Martini, Aloini, & Neirotti, 2012; Ortiz-de-Urbina-Criado, Montoro-Sánchez, & Mora-Valentín, 2012). Other authors verified the effect of collaborating with specific typologies of external partners, such as customers, suppliers, research institutions and competitors (Czarnitzki & Thorwarth, 2012; Sofka & Grimpe, 2010; Un, Cuervo-Cazurra, & Asakawa, 2010; Vega-jurado, Gutiérrez-

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Gracia, & Fernández-de-Lucio, 2009).

Nevertheless, firms' resources are typically limited, and interacting with external subjects is a costly activity (Koput, 1997). Indeed, active collaborations require large maintenance costs (Duysters & Lokshin, 2011; Kang & Kang, 2009; Lin, 2014). Therefore, in a cost/benefit perspective, the OI approach may have, after certain levels, diminishing marginal returns on innovation performance, or even a negative effect on it (Lin, 2014). Following this lead some authors demonstrated an inverted U-shaped relationship between OI (in terms of inbound or coupled strategies) and innovation performance (Duysters & Lokshin, 2011; Kang & Kang, 2009; Laursen & Salter, 2006; Lin, 2014). Most of them measured innovation performance in terms of turnover share from radically and/or incrementally innovative products, whereas Kang and Kang (2009) measured it in terms of the number of product innovations introduced. These articles analysed country-specific large samples (Netherlands, Korea, United Kingdom and Taiwan, respectively) whose cultural and macroeconomic peculiarities may have affected the external validity of the results.

Overall, as described above, studying the link between OI and innovation performance is pivotal in the OI literature. Most authors demonstrated a positive effect of several OI strategies on innovation performance, whereas only few authors found relationships taking an inverted U-shape. Nevertheless, such lack of agreement is probably due to authors' methodological choices rather than to the real characteristics of the phenomenon. Indeed, the vast majority of studies did not hypothesize, and consequently did not test, inverted U-shaped relationships between OI and innovation performance (Greco, Grimaldi, & Cricelli, 2015). All of the existing empirical evidence supporting U-shaped relationships resorted to country-specific samples. Most of them also measured only one or two OI strategies. In fact, the synergistic effect of coupled and inbound OI on innovation performance has not been explored yet, the effect of the two strategies having always been studied separately. Nevertheless, the inbound and coupled OI often coexist in the same firm, and their concurrent effect may differ from their individual ones (Mazzola, Bruccoleri, & Perrone, 2012).

Therefore, this study aims to fill the gap in the literature by answering to the following research question:

RQ. "Are OI strategies curvilinearly (taking an inverted U-shape form) related with innovation performance in European firms?"

The importance of a comprehensive and convincing answer to our research question lays both in its practical and theoretical implications. Indeed, managers are likely to benefit from knowing accurately which effect OI is likely to have on their firms' innovation performance. Providing an answer to our research question may also help scholars to produce more fine-grained researches comparing the results of different countries, industries or exploring the effect of specific OI sources in a different perspective from previous studies.

In order to answer to our research question properly we needed to analyse an appropriate amount of firms, covering multiple countries, sectors and sizes. The difficulty in identifying and contacting a vast, representative sample of the firms' population in a wide number of countries and sectors brought us to use high-quality secondary data collected by Eurostat. Thus, this article explores the relation between OI and innovation performance on a European scale, by means of the most recent micro data of the Community Innovation Survey (CIS), which is released by Eurostat for research purposes. The refined sample used in this article includes 84'919 firms from 14 European countries. To the best of our knowledge, this is the most extensive sample ever used in the OI literature.

The paper is structured as follows. Section 2 reviews the

theoretical background, while Section 3 presents the hypotheses of the study. Section 4 describes the dataset and the research methodology. The results of the study are shown in Section 5 and discussed in Section 6. Finally, Section 7 identifies the implications for academics and managers, suggesting future developments.

2. Theoretical background

Firms have always been prompted to develop innovations in order to achieve competitive advantage (Lengnick-Hall, 1992). To this aim, for much of the 20th century firms' internal R&D laboratories were considered the main sources of technological innovation (West & Bogers, 2014). Nevertheless, far before the term "Open Innovation" was introduced by Chesbrough (2003), firms were already interacting with other organizations such as universities and suppliers in order to improve their innovation performance (Vanhaverbeke, West, & Chesbrough, 2014). According to the OI paradigm, firms are becoming increasingly aware of the need to interact with their abundant underlying knowledge landscape to integrate their internal Research & Development (R&D) efforts and of the importance of managing their outbound flows of knowledge and technology (Chesbrough, 2006). In this perspective, internal R&D is just as important as gathering external knowledge from other sources, whereas in the past the latter approach had a somewhat supplementary and limited role in shaping most firms' innovation strategy (Chesbrough, 2006).

In several industries even the largest firms need to open their innovation activities by collaborating with other organizations in order to keep pace with technological developments (Brusoni, Prencipe, & Pavitt, 2001; Chen, Chen, & Vanhaverbeke, 2011). A firm whose internal innovation process involves external organizations may insource some of their knowledge, competences and technology (inbound OI), or may actively collaborate with them (coupled OI).

When resorting to an inbound OI strategy, a firm tries to search outside of its boundaries the skills, competences or technologies that it does not own, and that would take too much cost, effort and time to be developed internally. A large amount of external subjects such as research institutions, suppliers, customers, consultants and competitors may provide the firm with the knowledge it needs (Faems, Van Looy, & Debackere, 2005; Tether & Tajar, 2008). The variety of external sources used by a firm describes its external search breadth (SB), whereas the extent to which a firm draws deeply from different external sources describes its external search depth (SD) (Laursen & Salter, 2006). According to a recent study, a remarkably high percentage of European firms were already adopting the inbound OI mode before Chesbrough's seminal work on OI itself (77% in 2001), and after a steep increase measured in 2004, the percentage remained stable on very high levels (around 90%) (Cricelli, Greco, & Grimaldi, 2016). This reinforces the perception that inbound OI strategies are considered very effective to enhance firms' innovativeness, and are already widespread in most industries.

Similarly to inbound OI, coupled strategy may imply collaborations with several partners of different types (Un et al., 2010), to a higher or lower degree of intensity (Kang & Kang, 2009). A firm may want to collaborate with external subjects in order to achieve several business goals, such as increasing its profitability, shortening the time-to-market, enhancing innovation capability, creating greater flexibility in internal R&D or expanding market access (Chesbrough & Schwartz, 2007). On the one hand, collaborating with external subjects requires additional efforts and costs with respect to merely acquiring know-how from them. Firms may sustain costs of coordination when interacting with other organizations (Faems, De Visser, Andries, & Van Looy, 2010), and an

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