



# Hitting the nail on the head: Exploring the relationship between public subsidies and open innovation efficiency



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## ABSTRACT

The success of open innovation as a new paradigm to enhance innovation development has brought public authorities to incentivize firms to collaborate with external organisations. Such incentive is often provided in the form of public subsidies to research and development activities. Some studies observed that public subsidies are generally successful in pursuing the goal of promoting open innovation. Nevertheless, as the number of partners increases, the positive effect of collaboration on innovation performance is likely to decrease due to over-search and over-collaboration issues. In this perspective, a mere increase of the firms' propensity to collaborate should not satisfy public authorities, which instead should carefully monitor how public subsidies can improve the efficiency of such collaborations. This article advances the literature about the relationship between public subsidies and open innovation by assessing how funds provided by local, national and European authorities are associated with open innovation efficiency. By analysing an extensive sample of 43,230 European firms, this study confirms that the three typologies of public subsidies are associated with collaboration in beneficiaries. Furthermore, the study shows that local and national subsidies are also associated with open innovation efficiency, whereas European subsidies are not statistically significantly associated with it. This study provides theoretical and policy implications. In a theoretical perspective, it introduces the concept of open innovation efficiency, it analyses its public policy drivers and presents several recommendations for future research. In a policy perspective, it suggests explanations for the results obtained and advises policy initiatives to foster open innovation efficiency.

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## 1. Introduction

The open innovation (OI) paradigm, which describes how purposely interacting with external organizations may help firms to fulfill their innovation goals (Chesbrough, 2003), has achieved resounding success both among academics (Greco et al., 2015; Hossain and Kauranen, 2016; Huizingh, 2011; Schroll and Mild, 2012; West and Bogers, 2014) and among firms (Cricelli et al., 2016; Poot et al., 2009). One of the reasons for the OI paradigm success probably lays in the large amount of studies that demonstrated the positive effect of OI on innovation performance (Chiang and Hung, 2010; Czarnitzki et al., 2007; Duysters and Lokshin, 2011; Grimpe and Kaiser, 2010; Mazzola et al., 2012; McMillan et al., 2014; Miotti and Sachwald, 2003; Negassi, 2004; Schweitzer et al., 2011; Wang et al., 2015). As innovativeness is at the basis not only of the wealth of firms, but also of the communities that benefit from such firms' positive externalities (Messeni Petruzzelli et

al., 2009), public authorities have been showing an increasing interest in the implications of OI. Indeed, public authorities willing to enhance firms' innovation capabilities are increasingly recognising inter-organizational collaborations when granting public financial research and development (R&D) incentives, also referred to as public subsidies (PS). For example, the preface of OECD book 'Open Innovation in Global Networks', begins with:

'As global competition intensifies and innovation becomes riskier and more costly, the business sector has been internationalising knowledge-intensive corporate functions, including R&D. At the same time, companies are increasingly opening their innovation processes and collaborating on innovation with external partners (suppliers, customers, universities, etc.). This clearly has important implications for policy-making, given the important role of innovation in OECD countries' economic growth.' (OECD, 2008, p. 3).

So far, several studies have shown that PS beneficiaries are encouraged to collaborate with external organisations (Gallego et al., 2013; Miotti and Sachwald, 2003; Negassi, 2004; Segarra-Blasco and Arauzo-Carod, 2008). Noticeably, most public agencies explicitly

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require, reward or at least recommend cooperation among different organisations (Miotti and Sachwald, 2003). In this perspective, the fact that PS enhance OI is expected and reasonable, but deserves further investigation.

Indeed, we advance that PS should aim to facilitate firms in purposefully adopting the OI paradigm in order to enhance innovation performance. In other words, PS should aim to improve the OI efficiency of the funds' beneficiaries, rather than to merely incentivize them to establish collaborations. In fact, PS may activate *pro forma* collaborations (Ben Letaifa and Rabeau, 2013) that have little explanatory power of innovation performance, and that may rather respond to the mere need of involving partners that may increase the odds of receiving the subsidy. Furthermore, merely increasing the number of collaborations is likely to cause diminishing returns to innovation performance (Bader and Enkel, 2014; Duysters and Lokshin, 2011; Greco et al., 2016; Koput, 1997; Laursen and Salter, 2006), reducing the effectiveness of PS. Conversely, PS may actually sustain funds beneficiaries in organising their innovation activity, incentivizing them to find and cooperate with outstanding experts rather than with usual partners, requiring periodic milestones, analysing deliverables, etc. Nevertheless, to the best of our knowledge, no previous study attempted to assess how PS are associated with firms' OI efficiency.

Thus, this article aims to fill this gap in literature, exploring the extent to which three typologies of PS (European funds, national funds, and local authorities' funds) are associated with OI efficiency, resorting to a sample of 43,230 firms from 14 European countries drawn from the Community Innovation Survey (CIS).

The results of the article confirm those observed in the literature regarding the positive link between local, national and European PS and firms' OI adoption, but also emphasise that only local and national PS are positively and statistically significantly associated with OI efficiency. The analysis is then repeated to compare the relationship between PS and OI efficiency in firms of different size, and in firms based in European Eastern versus Western countries. It turns out that that local PS are positively associated with OI efficiency in small firms, while national PS are positively associated with OI efficiency in small and medium-sized firms. Finally, OI efficiency in Western countries is positively related to local and national PS, whereas in Eastern countries it is positively related to local and European PS.

The theoretical background of this article is presented in Section 2, whereas Section 3 defines the variables and describes the sample. Section 4 shows the main research results, which are discussed in Section 5, while Section 6 presents the conclusions and the suggestions for future developments.

## 2. Theoretical background

### 2.1. From open innovation to open innovation efficiency

The OI paradigm describes the extent to which a firm interacts with other private or public organisations in order to complement its internal R&D efforts and enhance its innovation performance (Chesbrough et al., 2006). Therefore, the analysis of external interactions is a core topic in the OI literature. Firms can access to resources and competencies that they need, but do not own (Grimpe and Kaiser, 2010; Weigelt, 2009), increase their problem solving capabilities (Duysters and Lokshin, 2011) and enable new paths to existing market, or favour the creation of standards in new markets (Dahlander and Gann, 2010).

The external interactions related to OI may be oriented according to three approaches: inbound, outbound and coupled OI (Chesbrough et al., 2006; Gassmann et al., 2010; Huizingh, 2011; Mazzola et al., 2012). Inbound OI (outside-in process) describes the focal firm's use of external knowledge, resorting to partners, customers, universities, research organisations, etc. Outbound OI (inside-out process) designates the opposite process, in which the focal firm's expertise is used outside its organisational boundaries, through selling patents, direct licensing, or

by other means. Finally, coupled OI (bidirectional process) refers to the phenomena in which both inbound and outbound OI coexist by means of partnerships, collaborations, alliances, joint ventures, etc.

One of the main propositions related to the OI paradigm is that firms can actually improve their innovation performance by collaborating to various extents with other organisations. The extent to which OI contributes to enhancing innovation performance has been increasingly studied in the past decade, as several recent literature reviews outline (Greco et al., 2015; Schroll and Mild, 2012; West and Bogers, 2014; Zhao et al., 2016). Even if some aspects of the OI impact on innovation performance are still opaque (for example, very few studies explored the effect of outbound OI), the vast majority of empirical studies confirmed that OI has a positive impact on innovation performance (Chiang and Hung, 2010; Czarnitzki et al., 2007; Duysters and Lokshin, 2011; Greco et al., 2016; Grimpe and Kaiser, 2010; Maietta, 2015; Mazzola et al., 2012; Miotti and Sachwald, 2003; Negassi, 2004; Schweitzer et al., 2011). Nonetheless, some authors found diminishing marginal returns of OI to innovation performance (Duysters and Lokshin, 2011; Greco et al., 2016; Kang and Kang, 2009; Laursen and Salter, 2006), due to the over-search (Koput, 1997; Laursen and Salter, 2006) and the over-collaboration (Bader and Enkel, 2014; Duysters and Lokshin, 2011) phenomena, which may disperse the focal firm's resources. The rationale behind over-search and over-collaboration is that a firm may be overwhelmed by an excessive number of innovation ideas, methods or strategies, facing costs to choose among them or not paying enough attention to implementing all of them (Koput, 1997). Furthermore, each channel of collaboration (i.e. with universities, suppliers, customers, etc.) encompasses different institutional norms, habits, and rules, consequently requiring different organisational practices in order to make the OI process effective (Laursen, 2011). Finally, collaborating with external organisations may require large maintenance costs to sustain the coordination complexity (Duysters and Lokshin, 2011; Narula, 2004).

The discussed diminishing marginal returns of OI to innovation performance urges firms to understand how they should approach to OI in order to maximise its efficiency. Somewhat surprisingly, the concept of OI efficiency has not been introduced in the OI literature, which leads us to propose the following definition: *a firm is more efficient in its OI approach than another if it obtains better innovation outputs starting from similar OI inputs.*

Even if the term 'OI efficiency' is novel to the OI literature, the extent to which OI can influence performance has been considered context dependent, being influenced by both internal (such as firm size, location, strategy, etc.) and external environment (such as industry, context, etc.) (Huizingh, 2011), and several articles proposed punctual analyses of factors that can moderate the effect of OI on performance.

Among them, several discussed the moderating role of internal R&D (Segarra-Ciprés et al., 2012; Tsai and Wang, 2008) and absorptive capacity (Huang and Rice, 2009) on the relationship between OI and innovation performance. In a similar vein, Sisodiya et al. (2013) described how relational capability and flexibility can enable inbound OI and increase firm performance. Other authors explored the moderating role of strategic factors. For example, Cheng and Huizingh (2014) showed that having an explicit strategic orientation enhances the OI efficiency in terms of new product/service innovativeness, new product/service success, customer performance, and financial performance. They also emphasised that entrepreneurial strategic orientation strengthens innovation performance comparatively more than other strategic orientations. In another perspective, Rogbeer et al. (2014) demonstrated that a purposeful macro-design of an alliance portfolio can facilitate OI efficiency in terms of patent citations.

The selection of articles discussed above shows how the assessment of the OI efficiency drivers has been pursued by several studies that discussed punctual moderating factors, often under specific circumstances, giving birth to an emerging but fragmented stream of the OI literature. In such stream, to the best of our knowledge, no previous study

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